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# **Mobile Communication Technologies and Their Effects on Elderly**

**A Case Study of Diabetes type 2 Elderly**

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## **ABSTRACT**

Ageing population's increasing ratio is alarming and the needs of elder persons are increasing day by day. Fast increase in ageing population means the growing of chronic diseases as well. Diabetes type 2 is a chronic disease which commonly found in elder persons. Technological innovations in Health care sector playing an enormous role in improving the healthy life of all humans. Use of latest technologies in perceiving the health services are now common. Each technology in this era is facilitating in many ways, same is the case with mobile phone which can provide multiple functionalities for the betterment of elderly life.

The focus of this study is to investigate the reasons of less use of mobile phone in elderly life and what other functionalities elderly want in coming mobile phones. The results of this study would be supportive in understanding the problems of diabetes type 2 patients in using mobile phone. This study would also be helpful for the manufacturers in developing the mobile phones according to the needs of elder persons. The analysis of this research work depends on three study stages. It starts from the literature review, in which we learned the effects of diabetes on elder persons. It also includes the usability features of mobile phone which necessary for implementing the future functionalities with elderly perspective. On the basis of literature review we designed the questionnaire and prepare the interviews. Interviews were conducted with two health care professionals and questionnaires with the citizens of county of Blekinge. We believe that our analysis will be helpful for both elderly and mobile phone manufacturing companies and they will also be supportive in increasing the quality of life of elderly.

**Keywords:** Information and Communication Technologies (ICTs), elderly, diabetes type 2, elder persons, mobile phone.

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We also dedicate this work to respected reader who chose this thesis for study.

<b>MOBILE COMMUNICATION TECHNOLOGIES AND THEIR EFFECTS ON ELDERLY .....</b>	<b>I</b>
A CASE STUDY OF DIABETES TYPE 2 ELDERLY .....	I
<b>ABSTRACT .....</b>	<b>II</b>
<b>INTRODUCTION.....</b>	<b>1</b>
<b>1 BACKGROUND .....</b>	<b>3</b>
1.1 HISTORY OF WIRELESS TECHNOLOGIES .....	3
1.2 INFORMATION COMMUNICATION TECHNOLOGIES (ICT'S).....	3
1.3 EHEALTH CONCEPTS.....	3
1.4 CURRENT MOBILE COMMUNICATION TECHNOLOGIES FOR ELDERLY .....	3
1.5 IMPORTANCE OF MOBILE PHONE.....	4
1.6 GLOBALLY ELDERLY RATIO .....	4
1.7 DIABETES AND TYPES.....	5
<b>2 PROBLEM DEFINITIONS/GOALS .....</b>	<b>6</b>
2.1 ELDERLY POPULATION.....	6
2.2 FUNCTIONALITY OF THE MOBILE PHONE.....	6
2.3 RESEARCH QUESTIONS.....	7
2.4 GOALS AND OBJECTIVES .....	7
<b>3 RESEARCH METHODOLOGY .....</b>	<b>9</b>
3.1 OVERVIEW .....	9
3.2 LITERATURE REVIEW .....	10
3.3 QUESTIONNAIRE.....	10
3.4 INTERVIEWS.....	11
<b>4 ICTS AND USABILITY .....</b>	<b>12</b>
4.1 INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTS) .....	12
4.2 ICTS AND EHEALTH.....	13
4.3 USABILITY.....	13
4.4 MOBILE PHONE INTERFACES .....	15
<b>5 DESIGN AND FUNCTIONALITY OF MOBILE PHONE FOR ELDERLY.....</b>	<b>17</b>
5.1 MOBILE PHONE DESIGN REQUIREMENTS FOR ELDERLY.....	17
5.2 AGEING POPULATION.....	18
5.3 FUNCTIONALITY OF THE MOBILE PHONE.....	18
5.4 PERFORMANCE CAPABILITIES AND FACETS OF AGEING .....	19
5.5 ELDERLY AS USERS OF MOBILE PHONE.....	20
5.6 MOTIVATIONAL FACTORS FOR ELDER PERSONS.....	21
<b>6 QUESTIONNAIRE AND INTERVIEW .....</b>	<b>23</b>
6.1 QUESTIONNAIRE PLANNING.....	23
6.2 QUESTIONNAIRE DESIGNING PHASE.....	23
6.3 QUESTIONNAIRE ABOUT THE USE OF MOBILE PHONE.....	23
6.4 QUESTIONNAIRE ABOUT THE NOT USING OF MOBILE PHONE.....	26
6.5 QUESTIONNAIRE DISTRIBUTION .....	26
6.6 QUESTIONNAIRE ANALYSIS.....	26
6.7 ELDERLY WHO DO NOT USE MOBILE PHONE.....	29
6.8 INTERVIEWS.....	29
6.9 IMPORTANCE OF INTERVIEWS .....	30
6.10 INTERVIEWS PLANNING AND DESIGN .....	30
6.11 DATA SAVING.....	30
6.12 INTERVIEW 1.....	30
6.13 INTERVIEW 2.....	31
6.14 ANALYSIS.....	32
<b>7 DISCUSSION AND VALIDATION .....</b>	<b>34</b>
7.1 DISCUSSION .....	34
7.2 FUNCTIONALITY OF THE MOBILE PHONE .....	34

7.3	ANSWERS OF RESEARCH QUESTIONS.....	36
7.4	VALIDATION ASSESSMENT .....	36
<b>8</b>	<b>EPILOGUE.....</b>	<b>38</b>
8.1	CONCLUSION .....	38
8.2	RECOMMENDATIONS .....	38
8.3	FUTURE WORK.....	39
<b>9</b>	<b>REFERENCES .....</b>	<b>40</b>
	<b>APPENDIX: A INTERVIEWS .....</b>	<b>42</b>
	<b>APPENDIX: B QUESTIONNAIRE .....</b>	<b>46</b>

# INTRODUCTION

Technology is playing an enormous role in the life of humans. According to Richta and later Bloomfield [1], the technology evolution progresses in three stages; tools, machines and automation. This progressive elaboration of technology moves from physical labor to machine controlling and then towards computerization. In third stage humans controlling factor removed with automatic algorithms. The role of technology cannot be extracted from the human life. It makes the lives more comfortable, secure, and independent. The work load and burden of human life is reduced with the use of technology. Mobile Phone is one example of automation which uses for mobile telecommunication.

The mobile phone invention makes the lives easier as it finished the distances. Now a day mobile phones are not only using for telecommunication but also providing many other functionalities e.g. SMS, GPRS, MMS etc. According to International Telecommunication Union (ITU), more than 60% of world's population owns mobile phone [2]. The advantages and growth of mobile phone in today's society is well known. Mobile Phone has broken the restrictions of fixed telephone and allows the people to move anywhere and stay connected all the time. The independence of movement is increased specially in elderly; they can enjoy independent life, travelling without the fear of insecurity due to having mobile phone.

According to Kurniawan et. al., Young mobile phone users are increasing very fast but elder users are not growing with expected rate due to unfamiliarity with new mobile phones. This gap of unfamiliarity with mobile phones causes serious side effects to elder. The use of mobile phones in people of age 75 and above is only 24%. Elder people use mobile phones only for calling to their relatives and sometime for emergency. This gap of unfamiliarity with mobile phones is harmful for both elderly and mobile phone manufacturing companies. The manufacturers, who are launching new mobile phones in the markets, are not considering the elder people while making structures of mobiles.

The average population of elder people is increasing with smooth percentage. According to the statistics of the United Nations, the world's population with age of 60 years and above was 9.9 % in 2000, which will increase up to 11% in 2010. In 2025 this will be 14.9% and in 2050 the 21.9% of the overall population of the world will be above than the age of 60 years. In northern Europe older population is comparatively high with other parts of the world. In 2000 the elder people were 20.4% which will increase to 22.6% in 2010. It will be 26.1% in 2025 and 29.5% in 2050. Sweden is a country where elder population rate is very high comparing with other parts of the world. The statistics shows, elder population was 22.1% in 2000 which increased to 23.3% in 2005, the expected elder population in 2025 is 27.8% in Sweden [5].

Diabetes is most common disease which majorly founds in elder persons. According to [26] the affected patients in the world are one billion and most of them belongs to diabetes type 2. The ineffective countermeasures of diabetes results in unpredictable outcomes and causes more complexities in diabetes patients. The increasing number of complexities put more burdens on existing healthcare system. The types of diabetes people facing is either type 1 or diabetes type 2. Type 2 and blood sugar (glucose) are more common, about 200 to 300 million people worldwide belongs these two categories.

Diabetes type1 mostly found in children but it may occur at any stage of life. Type 1 develops when "the body's immune system attacking the cells in the pancreas that produce insulin." [26]

Diabetes type 2 found normally in elderly, many reasons are behind the development of this disease in elder people. The lack of exercise and overeating are the main reasons of type 2, it starts developing when the production of insulin stopped or reduced up to the requirement and as a result body doesn't getting enough insulin. In both types the high blood glucose level can affects the eyes, kidneys, nerves, and blood vessels. [26]

Majority of the type 2 patients belongs to elderly and they need the special care. People in this age prefer to live in home either alone or with family. It is difficult for health care organizations to provide the health care services or nursing staff to each individual in their homes due to limited resources. The use of technology can achieve health care services more friendly during their stay at home. Mobile Phone is the best example of technology which reduces the communication gap and provides healthcare services effectively. This study will help in reducing the difficulties of elder persons in using mobile phones. Interviews with health care professionals and questionnaires with type 2 elderly help in finding the actual missing functionalities in current mobile phones they are using. So, the mobile phone companies include those functionalities in future mobile phones.

# 1 BACKGROUND

This is initial chapter which gives an overview of all work which we complete in our study. Evolution of wireless technologies, Information and Communication Technologies, Current Mobile Communication Technologies for Elder people, Importance of Mobile Phone in elder people's life, elder person's growth ration in all over the world, and diabetes type 2 patients; these are the topics which are covered in this chapter.

## 1.1 History of wireless technologies

Zysman I. G. et al [20] describes that the history of wireless communication starts in 1880s when Heinrich Hertz performed the fundamental experiments of wireless communication. The first wireless communication experiment was held with ships in the sea which was demonstrated by Marconi. Bell Lab started research on radio in 1914; engineers of Bell Lab had conducted the first two way radio communication with naval ships in 1916. The first mobile radio system deployed in 1921 in Detroit Police department [20]. Bell Lab performed the experiment of first commercial mobile communication system in 1946; it was push-to-talk mobile communication system which was operated by an intermediate person. The services of analog cellular systems were initially started in ending 1970s and early 1980. The GSM (Global System for Mobile Communication) phase 1 completed in 1990 and the initial commercial services started in 1992 [20].

## 1.2 Information Communication Technologies (ICTs)

The ICTs are playing vital role everyday life of humans. The benefits of ICTs to the peoples of all ages are significant. The history of the term ICTs is not too long but these technologies are the advance form of all historical communication technologies such as telephone, telegraph, and other wireless communication technologies. The early history of the term ICTs start from mid 1980s particularly with PICT initiative of Britain, which was a program for monitoring the ICTs [12].

## 1.3 eHealth Concepts

According to Elizabeth et al. eHealth is a term which includes the internet and other technologies in providing health care related services. The main purpose of eHealth is effective usage of technology in providing medical information, maintaining the patient's record electronically, and efficient user interaction with the system [4]. Eysenbach, G. define the eHealth as "*e-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies*" [36]. Furthermore Eysenbach explain that eHealth is not only the use of technology in local health services but it includes the improvement networked health services globally as well [36].

## 1.4 Current Mobile Communication Technologies for Elderly

Several mobile communication technologies are available in the market such as PDA/Palmtops, Pager, Mobile PC, Cordless Phone, and Mobile Phone. These all are handheld devices, which provides independence in living and working. The importance of these mobile devices will increase when we consider them in elderly point of view. The mentioned devices also help the healthcare departments in providing better health care services to elderly at home.

Personal Digital Assistant (PDA) is a handheld device which works as a day planner, electronic organizer, and information handler. The advancement and new capabilities in PDA increased a lot and

current PDA devices are different from standard PDAs [25]. Pager is a radio enabled device which receives radio signals in a particular frequency. All Pagers contain built-in receiver which tuned at required band of frequency to receive the incoming signals from base radio broadcasting station [25]. Mobile PCs are very small kind of laptops which can handheld easily, mobile PC looks like PDA but it contains more functionality as compared to PDA. PDA don't allows to run the windows OS but Mobile PC runs the OS same like table notebook. The only difference is holding and moving, it is beneficial when you are in travelling [25].

Cordless Phone is combination of telephone and radio technology. Cordless phone has removed the restriction of fixed telephony. It has two main parts bas and handset, a standard wire connection used to attach to bas with phone jack. Base converts the incoming calls in to radio signal and broadcasts those signals. The handset catches those signals and after converting into electrical signals sends to speaker. The area of cordless is limited; it cannot work out of its jurisdiction [25]. The advantages and growth of mobile phone in today's society is acknowledged. Mobile phone has finished the limitations of fixed line telephones and provides the freedom to stay connected from anywhere and anytime. The independence of movement is increased specially in elderly; they can enjoy independent life without the fear of insecurity. The increase in use of mobile phone has given a new way of life to all ages. Usability of mobile phone is different for different age groups. For elder people mobile phone is not only a source of ubiquitous communication but it also provides the autonomy, security, and every time access in emergencies.

### **1.5 Importance of Mobile Phone**

The adoption of mobile phone is growing very fast, the main reasons of growing are autonomous communication, connect from anywhere anytime, and emergencies services. Stay in touch all the time, safety, and some job related issues were the major factors of early adoption of mobile phone in young adults. However, safety and security were the main issues for elderly in adoption of mobile phone [22]. The importance of mobile phone is increasing on daily basis because people need the safety, self actualization, support, enjoyment, and simplicity in operating mobile phones [22].

Safety is main concern for people of all ages; one of the major features of mobile phone is that it creates the sense of security. Elderly, who lives in small towns or away from their relatives, feels comfort having mobile phones because elderly knew in case of emergency they will be rescued most probably in good time [22]. According to Maslow's theory the most important thing which needs to satisfy is self actualization. Self actualization includes building of identity, increasing potentials, expectations, and development of a reasonable social status [22]. Self actualization is effected with the usage of mobile phone, because mobile phone is essential part of today's life. The importance of mobile phone is different for youth and elderly. Initial use of mobile phone is very difficult for elders due to complexities in functionalities. They need the support from families, friends, and relatives to overcome the deficiencies in using mobile phones. Usability is an essential part for mobile phone; multi functional mobile phones are the barriers that stop the elders to adopt mobile phone.

### **1.6 Globally Elderly Ratio**

The population of elderly is growing continuously with a high ratio. In last 50 years the population of elder people is increased three times and it is expected that it will increased more than three times in next 50 years [7]. According to the world population agency [7] the population of elder's people were 205 million in 1950 which became 606 million in 2000. The expected population of the world in 2050 will be 2 billion. The growth ratio of elder people is (1.9 percent) higher than the other age groups (1.2 percent). The difference between elderly and other ages is becoming larger with passage of time. In 1950 from every 12 persons 1 was of age 60 and 1 out of 20 was of age 65 or elder. But this ratio is increased in 2000 when from every 10 persons 1 was age 60 and from every 14 persons 1 was of age 65 or elder. Due to the fast growing ratio it is expected that in year 2050, 1 person from every 5 will be the 60 and from every 6 person 1 will be 65 or above [7].

The elderly growth ratio in developed countries is higher than the ratio in less developed countries. The proportion of older is higher in Europe by the rest of the world. The elderly percentage in Europe was 15% in 2000 which is projected 30% by the year 2050. On the other side, in Africa 10% of population will be of age 60 in 2050 which was only 5% in 2000 and 65 or above will be 7% which were 3% in 2000 [7]. In northern Europe the elderly ratio is high comparing to all parts of the world. Elderly population which was 20.4% in 2000 is projected 29.5% by the year 2050. Sweden is one from developed countries where elderly population is very high than the all parts of the world's. The elderly percentage was 22.1% in 2000 which is projected 33.4% in 2050 [5].

## **1.7 Diabetes and types**

The diabetes is increasing significantly as the ageing population is increased with high magnitude. The micro and macro vascular complications are also increasing in diabetes patients which results in adverse effects of functional disabilities, depression, cognitive dysfunctions, persistent pain, and urinary incontinence [27]. The diabetes could transfer to born baby genetically if one or both of the both parents facing this disease; also it may come from environmental factors such as obesity or lack of exercise [27].

### **1.7.1 Diabetes Type 1**

Type 1 diabetes also known as insulin dependent, it can occur at any stage, mostly it is common in young adults. Once it diagnosed then cannot be cured completely, it is a long life disease; people need injections of insulin daily to keep it under control. It occurs when pancreas produce little or no insulin for the maintenance of sugar level. Persons suffering from diabetes type 1 face the absence of insulin in blood glucose level in cells reduced. It also increases hunger because beta cells of pancreas are destroyed. Its development occurs in short time but its symptoms may helps in diagnosing; the symptoms in type 1 diabetes are constant hunger, blurred vision, increase in thirst and urination, and extreme fatigue [30].

### **1.7.2 Diabetes Type 2**

Diabetes type 2 is most common in all over the world, approximately 95% of diabetic are suffering from type 2. It starts after the age of 40 and elders. Overweighed people also effected from it, due to high cholesterol in body and high blood pressure. Diabetes type 2 has 3 stages, first is against insulin and then dying of cells lastly sugar level become high in blood. This type is non-insulin dependent, and people suffering from it, do not require injection of insulin frequently [30]. It can be controlled by balanced diet, good exercise, and oral medication. If the patients of this disease are not cured and diagnosed, it may cause serious complication or may be end to death. Awareness is key factor to avoid serious type of problems and by getting awareness, patient needs to care about diet. The symptoms of diabetes type 2 includes frequent urination, weight loss, slow healing of wounds, increased in hunger and thirst, and blurred vision [30].

Elderly requires a special care all the time, due to age sometime it becomes difficult for them to solve their basic problems. The self management and control of diabetes in elderly sometimes goes out of control. It is difficult to put nursing staff with each elder person, to remove this problem it is required to motivate the elderly to use mobile phones, so they will get early rescue in case of emergency. The main focus of our study is on functionalities of mobile phone which elderly type 2 want in future mobile phones. Majority of the elderly are unaware from using mobile phones; we also figure out the reasons of unfamiliarity with mobile phones and motivate them to use mobile phones. The type 2 elderly who are using mobile phones and feeling any difficulty in operating will better guide us about future functionalities on the basis of their experience.

## **2 PROBLEM DEFINITIONS/GOALS**

This chapter briefly explains the problems which we intend to solve in our research. The study mainly focuses elderly type 2 diabetes persons. Their use of mobile phone and problems which they are facing with using or not using mobile phones and the adoption of mobile phone in elder people. The research questions of our study and goals which we will achieve through our research are described in this chapter.

### **2.1 Elderly Population**

According to the United Nations statistics the growth rate of elderly population in all over the world higher than overall growth rate of the populations. In Western world the elder people are the most important part of the society. Sweden belongs to those countries where approximately one person from every four is elder [5]. The elder people are suffering health issues more than other people. Diabetes type 2 disease commonly found in elder people, in Sweden 85% to 90% patients of diabetes belongs to type 2. Type 2 diabetes ratios among men are greater than in women, half of the diabetes patients are working people [9].

Majority of elder people prefers to live in their homes; even they live in country side or rural areas. People in this age desire all formal and informal health care facilities in their homes [19]. In Sweden the majority of elder people needed help in transportation, legal matters, shopping, house work, and bathing. This is the fact that aged people suffer from functional impairments, handicaps, and illness as a result they become dependent on others for health care and their quality of life putted to danger [19].

#### **2.1.1 Health Care Services for Elderly**

According to [19] majority of the elder persons are getting health care services at home from informal health care. Most of them suffer from serious diseases and one third of them depend on others to perform daily activities. It is difficult to acquire all the information about the services elderly getting in their homes as well as informal care satisfying their needs or not. Technology awareness in elder persons is lower as compared to other groups of people. This unfamiliarity of elder people with technology causes many side effects on the lives of elders [19].

### **2.2 Functionality of the Mobile Phone**

The adoption rate of mobile phone in elder person is very low; even those elder persons who owned mobile phone can use it for some purposes such as emergency calling. Several reasons are behind this low adoption rate one of the reason is, complex functionality of mobile phone. The major causes to avoid mobile phones are small displays which are difficult to see, small buttons that sometime create problems in pushing and make wrong entries, complex arrangements of menu items, and some unclear instructions which sometimes misguide the elder persons [3].

Moreover there are some other problems involved that makes the use of mobile phone difficult for elder persons. Design of mobile phones is not appropriate for elder persons because normally in design phase elder people are not kept in mind. Elderly face hearing problems due to their age factors or due to their illness, visibility weakness is common in diabetes type2 elderly so the elder persons face problems in focusing objects. Other very common issues are weakness in motor function and cognitive complexity. All these issues required special attention to make functions of mobile phone considering these issues of elderly in mind [8] [17].

### **2.2.1 Mobile Communication Facilities for Elderly**

The main motivation of this study is to provide the mobile communication facilities to elderly in their homes. Their independence of life will increase with using mobile phone and they will stay at the distance of one call. Those elderly who are not using mobile phones will motivate towards the use when they find mobile phone with simple functionalities available in the market. We will try in our study to obtain the maximum solutions which facilitate elderly type 2 in using mobile phone. To achieve these goals our focus will be on the following research questions.

### **2.3 Research Questions**

These are the research questions which we have selected to achieve our targeted goals. These questions will supports in finding the actual state of ubiquitous technology awareness in elder people.

- How the features of usability helps in designing the mobile phone for elder persons with minimum complexities?
- What functionalities the diabetes type 2 patients require in future mobile phones?

The contribution of these research questions in our research work is very important. A detailed literature review and interviews and survey with diabetes type 2 elderly helps us in conducting our research. These questions will cover the existing and future mobile communication technologies for elderly.

#### **2.3.1 Contribution of the First Question**

The first question based on the literature review with the perspective of usability and functionality of the mobile phone. In this part we do not focus on usability as a whole because usability itself is broad field, but we mainly target the usability attributes which helps in designing the simple mobile phones for elder persons. Normally usability features applies on finished products or systems for evaluating their degree of interaction with users. But in our study we will describe the usability attributes which are necessary in the phase of designing new mobile phone for elder persons. The combined study of functionality of mobile phone and its usefulness will be helpful for the designers and manufacturers of mobile phones in understanding the future requirements of the users.

#### **2.3.2 Contribution of Second Question**

The Second question will be solved through interviews with health care professionals and survey with elderly type 2. Interviews will carry out with those health care professional who are dealing with type 2 patients and understand the problems which type 2 patients facing in the use mobile phones. The second part is survey, we distribute questionnaire to type 2 elderly although they use mobile phone or not but majorly we will focus on those elderly who are already users of mobile phones. The results of questionnaire will find out the satisfaction of elder persons with their current mobile phones and also reasons of not using from those who are not the users of mobile phone. These Questionnaire's results will better explain the functionalities which needs to rebuild because the respondents better understand about the functionality of their current mobile phones. The focus of questionnaire will be on functionality of mobile phone with elder person's perspective. So, the results can better explain about the complexities, displays, menus, key pads, and functions which hard to understand by elder users.

We believe our study will be helpful for diabetes type 2 elderly in future and it will also helps out to other elder people in using mobile phone. They research will also helps the mobile phone companies in manufacturing mobile phones which elderly accepts happily.

### **2.4 Goals and Objectives**

The expectations of elderly users from mobile phones are reliable communication, improved services, safety, and independence in life. These features are also required by other users but the difference

comes in some kind of special services and interfaces. A deep study in this area helps in fulfilling the expectations of the elderly. Obtaining the needs of elderly is not a difficult process because everybody has intuitive picture of elderly needs in mind [24]. In requirement gathering from elder persons we will keep the functionality and usability attributes at the same stage. These two factors will help in better suggestions about the mobile phones having simple functions and more usable.

We assume that the contribution of our study in independent life of elderly will be appreciated. Our study will play a positive role in benefiting the elders in using mobile phones. The goals and objectives of our study are listed below:

- To identify the usability attributes which are necessary in designing less complex mobile phone
- Difficulties elderly facing in using current communication technologies.
- Interviews with diabetes type 2 elderly and identify the ratio of users and not users of mobile phone.
- Finding the reasons why they do not use mobile phones.
- To identify the satisfaction level with current mobile phones.
- To identify the functionalities diabetes type 2 elderly require in future mobiles.

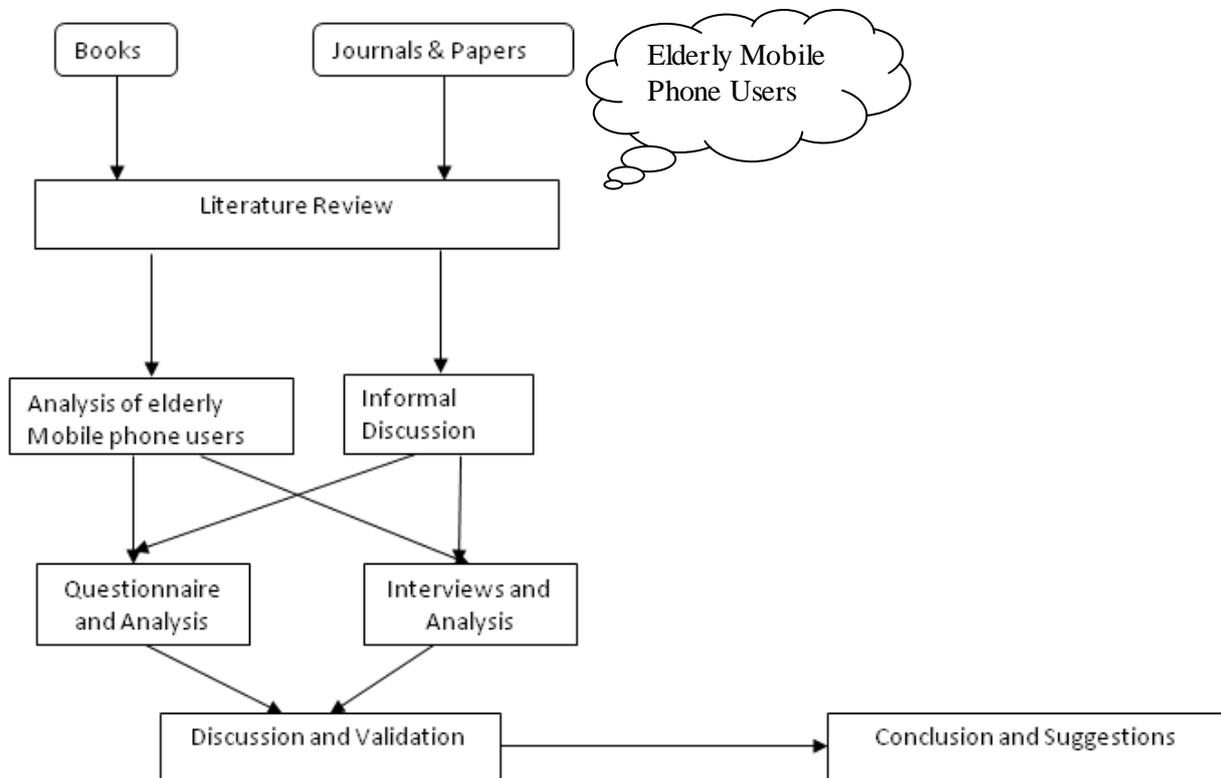
This research work will help elderly in identifying their needs regarding the future functionalities of mobile phones. It will also help manufacturers in understanding the actual requirements of elderly about future mobile phones.

### 3 RESEARCH METHODOLOGY

This chapter illustrates the research methodology used in this research work. The first part gives an overview about the methodology we chosen to accomplish over goals. In second part we demonstrate the literature review, how we enables to get all the material regarding to our thesis. Designing of questionnaire is the third part which describes method of questionnaire design. The last part of this chapter is interviews.

#### 3.1 Overview

The mixed method research approach [9, 10] is used in different phases of study to achieve our targeted goals. “Mixed methods research is formally defined here as the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study”. [10]



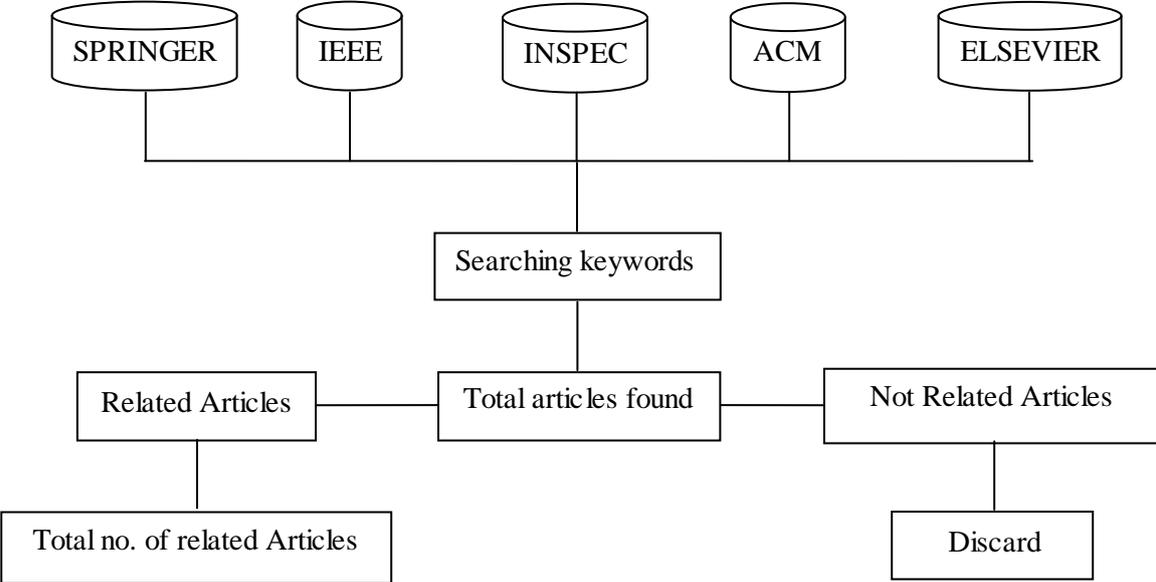
**Figure 3.1 Research Methodology**

The first part about current mobile communication technologies for elderly will be covered through literature review. This literature review will help us in finding the current functionalities of mobile phones elderly using. It will also help in finding the satisfaction level with current mobile phone and functionalities which they require in coming mobile phone that helps them in better way. Mobile Phone is the main focused area in communication technologies and diabetes type 2 patients will be approached for getting the quantitative analysis about current state of mobile phone usage [18]. We also get the understanding of eHealth concepts, services, and how it helps the elder persons. The understanding of ICTs is lacking in elder people which is the big problem in providing facilities of eHealth to elderly. According to [18] there are two reasons to choose diabetes type 2 elderly for qualitative analysis, first diabetes is still incurable and second is diabetes type 2 mostly found in elder people. Ubiquitous communication will help in monitoring the patient and reducing the risks

accidental happenings [18]. A detailed literature review enables us to construct questionnaire for interviews.

**3.2 Literature Review**

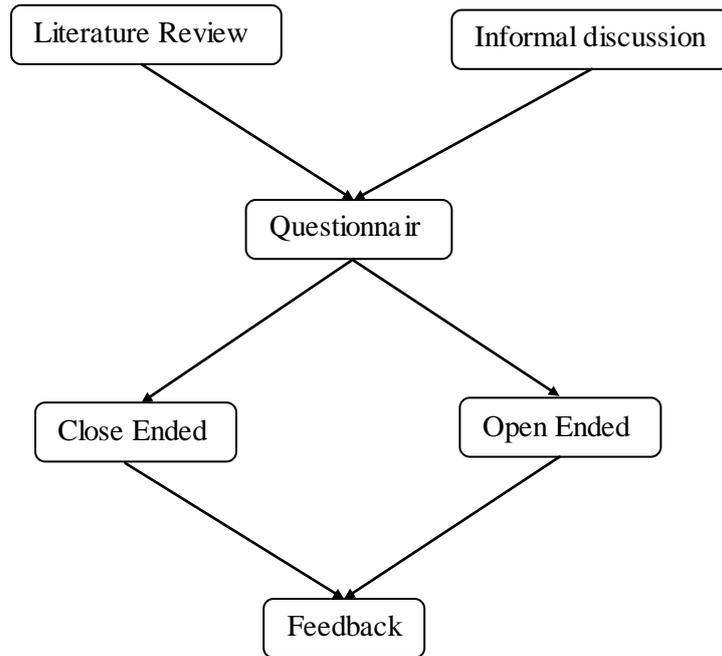
Literature review is essential part of mixed research methodology. Literature review makes easy to identify the current state of study in selected area of research. Through literature review we identified the current communication technologies for elderly, problems elderly facing in using mobile phone, and the reasons why elderly avoid in using mobile phones. According to Dawson the main objective of the research is to provide the appropriate context of our research and study the work which already has been done in current area. We used several key words for searching relevant information. Blekinge Institute of Technology (BTH) library is used for borrowing books, IEEE, ACM, INSPEC, SPRINGER, and ELSEVIER are used for searching relevant articles and journals. The basic reason of literature review was to explore the previous studies, their contributions in the area of mobile phone for elderly and extending previous work for future.



**Figure 3.2 Literature Review**

**3.3 Questionnaire**

The construction of questionnaire based on literature review, informal meetings and general knowledge about the selected field of research. With the help of literature review we come to know about the current state of our work. Our proposed problems and literature study helps in designing the questionnaire which covers all the issues which we need to solve. The questionnaire was the initial step towards interview because we were knew the problems elderly facing in using mobile phones due of our detailed study in literature review. The questionnaire covers questions which are specially relates to diabetes patients. But the major portion of questionnaire asks about the functionality of the mobile phone which they are using and which they want in future mobile phone.



**Figure 3.3 Questionnaire**

### **3.4 Interviews**

Interviews will be conducted with diabetes type 2 elderly and we will target old homes to obtain the data regarding diabetes type 2 elderly. The interviews mainly focus on; investigating the factors involve in motivation/de-motivation of using mobile phones in elderly type 2 and identification of the functionalities that elderly type 2 requires in future mobile phones. The detailed literature review and the survey results make it possible to provide better analysis report. The analysis will mainly rely on our survey results.

## **4 ICTS AND USABILITY**

This chapter covers ICTs and usability part of theoretical work. In 4.1 ICTs describes in detail and 4.2 shows the relation between ICTs and eHealth. Usability, its definitions, usability of mobile phone, and mobile phone system accessibility model is elaborated in 4.3 and mobile phone interfaces discussed in 4.4.

### **4.1 Information and Communication Technologies (ICTs)**

Information and Communication Technologies (ICTs) are the maintenance and processing of communication, wired and wireless technologies, and the use of computers to transform the information. ICTs covers all media which use in transmitting video, audio, satellite, multimedia or data such as cables, fiber optics; Networks such as Personal Area Network (PAN), Local Area Network (LAN), Campus Area Network (CAN), Metropolitan Area Network (MAN), and Wide Area Network (WAN); computer technologies (flash memories, optical disks, video books, electronic boards, multimedia projectors etc.); Mobile Technologies ( Mobile Phones, PDA, PAGER, Pocket PC, Cordless Phones). All these technologies are the main source of spreading of knowledge and information sharing. The important thing is not, what is the technology, but, important is understanding and effectively use of technology in communication and information sharing [15].

#### **4.1.1 Evolution of Technology**

The emergence of technological history is not only depends innovation of technology but it also depends on social values. Innovation and development of technology depends on the growth of social behaviors and beliefs. Innovation of technology is not only a production matter. Production and consumption are equally necessary components of the technology innovation process. Information and Communication Technologies (ICTs) has an enormous role in social and cultural developments. Innovation is a process which includes both consumers and producers in combining activities which cannot be completely determined by technological change or individual choices [13].

#### **4.1.2 Historic Perspective of ICTs**

The history of ICTs dates back mid 1980s [12], according to (Dutton, 1996) ICTs all types of electronic devices used for telecommunications, broadcasting, and computer based communications; Personal computers, interactive TV, video games, internet, cell phones, and electronic payment systems [12]. The advanced research in the field of ICTs started in 1990s because of rapid growth in information related products especially in internet and mobile phones. ICT companies has invested their resources in increasing the awareness in private public about the importance of ICTs, telecom companies invested huge in expanding their market to extreme level [12].

However in 1990s ICTs entered in homes as a social part of life when the use of internet started to grew up and mobile phone became the integral part of private public rather than only businessmen. The adoption of ICTs was based on the interests in new technologies and also the people want to save the future of their next generation. The example of mobile phone is same like all other communication technologies, when in the mid-1990s various telecom companies started to promoting social usage of mobile phone. However, in start the use of mobile phone was as an industry tool. Then the companies changed the policy and made it market commodity and with the end of twentieth century mobile phone became the fashion accessory of normal life [12].

#### **4.1.3 Role of ICTs in Elderly life**

The area of use of ICTs in elderly life is limited with sociological perspective. Due to the small knowledge in this field, the reasons are still unclear about the adoptions and non adoption of ICTs in elderly. The knowledge is also not vast, how ICTs support elder people in everyday life and what are the outcomes and drawbacks of avoiding ICTs in elder's life. According to (Bernard & Phillips, 2000)

the information society is not different for ageing society so we should encourage them to use ICTs [14]. In previous studies the benefits of ICTs for older adults are characterized as ICTs helps them in self and social understanding. The good knowledge of ICTs in elderly life will benefits them in getting good access to health information, current affairs, social connectivity, and shopping, travelling, and financial management. The use of these technologies will increase the quality of life and also connect elderly with outside the world [14].

## 4.2 ICTs and eHealth

ITU (International Telecommunication Union) defines the eHealth “*Encompasses all of the information and communication technologies (ICT) necessary to make the health system work*” [33]. Silber defines the eHealth “*eHealth is the application of information and communications technologies (ICT) across the whole range of functions that affect health*” [33].

According to the definitions eHealth combines the technology and health at one place. In the eHealth, health is used as concept of healthcare rather than simple word health and technologies cover all types of technologies which facilitate the healthcare centers or to the patients [33].

### 4.2.1 eHealth

According to [23] Petra Wilson explained (in eHealth 2005 conference) that eHealth does not mean to put computers on doctors’ table. eHealth is a term which covers different technologies, applications, tools, devices, methods, several procedures of work. eHealth is broad term which provide the health information electronically, patients access health portals, includes monitoring of patients remotely, access of bio-signals from the human body as well as control of human body [23].

### 4.2.2 eHealth 2009

eHealth 2009 conference which is jointly organized by European Commission and Czech Republic [31] has focused three main areas in relation with eHealth:

- Individuals
- Society
- Economy

eHealth for individuals means to increase the quality of life of individuals using latest technologies in health area. For society, implementation of eHealth means to increase the challenges of e-literacy, interoperability and access of new technologies. eHealth increases savings with offering new solutions to economy [31].

## 4.3 Usability

Usability means the use of a product or system which allows the persons to accomplish their tasks and goals easily and quickly. It applies on every part, aspect, and feature of the product which offers the users to interact with, such as software, hardware, icons, menus etc [28].

Usability is defined by different standards as “*the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use*” [ISO 9241-11:1998]

“*The capability of the software product to be understood learned, used and attractive to the user, when used underspecified conditions*” [ISO/IEC 9126-1, 2000]

“*The ease with which a user can learn to operate, prepares inputs for, and interprets output of a system or component*” [IEEE Std. 610.12-1990] Usability is term which refers easy interaction of the user with the system. Usability of a system often assessed as how easy it is in operating and learning and how much is satisfied the users [32].

### 4.3.1 Benefits of Usability

According to Pieratti [28] the benefits of usability are important in terms of product quality, cost, and customer satisfaction. Few benefits of usability are following:

- Usability improves the development process through efficient design
- Usability removes the complex functionalities and design the product as per the user requirement
- A usable product reduce the cost of the product because it minimizes the extra trainings
- A usable product benefits in three ways; it satisfies the user, increase productivity, and reputations both for product and for the organization that developed it [28].

### 4.3.2 Usability of Mobile Phone

Mobile phones are the devices that accumulated the concept of a system in one device. Technically mobile phones are complex devices and normally usefulness of mobile phones depends on the services of network. Mobile phones are not only considered as a device but they own system in themselves. Technical complexities in mobile phones need to solve, so they can be made usable and useful for every type of users [34]. Usability depends on easy interaction with system, a mobile phone with usable interface, simple functionality, and good service quality can facilitate much better users especially elder users. The poor interface design, problems in completing tasks, complex functionality etc. not only decreases the value of mobile phone brand but the attraction of network service provider also declines [34].

### 4.3.3 Design and User Perspective

Mobile phone comes in the category of “*interactive systems*” [34] from design perspective. According to ISO 13407 an interactive system is: “*a combination of hardware and software components that receive input from and communicate output to a human user in order to support his or her performance or a task*” [34]. From the user perspective a mobile phone is an “*information appliance*” [34]. Information appliance means to design something for performing activities [34].

### 4.3.4 Universal Usability and Digital Convergence

**Universal usability** means that more than 90% of users have complete information about the system. The complete information can be achieved through high level of interactive with system [34].

**Digital convergence:** “*digital convergence introduces new kind of usability requirements when complex technologies are embedded to everyday appliances*” [34]. The interfaces of mobile phones depend on brands, each brand design interface according to its requirements. Only few interface elements in all brands are common, it is necessary to define standards and requirements for design principles and universal usability which all brands adopt [34].

### 4.3.5 Attributes of Usability

It is important to understand that usability is not considered as a single property which deals the user interactions with the system [35]. Usability has several components and which are associated with following attributes of usability:

**Learnability:** The system should be simple and easy to operate so the user can start working on it without having huge training. The system allows self learning to the users.

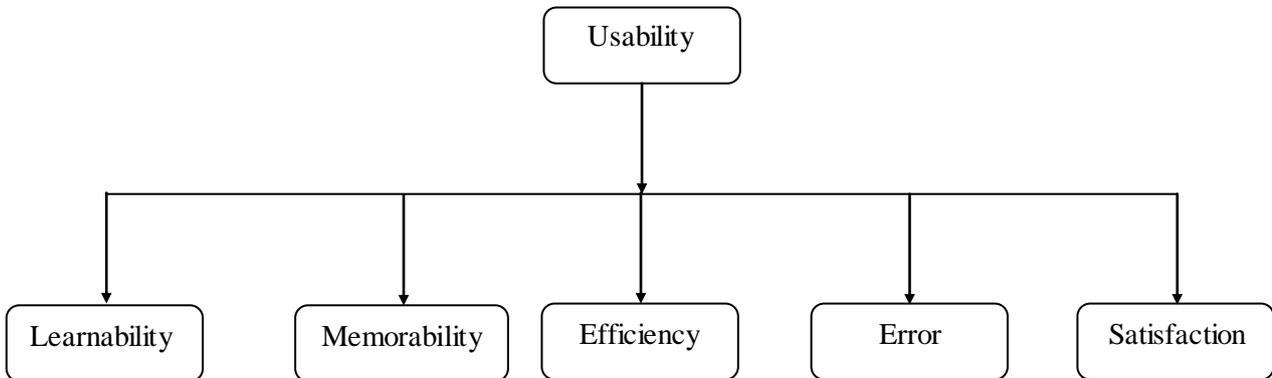
**Memorability:** The functionality of the system should not be complex so the user can remember it easily. When a user who stops using the system for a short period when return to the system can start working easily without having complete training again.

**Efficiency:** Efficiency of a system can be judged through the high productivity level and it can be achieved when the system will be efficient to use.

**Errors:** It is difficult to make a system completely error free but it is necessary to make the system with low error rate, so the chances of errors from user minimized.

**Satisfaction:** The success of any system depends on the users' satisfaction with it. A system which gives the freedom to users in operating subjectively satisfied the user.

These are the key attributes of any system or product which needs to be fulfilled for achieving the maximum usability of that system or product [35].



**Figure 4.2: Attributes of the Usability**

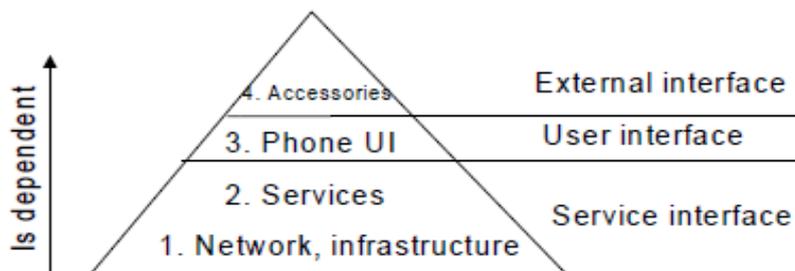
All these attributes of usability are necessary for less complex functionality of mobile phone. These attributes makes the mobile phone more usable for elderly. Learnability and Memorability of are important factors in functionality because involving of these two attributes means the functionality of mobile phone is easy is easy to learn. A mobile phone which keeps above mentioned attributes can helps elder persons in better way.

#### 4.3.6 Mobile phone System Accessibility

Usability is a sub part of system acceptability which ensures that the system is good and fulfills the requirements and needs of the all stakeholders, such as clients, users and managers. The accessibility of a product is depends on its social and practical acceptability [35]. Mobile phone and network services are inter-related with each other, in some cases user face difficulties from network but due to misunderstanding he/she blames to mobile phone interface. Same case applies on problem from mobile phone interface. These kind of issues can b removed with standardize hierarchy which explain and separates the functionalities of mobile phone interface from network services [34].

#### 4.4 Mobile phone interfaces

Ketola, P. and Røykkee, M., [34] defined three conceptual interfaces for the user interaction with mobile phones; they are user interface, service interface, and external interface. For each interface some important elements and attributes are defined.



**Figure 4.3: Interface hierarchy [34]**

#### **4.4.1 User Interface**

Several factors are involved in building a mobile phone user interface. The factors includes in user interface are input/output techniques, and design factors with industrial and mechanical perspective. Input tools for mobile phone are keypad and voice. Call management and navigation keys are the tools which mobile phone interface needs. Output to users is given through display and voice, display includes localization, indicator, icons, and language familiarity, voice includes ringing tones, quality speakers, and minimum interruption [34].

#### **4.4.2 External Interface**

External interface is not the physical part of mobile; it just helps in using the mobile phone. It includes accessories, support elements, software add-ins, and PC connectivity. External interface is important part of mobile phone usability but some time omitted at the time of usability engineering [34].

#### **4.4.3 Service Interface**

The visibility of operator's services to mobile phone users through user interface is known as service interface. Service interface facilitate the users in using different services such as internet service, voice mailbox, data services, and text messaging services. The important factors of in service interface are utility, availability, and interoperability of services [34].

## 5 DESIGN AND FUNCTIONALITY OF MOBILE PHONE FOR ELDERLY

This chapter elaborates the design requirements of mobile phones for elder persons. This chapter also includes mobile phone functionality and ageing effects on different capabilities of elder's body. In the end of this chapter common problems of elder person in using mobile phone and motivational factors are discussed. Mobile phone design is directly linked with human interaction with system. In one level the design of mobile phone allows the users to interact with screen and keypad easily. Whereas in other level complex interactions are included in the design of interfaces according to the context of use. The simplicity of mobile devices evaluated with their successful usability [8].

### 5.1 Mobile Phone Design Requirements for elderly

Pattison, M. et al., suggests that developers should understand the needs of elder people while they designing of new technologies so, they can live through independent life and interaction with technology. Rather than alienate them because they do not know how to interact with new graphical user interfaces, use internet and mobile phone [8]. According to [8] “As users grow older and their requirements change, designers should be sensitive to their changing user needs as well designing for the users they might eventually become themselves” [8].

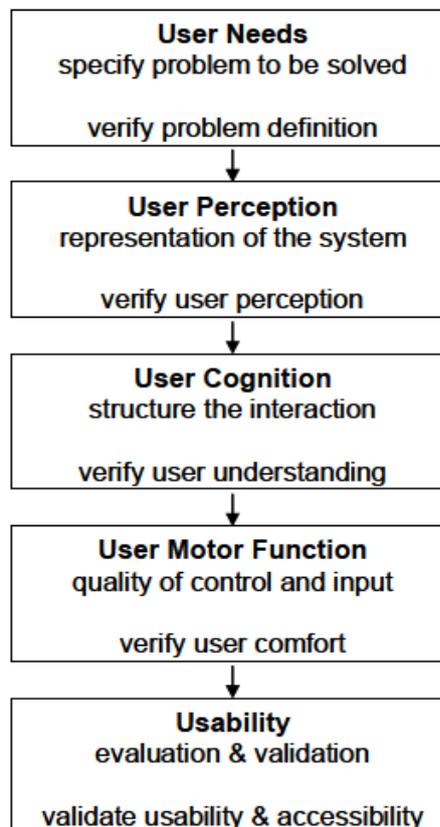


Figure 5.1: Inclusive requirement design model [8]

- The model describes that first identify the user needs in terms of design problem and verify the problems.
- User's awareness with the system, verification of the user's perceptions.
- Design the interaction structure according to the user understanding.
- Keeping in mind the motor function of user while verifying the ease and control of input.

- Usability evaluation of the system.

The design of mobile devices for older users means that first identifies the requirements and then designs the products according to their needs [8].

## **5.2 Ageing Population**

In previous 50 years the ageing population has tripled and in next 50 years it is expected that it will be more than three times of current populations [7]. According to the United Nation's the growth rate of elder people is faster than the overall growth rate of population in all over the world. The difference between these two growths rates are increasing continuously. The proportion of elder persons is relatively high in more developed countries comparing with less developed countries [7].

### **5.2.1 National ageing situation of Sweden**

In Sweden the average life expectancy was 83 years for women and 78 years for men by 2005 statistics. According to the national statistics of Sweden the people of 65 or over is 17 percent of total population. The growth trend intimates that in the next 30 years the portion of population which grows more fastly will be the 65 or over. The oldest-old population part is projected to be doubled in 2050 [29].

According to (Ministry of Health and Social Affairs) Majority of the elderly living in ordinary homes and getting help with formal or informal ways. Around 8.6 percent of 65 and above are getting regular housing home help while the proportion of 65 and above who are getting special housing home care is 6.4 percent. The elderly living in ordinary homes needs help in daily activities such as meals on wheels, medical services, transportation, safety alarms etc. Approximately 70 percent of elder people living in their homes suffer from some kind of diseases. Diabetes is most common disease which founds in elder people [29].

## **5.3 Functionality of the Mobile phone**

A detail of mobile phone's history, functions, interfaces, its role in elder person's life, problems in using, benefits to elderly etc. described in following points.

### **5.3.1 Mobile Phone**

Currently the mobile phone is basic necessity of everyday life; it becomes the important part of private and professional life in all over the world. The use of mobile phone can be distinguished in four main areas, communication with geographically independence, send and receive information, entertainment, and supportive in building social relations. It gives the freedom of communication without bounding at a particular location as regular telephone bounds [2]. Majority of the people says that the mobile phone is much convenient device other than telephone, it will not bound to stay at a particular location like regular stationary telephone do. It provides the access almost everywhere and all the time [2].

### **5.3.2 Historic Perspective of Mobile phone**

Alexander Graham Bell was the scientist who invented the telephone in 1876 [2]. Although Alexander invented the telephone but he did not think that the telegraph will be competed with his invention [Sidney H. Aronsson 1981:15]. According to [Peter Andersson 1987:58] the first telephone network in Sweden is established in Linköping. In the end of 1880, Sweden was the first country where per capita telephone ratio was the highest among all parts of the world and Sweden was called "*the telephone country Sweden*" [2].

### **5.3.3 Wireless Communication in Sweden**

In 1950 the first mobile phone communication experienced in Stockholm, before this experiment only prototype of wireless communications has been used. [2] According to (Swedish Agency for

Administrative development) the reasons of mobile phone development are less costly and easy to recharge. According to the (Susana Mathiesen) in December 31, 2000 the 71% of overall population owns mobile phone and in 2007 mobile phone users between the ages of 16-75 were 94%. [2]

Current mobile phones have too many functions other than the basic services communications establishment. Some other important functions which current mobile phones have are; voice mail, conference function, SMS, MMS, GPS, GPRS, camera, video, games, Bluetooth, MP 3 player, Games, e-mail application. Games, Google Maps, file readers etc [2].

### **5.3.4 Mobile Phone Usage in Elder People**

The adoption of mobile phone in older persons is not very high but slowly mobile phone is getting popularity in them and becoming a personal item of daily life. Kurniawan claims that in the start of 2006, the ownership of mobile phone in elder people is highly varied in UK. Only 36% elder people above 75 years owned mobile phone whereas 60% of elderly between 65-74 years owned mobile phone [6]. Mobile phone is more usable technology in elder persons comparing with other ICTs such as internet. Elder people use mobile phone for different purposes such as work and leisure activities. For some elder people mobile phone is an enjoyable experience but currently most of the mobile coming in the market is not designed considering the elder people in mind [6].

If the mobile phone developing companies remove elder people related problems from mobile phones, the role of mobile phone potentially becomes high in maintaining quality life of elder persons. By carrying mobile phone they feel safety and security and will be accessed anytime and anywhere. The desire to adopt new technologies is also high in elder people [6].

## **5.4 Performance Capabilities and facets of Ageing**

By definitions the elderly are the long living users than the young users that's why elder user considered heterogeneous group. The hearing, vision, cognition, and motor functions are the terms which exist as a function of age in performance capabilities [8].

### **5.4.1 Hearing**

Gradually decreasing in listening capabilities is most common factor associated with ageing. Decrease in hearing results in many impairments and this decreasing is can be the result of many factors such as genetic influences, work, diet, and most obviously by the age when it turns to above 50( sufficient loss of hearing often occurs at or after this age). Ageing also has effects on the ability of inferring the information from complex hearings. The ability to distinguishing the frequency also get worse gradually in the age of 25 to 55 but after that special devices are required especially in case of higher frequencies [8].

### **5.4.2 Vision**

Holzinger, A. et al., describes that visual impairment took place in many forms; it starts from a minor loss to complete blindness. One cause of reducing visual capacity is macular degeneration with increasing the age. Macular degeneration reduces the eyesight which results in partial visual impairment. But this is not an obstacle in the existence of modern technology and can be covered with the help of good interface design [17].

Effects on eyesight in older adults can be seen in different ways, some of them are mentioned below:

#### **5.4.2.1 Visual Acuity**

It normally starts decreasing after the age of 50 years. The ability to differentiate between the objects decreased and in this case older adult need three times more light for concentration than the average young man [8].

### **5.4.2.2 Contrast Sensitivity**

The decreasing of contrast sensitivity results in reducing the ability to differentiate between the dark and light. It starts from 20 years of age to 80 years but the normally declining of contrast sensitivity starts between the ages of 40 to 50 years [8].

### **5.4.2.3 Focus on Objects**

The ability to focusing on objects starts decreasing from any age between 8 to 50 years normally. In this case person suffers from declining the light accommodation cannot focus on the near and far objects [8].

### **5.4.2.4 Problems with glare**

The increasing in the effects of glare results from the “*scattering of light in the eye due to increasing lens opacity. [8]*” For elder people three times more light (compared to visual acuity) required to increase the probability of glare needs in design solutions [8].

## **5.4.3 Motor Function**

The part of the nervous system that control and regulates the movements of muscle in the body is known as motor function. The strength and power of muscles reduces with the passage of time in functionality and working. When hand motor function loses its strength, it weakens the grip power of the hand. In few cases weakness of hand motor function starts from the age of 30 years but normally the elder people of 65 or above face reduction in motor function. The grip strength of elder people normally reduces up to 25% in their hands [8].

## **5.4.4 Cognitive Complexity**

According to [11] “*Kieras and Polson (1985) proposed a theoretical model (Cognitive Complexity Theory (CCT)) specifically dealing with the cognitive complexity of the interaction between user and device by describing the user’s goals on the one hand and the reaction of the computer system on the other by means of production rules*”[11]. The procedural knowledge and technological applications are indispensable for each other. The usability of the systems helps in acquiring the more knowledge procedures to interact and operate the application efficiently. Ziefle & Bay’s experiment shows that navigations performance of elderly users is lower than the younger users. However, in mobile applications with low complexity the performance of elder users matched with younger [16, 17].

### **5.4.4.1 Cognitive aspects of Aging**

“*In general, working memory appears not to decline in relation to storage capacity, but rather processing efficiency declines over time (Norris, Smith and Peebles, 2000)*”[8]. According to Pattison, M. et al., the age is an important factor in reduction of long term memory; it declines with passage of time however, the semantic memory remains same till the older age and decline is rare. The learning capabilities in elder persons remain same as young ones but the processing of complex information takes more time [8].

Pattison, M. et al., describes older age do not effects on language and vocabulary and these skills remains unimpaired but the logical thoughts, quick processing of complex knowledge, and spatial ability are declines as the old age comes [8].

## **5.5 Elderly as Users of Mobile Phone**

It is true that mobile phones are designed with keeping in mind the needs and fashions of young users. But the mobile phone is a technology which never only facilitates a focused group; its benefits are equal for all users. The elder users are ready to increase their sense of freedom and enjoy with quality of life using mobile phones. Furthermore a different utilization of mobile phone for elder people is as a

health monitoring tool. In one way mobile phones helps elderly in creating the sense of security and freedom but on other way complex design and functionalities isolate them with society [8].

### **5.5.1 Elder User's Problem with Mobile phone**

The elder users are facing several problems with current mobile phones such as too many and complex functions, little buttons, small displays, and difficult keypads. Visual impairments in elder users weaken the capacity to focus on small screens. Cognitive complexities slower down the response time of elderly because of the decline in long term memory with age [8].

### **5.5.2 Limited Knowledge**

Another major problem with elder people is the limited knowledge about interfaces. Interfaces are the necessary component of mobile phones. In new models of mobile phones due to advancement and new features other than call, the interfaces becomes complex. The young users can understand these interfaces with little effort due to their prior knowledge about the design of mobile phones. Furthermore the switching from one brand to another also troubles in learning new operating styles although there is little change but for elder people it is more than enough [8].

### **5.5.3 Common problems**

Following are some common problems which elder person faces using mobile phone [3]:

- Rubbery buttons with small size are difficult in pushing
- Unnecessary menu options which confuse the elder persons
- Complex functions which hard to understand and difficult to remember
- Small display create vision problems

## **5.6 Motivational Factors for elder persons**

Generally it is acknowledged that adoption of unknown and new technologies in elderly is less than younger. This is one of the reasons they feel uncomfortable. Motivation is defined as psychological construct, motivational issues includes computer literacy, attitude, acceptability etc. Motivation is an essential element for learning [17]. According to Holzinger, A. et al., some researcher says that we can motivate the elder people toward mobile phones after realizing them the benefits of use [17].

### **5.6.1 Social Influence**

Social influence means the elderly people believes that they should be in touched socially with having mobile phone. This belief is due to the relative and friend's influence in usage of the mobile phone. The social influence has great effects on elder persons when the adoption of mobile phone is in initial stages. Another reason of influence is their little knowledge with technology that's why they follow the opinions of their relatives and friends in adoption [22].

### **5.6.2 Safety and Self Actualization**

Safety is an important issue in elder persons, they wants to be protected against social, physical, and psychological damages. The use of mobile phone decreases the possibilities of unwelcome situations. According to [22] initial motivations for usage of mobile phone is sense of security in all age groups. Self actualization means the motivation of achieving everything which can be possible to achieve. According to the Maslow's pyramid of needs self actualization is the top most priority which everyone wants to satisfy. Self actualization is achieved through achieving a reasonable social status, experiences of new ideas, gathering information of new technologies, exploring world, personal growth, and increasing potentials [22].

### **5.6.3 Enjoyment**

Enjoyment is an important factor of motivation; generally mobile phone adoption in young users refers to enjoyment. Enjoyment also plays an important role in elder users. Enjoyable a system means easier in operating. Complexity of a systems decreases when more enjoyable features added in it. It directly influences the elder person's intentions to adopt the mobile phone [22].

### **5.6.4 Support**

Support is referred to help; support from mobile phone reduces the barriers with technology. Support is directly linked with several technologies. The support from mobile phone increases the freedom in the life of elder persons. Early users may find some difficulties and barriers of technology but help from relatives and friends increase the familiarity with functions of mobile phone. Receiving the support from mobile phone increases the intention towards its use [22].

## 6 QUESTIONNAIRE AND INTERVIEW

This chapter is divided in two parts first explain the questionnaire and second describes the interviews. Questionnaire is an easy way of obtaining the information and public opinion about any specific topic. The perfection and quality is an essential part of questionnaire in designing phase. Second part is the analysis of two interviews which we conducted with healthcare professionals for the better understanding of problems of diabetes type 2 elderly.

### 6.1 Questionnaire Planning

The main purpose of questionnaire planning was to obtain quantitative data to analyze the current state of mobile phone usage in diabetes type 2 elderly. The major portion of our questionnaire depends on close ended questions. In questionnaire our targeted goal was to achieve the mobile phone functionality which elder people want in future mobile phones. We have also focused on problems which elderly facing in using mobile phones. We have planned to visit old homes and hospitals in Ronneby and Karlskrona to target diabetes type 2 elderly. After the successful completion of questionnaire, we will analyze them statistically and will get final results.

### 6.2 Questionnaire Designing phase

A detailed literature review, formal and informal discussions with some seniors enables us to better designing the questionnaire. During literature review we tried to extract all problems and issues of elder people in use of mobile phones. We have designed two types of questionnaire, one for those elderly who are using mobile phones and the other for those who do not use mobile phones. We mainly focused those elder people who are using mobile phones. The questionnaire about mobile phone using was divided in five parts and consists of twenty two questions. The first four parts of questionnaire belongs acceptability of mobile phone, functionality of mobile phone elderly prefer, use of mobile phone, and visual effects of mobile phone on elderly. These four parts contain close ended questions and fifth part contains three open ended questions. In second questionnaire we designed only two open ended questions for those who are not using mobile phone [8] [11] [18] [34] [37] [38].

### 6.3 Questionnaire about the use of Mobile Phone

- a) What is your name? -----  
 b) Gender Female  Male   
 c) What is your age? 50 – 64  65+   
 d) How many years you are using mobile phone? -----Years.

Please specify at which level you are satisfy which following questions

S. No.	Questions	Agree	Level for agree or disagree					Disagree	N/A
			1	2	3	4	5		
<b>Acceptability of the Mobile Phone</b>									
1.	Do you prefer a single button for both connect and disconnect function?								
	Yes		No						
2.	Do you like to see all outgoing, incoming and missed calls shows together in call log?								
	Yes		No						

<b>3.</b>	Which characteristics you consider most when you purchase a new mobile phone?									
	a) Functionality	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
	b) Brand	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
	c) Outer Look	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
	d) Price	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
	e) Fashion	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
<b>4.</b>	What type of mobile phone you like?									
	a) Flip	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
	b) Straight	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
	c) Slide	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
<b>5.</b>	What size of Mobile Phone you like?									
	a) Small	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
	b) Medium	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
	c) Large	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
<b>6.</b>	What should be written on call connect button?									
	a) Call	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
	b) Send	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
<b>7.</b>	What should be written on call disconnect button?									
	a) End	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
	b) Stop	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
<b>8.</b>	How would you like to see the main manu items display?									
	a) Names	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
	b) Icons	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
<b>9.</b>	Which color of mobile phone you like?									
	a) Bright	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
	b) Dark	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
<b>10</b>	What size of mobile phone buttons suits you?									
	a) Small	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
	b) Medium	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
	c) Large	Agree	<input type="radio"/>	Disagree	<input type="radio"/>					
<b>Functionality of the Mobile phone you prefer in your mobile phone</b>										
<b>11</b>	Do you like a one locking button to avoid accidental dialing (rather than usual MENU and *)?									
	Yes		No							
<b>12</b>	Would you prefere a special “emergency button” in future mobile to avoid any inconvenience ?									
	Yes		No							
<b>13</b>	What size of screen would you like?									
	a) Small inches	1.4-2.4	Agree	<input type="radio"/>	Disagree	<input type="radio"/>				
	b) Medium inches	2.5-3.5	Agree	<input type="radio"/>	Disagree	<input type="radio"/>				
	c) Large inches	3.6-4.4	Agree	<input type="radio"/>	Disagree	<input type="radio"/>				

<b>14</b>	Which text size you like in mobile phone?								
	a) Medium	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	b) Large	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
<b>Use of Mobile Phone</b>									
<b>15</b>	Do you always carry mobile phone with you?								
	Yes		No						
<b>16</b>	At what level you use mobile phone other than regular call?								
	a) Emergency	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	b) SMS	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	c) Games	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
<b>Visual effects of Mobile phone on elderly</b>									
<b>17</b>	Do you face difficulties when you focus on small/large objects on mobile phone screen?								
	Yes		No						
<b>18</b>	Can you easily distinguish colors?								
	Yes		No (if No please specify below which colors)						
<b>19</b>	Can your Mobile Phone helps in managing diabetes?								
	a) Help in Medication	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	b) Maintain blood glucose level	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	c) Physical activities	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
How									
<b>20</b>	Do you need any special service in your mobile phone regarding your disease?								
<b>21</b>	What problems you are facing with your current mobile phone?								
<b>22</b>	What improved functionalities you want in future mobile phones?								

**Table 5.1: Questionnaire for those who are using mobile phones**

## 6.4 Questionnaire about the not using of Mobile Phone

S.No.	Questionnaire		
1.	What is your name?		
2.	What is your age?	50 – 64 <input type="radio"/>	65+ <input type="radio"/>
3.	Gender	Male <input type="radio"/>	Female <input type="radio"/>
4.	Why you do not use mobile phone?		
5.	What is the motivational functionality that intends you to use mobile phone?		

**Table 5.2: Questionnaire for those who are not using mobile phones**

## 6.5 Questionnaire Distribution

We visited the old home and health center in Ronneby and Karlskrona for distributing the questionnaire. The English questionnaire converted in Swedish language, so the targeted persons can easily understand the questionnaire and answer them accurately. The questionnaire was distributed to 12 persons who were the mobile phone users and 4 persons were chosen who do not use the mobile phone.

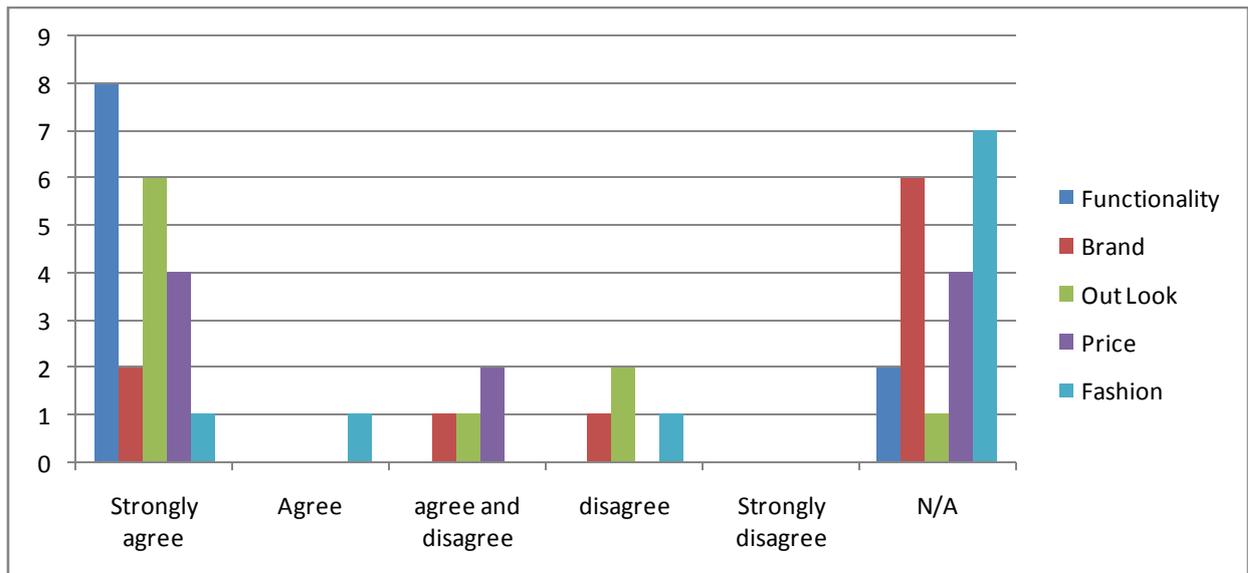
## 6.6 Questionnaire Analysis

After receiving the answers of questionnaires we performed quantitative analysis. Elder person's response against close ended questions is calculated through graphs. In this chapter only few graphs from each part of questionnaire are given and rest of graphs will be shown in appendix.

### 6.6.1 Close Ended Questions

The first four parts contain close ended questions. The first part is acceptability of mobile phone, in first question, 50% elder people responds that they prefer single button for both functionalities of connect and disconnect whereas 50% people says that they do not prefer single button. In question 2 of questionnaire, around 42% respondents said that they want all three incoming, outgoing, and missed call functionality in call log. But approximately 58% elder people said they don't want all three functionality in call log.

Third question was very important, which asks from the elder people's that what thing is most important for them when they purchase mobile phone. According to the responses functionality of the mobile phone is most important factor at the time of purchasing of mobile, 67% elder persons said that they consider functionality of mobile phone at the time of purchasing, 50% respondents consider the outlook of mobile handset. The fashion and brand do not effect in purchasing, around 58% respondents said they don't care fashion and 50% said they don't care brand while purchasing new mobile phone. The rest of responses are given in below graph:



**Graph 5.1: Question 3**

In question 4 of questionnaire, 50% elder persons replied that they like flip mobile phone and 50% did not replied on it. For straight mobile phone 42% people responds in strongly agree and 50% said it is not applicable in choice. 83% elder persons didn't showed interest in Slide mobile handset whereas only 17% strongly agreed that they like slide mobile phone.

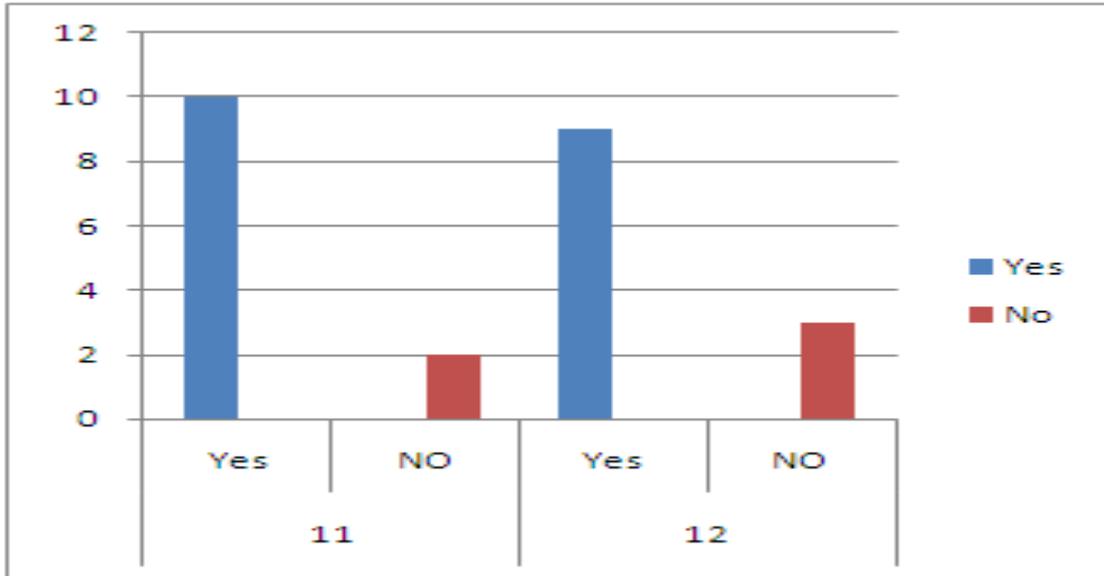
In question what size of mobile phone they like, 50% of respondents said they like medium size of mobile phone. While around 41% of people like small size mobile phones and only approximately 9% elder people like large size mobile handsets. This ratio shows that mostly elder people likes medium size mobile phones. In sixth question, 67% elder persons were strongly agree that "Call" should be written on connect button, only 25% people said that it is not applicable. Only 8.33% replied that "Send" should be written on connect button and 75% respond with not applicable. This percentage is showing that majority of elder people like that Call is more accurate word than Send on call connect button.

The majority of elder persons likes that "end" should be written on call disconnect button. Around 58% responds in favor of it and only 25% strongly agrees that "stop" should be written on call disconnect button. In question 8 of questionnaire, mostly people said they prefer that Icons are the best way to show the main menu items but the difference between two decisions is not very high. 58% respondents gave response in favor of "Icons" whereas 50% said they prefer "Names". Question 9 we asked from elders that which color of mobile phone they like, 83% elder persons responds that they prefer "Bright" colors of mobile phones whereas only 17% replied that they like "Dark". Statistics of this question showed that bright colors of mobile phones are much popular in elder people.

In question 10 of the questionnaire, we asked what size of mobile phone the like. The results of this question were almost same with little difference. 42% respondents said they like "small" size mobile phone, 33% prefers "Medium", and 25% elder persons favors large size mobile handsets. In second part of questionnaire "functionality of mobile phone elder people prefer" is asked.

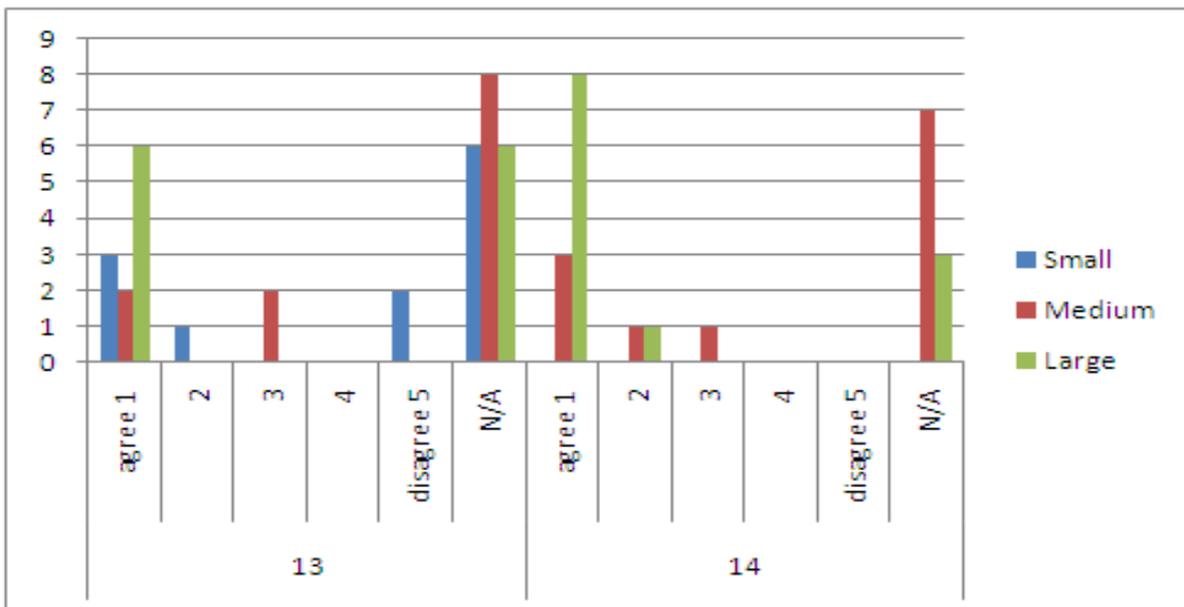
Question 11 was very important question for elderly point of views; due to ageing factor elder people lose their control on body movement especially on their motor functions. So a central locking button on mobile phone attracts them a lot. 83% elder people respond that they prefer central locking button in future mobile phone whereas only 17% reject this functionality in future mobile phones. Question 12 in the questionnaire is also very important question with the point of view of future functionality of mobile phone. Question was asking about the emergency button for some critical conditions when elderly do not know the exact number from where he takes help. Emergency button facilitate them to contact immediately with health centre or care centre. 75% elder persons replied in favor of emergency

button in future mobile phones and only 25% respondents answered against this button. Visual effects are one of the chronic factor which increases with the age of persons. In diabetes type 2 elderly decrease of eyesight is common factor. In this question 50% elderly replied that they prefer large screen sizes of future mobile phones. 25% said they want small screen size and only 17% responds about the medium size of screen.



**Graph 5.2: Question 11, 12**

The question 14 of the questionnaire is also very important question for type 2 elder persons, this question also helps in maintaining the font size of mobile phone according to the requirement of elder persons. 67% elder persons replied that they want large font sizes in future mobile phones whereas only 25% respondents said they prefer medium size fonts. Third part of close ended questionnaire contain 2 questions only, 15<sup>th</sup> question was very simple. 67% elderly replied that they always carry mobile phone with them and 33% told that they do not carry mobile phone all the time with them.



**Graph 5.3: Question 13, 14**

In question 16 of the questionnaire, we asked that how much they use mobile phone other regular calls. Only 33% elderly replied that they use mobile phone for SMS, 17% said they use it in some emergency situations. According the statistics of this question SMS is popular functionality in elder persons after the regular calls. The fourth part of close ended questionnaire asks the questions regarding the eyesight and some diabetic issues relating with mobile phone. In question 17 we asked do you face difficulties on focusing the small and large objects of mobile phone. 67% elder people responds with “Yes” where as 33% said they do not feel and problem in focusing the objects.

Question 18 was very simple question, in this question we asked whether elderly facing any problem in distinguishing the colors or not. 100% respondents replied positive and there was not a single person who was facing color blindness. Question 19 was about the maintenance of diabetes using mobile phone or at what level mobile phone helps them in managing their diabetes. Only one person responds that his mobile phone helps him in managing diabetes. The rest of respondents said they did not use their mobile phone yet for managing diabetes.

### **6.6.2 Open Ended Questions**

Open ended questions are the best method to get the opinions and views of public. An open ended question provides the freedom to express own ideas without any bound. Following are the answers of three open ended questions.

In question 20 out of 12 targeted persons 9 respondents did not answer the question. One respondent said, mobile phone must have some functionality regarding the diabetes. Mobile phone hold record of blood pressure, provide estimation of sugar level, and estimation of serum control. Another respondent suggested mobile should have features which help in managing diabetes. Mobile phone also contains the functionality which informs the patient about the medicine dosage time. The last respondent said mobile phone should be a multipurpose device. It should perform the functionality like diabetes checking.

Question 21 of questionnaire was about the problems user facing with current mobile phones. Five respondents did not replied about this question. 33% respondents said they are facing short battery life. One respondent said buttons of mobile phone are hard in pushing. Another was facing the accidental dialing problems. In question 22 of the questionnaire around 67% respondents did not give any suggestion. Two elder persons said that battery life of mobile phone should be increased and charging should take less time in completion. One person replied that the response time of mobile phone should be decreased. Another elder person said that mobile phone must contain the initial knowledge about the diabetes and also contain facilities to control the diabetes.

### **6.7 Elderly who do not Use Mobile Phone**

We distributed the questionnaire to 4 elderly who do not use mobile phones. Questionnaire contains two open ended questions, first was about the reason and second was about functionality.

In first question, two elder people said that they do not use mobile phone because they don't like mobile phones. One respondent said, he don't use mobile phone due to ageing factors. He is much older and his eyesight becomes weaker so, he is not interested in using mobile phone. Fourth respondent said, I use mobile phone only in homes but I am not a regular user of mobile phone. All four respondents have ignored the question 2. Because they are not the user of mobile phone so how they knew the current functionalities and also how they can express about the future functionalities.

### **6.8 Interviews**

We selected two interviewees, to complete the interview part of the thesis work. The first interview was conducted with the Lisbeth who working as a Nurse in Ronneby health care centre. She is working from last 4 years with the diabetes patients. The second interview conducted with Manzoor

Ahmed who is a senior medical officer in Pakistan and working with diabetes patients from last 3 years.

## **6.9 Importance of Interviews**

We planned to conduct interviews with health care professionals to identify the problems which diabetes type 2 patients facing in communication. The main reason behind the interviews was to validate our study, and the results of questionnaires. The opinions of professionals are helpful in better understanding of problems of diabetes type 2 patients and their solutions.

## **6.10 Interviews Planning and Design**

For conduction of interviews we have planned different times for interviews. We took the appointment from the healthcare professionals and reached on decided time. The time duration of each interview was 30 to 45 minutes. We tried to insert maximum questions in our interview to identify the problems of diabetes type 2 patients. We designed two types of questions for interviews; first one was preplanned or formal question and second was runtime questions or informal questions. Informal questions asked from professionals during the interview. We focused mainly those problems of diabetes type 2 elderly which directly relates with using of mobile phone or functionality of the mobile phone.

## **6.11 Data Saving**

For the purpose of accurate results we used two techniques for acquiring data during the interview. We decided that one partner will start questioning with interviewee and the other partner record that interview. The reason for recording the interview was informal discussion which occurs during questioning. After completing interviews we converted the recorded interviews into text format.

## **6.12 Interview 1**

First interview was conducted with a Lisbeth (nurse) in County of Blekinge, Sweden. She has been working with diabetes patient for 4 years. She identified there are about 650 diabetes patient are registered in hospital and two nurses are dealing with them but she has no idea how many diabetes type 2 patients are registered in county of Blekinge. She explained the effect of type 2 diabetes on patients, patients feel tired and some time become arrogant because of their sugar levels.

### **6.12.1 Communication Gap**

According to her patients only meet with doctors in special cases and after the check up nurses take care of that patient according to doctors instructions. She accepted that there is a communication gap between patient and health care staff because most often patients try to hide the facts about diet and exercise but health care staff gets all facts after the test results. She said the common reason for visibility problem is age not the type 2 diabetes effects.

### **6.12.2 Visibility Problems**

According to the Nurse diabetes patients do not take effective measures in starting phase when they feel that their eyesight is weakening. Their eyesight does not weak suddenly but it takes time and decrease slightly and takes 5 to 10 years. Doctor describes the visibility issues as vascular problems of eyes. According to him the patients who face vision problems some time cannot see properly because of the condition of lens. To overcome visibility problems screen sizes of the mobile phone should b increases so the diabetes type 2 elderly can view properly

She identified some physical impairment because of type 2 diabetes, they suffer kidney problem, get foot sours and also suffer from gangirria. She said diabetes type 2 patients do not face any hearing problems. According to her if diabetes patients have routine checkups of their eyes then they do not have any chances of color recognition problems in the future. She explained that diabetes patients do not face problems in touch sensitivity of hand fingers but they have problems in foots and to some extent their feet become senseless.

### **6.12.3 Mobile Phone Support in Diabetes**

According to her mobile phones cannot help them in managing diabetes. In her views it will be a difficult task for them to check their blood sugar level using mobile phones. She said that most of the diabetes patients who spent most of their time in home do not have any mobile phone. The patients who are living at home have a special alarm for emergency cases so in her views the patients who are living at home do not prefer to use mobile phones to manage their diabetes. She is agree with emergency button in mobile phones, she said alarms are better in homes which connects with health care centers for emergencies but if this facility can be included in mobile phones then patients feel more relax in contacting the health care centers in any situation.

### **6.12.4 Mobile Phone and Text Size**

She said mobile phone size matters but it mostly depends on how often patients use mobile phones and according to her the patients who are working mostly have mobile phones. She suggested that emergency button in mobile phones will be supportive if it will be simple to use. She argued that emergency button could be helpful in some situations because in emergency situations it will very difficult to find the mobile phone.

According to her mostly patients who visited hospital don not have mobile phones so they never received any response related to problems in using mobile phones. She prefers to have larger text size in mobile phones not only for type 2 diabetes patients but also for elderly because most often they face visibility problems. She said hospital contact with patients through letters but in case if they need them immediately then they have patients numbers in some case both mobile phone and land line numbers.

## **6.13 Interview 2**

Second interview was conducted with a senior medical officer MBBS doctor in Pakistan. Who was dealing with diabetes patients for last 3 years and working in hospital for more than 29 years. He said daily 250 diabetes patients get registered. He explained the effect of type 2 diabetes on patients; patients feel hyper glycemia, suffer heart disease, also disease related to kidneys like renal failure or nephropathy as well as some time pus albumin in urine.

He identified communication gap between patients and health care staff because of no proper awareness of disease and lack of education. Some time they come with complains and they take the test but most often they come at complicated stages not in start. Most of the patients use homeopathic medicines and try to avoid the actual treatment.

### **6.13.1 Visibility Issues**

He said type 2 diabetes patients face visibility problems like refractive errors suffer from retinopathy; it is a vascular problem of eyes. He identified patient face vision problems such as most of them suffer from cataract, it is the condition lens cannot see properly and some time chances of vision loss and in that cases they need to operate. He identified some physical impairment because of type 2 diabetes, such as they do not feel healthy, physically effect on foot, loss of sensation and pain. Moreover He said diabetes type 2 patients do not face any hearing problems. He explained diabetes also effect on color recognition sense of patients they suffer from color recognition problems, blurring of vision also retinopathy creates problem in critical cases they need to get operate. He explained sensitivity problems in diabetes type 2 patients some effect on hands, like feeling pins pinching in hands; they don't differentiate between hot and cold. Their foot become senseless and they do not feel and pain.

However according to the doctor mobile phone can be useful in managing diabetes such as making contact with health care staff, person having the mobile phone can get help easily by contacting with them and communication gap will be decrease. He suggested that more the simple mobile patients will like to have it, light weight, easy to use, simple buttons and features, large screen, these all will be helpful and attract to patients.

### **6.13.2 Emergency Button of Mobile Phone**

According to him especially in large population's area emergency button will be effective to get help quickly without delay. He suggested that there should be additional function, that patient just get his sugar level in his mobile just by pressing the button, so he can provide the correct information on time to the doctor. According to him larger text size will be very effective for diabetes type 2 patients. He thinks that Large text size is easy to read they can feel problem with small text because of catric, so they may be avoid to use the mobile so he think it is better having large text on mobile.

### **6.13.3 Mobile Phone Use**

He analyzed that most of the old age do not have mobile phones; they even do not have idea how to use them. He said that from last 10 years trend are changed people between 50 to 60 years mostly having mobile phones as compare to older. He explained that they do not contact with the patients, all come to hospital and get there check up and get other appointment date from them. He said if patients come to their private clinics which is very common trend in our country so we have their mobile numbers, and we contact them if needed but mostly we do not.

## **6.14 Analysis**

The first interview we conducted with the Lisbeth a nurse in County of Blekinge, Sweden. She has been working with diabetes patient for 4 years. Second interview was conducted with a senior medical officer MBBS doctor in Pakistan. Who was dealing with diabetes patients for last 3 years and working in hospital for more than 29 years. Nurse identified there are about 650 diabetes patient are registered in hospital and two nurses are dealing with them but she has no idea how many diabetes type 2 patients are registered in county of Blekinge. Doctor said daily 250 diabetes patients get registered. Nurse explained the effect of type 2 diabetes on patients, patients feel tired and some time become arrogant because of their sugar levels. Doctor explained the effect of type 2 diabetes on patients; patients feel hyper glycemia, suffer heart disease, also disease related to kidneys like renal failure or nephropathy as well as some time pus albumin in urine. Nurse accepted that there is a communication gap between patient and health care staff because most often patients try to hide the facts about diet and exercise but health care staff gets all facts after the test results.

Doctor identified communication gap between patients and health care staff because of no proper awareness of disease and lack of education. Some time they come with complains and they take the test but most often they come at complicated stages not in start. Most of the patients use homeopathic medicines and try to avoid the actual treatment. Nurse said the common reason for visibility problem is age not the type 2 diabetes effects. Doctor said type 2 diabetes patients face visibility problems like refractive errors suffer from retinopathy; it is a vascular problem of eyes. Nurse said another reason is that diabetes patients do not take visibility problems serious in initial stages that respond as serious problem after 5 to 10 years. She identified some physical impairment because of type 2 diabetes, they suffer kidney problem, get foot sours and also suffer from gangiria. Doctor identified some physical impairment because of type 2 diabetes, such as they do not feel healthy, physically effect on foot, loss of sensation and pain. Nurse and Doctor both agree that diabetes type 2 patients do not face any hearing problems. According to nurse if diabetes patients have routine checkups of their eyes then they do not have any chances of color recognition problems in the future. Doctor explained diabetes also effect on color recognition sense of patients they suffer from color recognition problems, blurring of vision also retinopathy creates problem in critical cases they need to get operate.

Nurse explained that diabetes patients do not face problems in touch sensitivity of hand fingers but they have problems in foots and to some extent their feet become senseless. According to the Doctor effects on body's feeling sense, like when it effect on hands patients feels pins pinching in hands; they don't differentiate between hot and cold. Their feet became senseless and they do not feel and pain. According to nurse mobile phones cannot help them in managing diabetes. In her views it will be a difficult task for them to check their blood sugar level using mobile phones. She said that most of the diabetes patients who spent most of their time at home do not have any mobile phone. The patients

who are living at home have a special alarm for emergency cases so in her views the patients who are living at home do not prefer to use mobile phones to manage their diabetes.

On the other side According to doctor mobile phone can be useful in managing diabetes such as making contact with health care staff, person having the mobile phone can get help easily by contacting with them and communication gap will be decrease. He suggested that more the simple mobile patients will like to have it, light weight, easy to use, simple buttons and features, large screen, these all will be helpful and attract to patients. According to him especially in large population's area emergency button will be effective to get help quickly without delay. He suggested that there should be additional function, that patient just get his sugar level in his mobile just by pressing the button, so he can provide the correct information on time to the doctor. Nurse said mobile phone size matters but it mostly depends on how often patients use mobile phones and according to her the patients who are working mostly have mobile phones. She suggested that emergency button in mobile phones will be supportive if it will be simple to use.

She argued that emergency button could be helpful in some situations because in emergency situations it will very difficult to find the mobile phone. According to doctor larger text size will be very effective for diabetes type 2 patients. He thinks that Large text size is easy to read they can feel problem with small text because of catric, so they may be avoid to use the mobile so he think it is better having large text on mobile. According to nurse mostly patients who visited hospital don not have mobile phones so they never received any response related to problems in using mobile phones. She prefers to have larger text size in mobile phones not only for type 2 diabetes patients but also for elderly because most often they face visibility problems. Doctor analyzed that most of the old age do not have mobile phones; they even do not have idea how to use them. He said that from last 10 years trend are changed people between 50 to 60 years mostly having mobile phones as compare to older.

Nurse said hospital contact with patients through letters but in case if they need them immediately then they have patients numbers in some case both mobile phone and land line numbers. Doctor explained that they do not contact with the patients, all come to hospital and get there check up and get other appointment date from them. He said if patients come to their private clinics which is very common trend in our country so we have their mobile numbers, and we contact them if needed but mostly we do not.

## **7 DISCUSSION AND VALIDATION**

Discussion and Validation of the thesis is assessed in this chapter. The chapter is divided in two parts, first part illustrated the discussions. We have discussed diabetes effects on elder persons, communication gap between the elderly and health care professionals, how the effects of diabetes becomes a hurdle in using mobile phone in elder person. The second part of this chapter describes the validity assessment of the results which we have taken through interviews and questionnaires.

### **7.1 Discussion**

Functionality of the mobile with respect to elder people is studied in detail. Diabetes type 2 patients were selected as a case study. We studied in detail the physical problems of diabetes type 2 elderly which creates problem in using mobile phone by them. For obtaining accurate and authenticated results we adopted well organized approaches to complete this work.

It was a difficult task to find out the problems which elder people facing in using mobile phones, functionalities which they want in future mobile phones, and also the reasons from those elderly who are not the user of mobile phone. Diabetes type 2 is a chronic disease and mostly it founds in elder persons that's why we chosen elderly type 2 patients as a case study. Diabetes type 2 effects on elder's body in multiple ways and it reduces the physical strength of their body.

Lack of awareness with communication technologies and effects of diabetes are the reasons of not using mobile phone by elder persons. Another reason is complex functionalities of mobile phone which are harder in understanding by elder person. This isolation with technology leads the communication gap between the health care providers and elder persons. In case of any emergency elder persons cannot make contact with health care departments efficiently.

### **7.2 Functionality of the mobile phone**

In our thesis work we mainly focused the functionality of mobile for elder persons. Diabetes type 2 patients were chosen as a case study. The reason of choosing the type 2 patients was that, this disease is mostly occurred in old age. By targeting diabetes type 2 patients we analyzed the requirements of both elder persons and type 2 patients. The important points which we asked in functionality of mobile phone from the elder persons and health care professional were highly appreciated.

They gave us positive response and told us how much important these points are for them. Nurse suggested that there should be some more functions in future mobile phone so they can better facilitate the diabetes patients. She said it is a difficult task to include the functionality of sugar checking in mobile phones but if this could implement, it will be a great achievement. Because in this way usage of mobile phone will be increase and the patients will get a good option. So the mobile phone will work for them as a communication device as well as a sugar checking machine. Following are the points related to the functionality of the mobile phone:

#### **7.2.1 Central Locking Button**

In current mobile phones normally two buttons are using for locking the mobile handset and it may create problem some time for elder people. The elderly who suffers from nervous system or facing troubles with their motor function can have problem with locking buttons. One central locking button can facilitate them in avoiding accidental dialing. In our questionnaire response majority of the elder people replied that they want a central locking button in future mobile phone. So, they can easily lock their handset and safe themselves from any problem.

### **7.2.2 Emergency Button**

The most important functionality which should be inserted in future mobile phones. An emergency button in mobile phones can provide a high level sense of security to the users. The elder person who lives alone in their homes in rural or urban areas is not getting all health care facilities in homes. For health services they visit the health care centers or in emergency they call health departments for help. Embedded emergency button can establish the direct contact with emergency service center and with this facility elder people will feel free from remembering the numbers of emergency centers.

In surveys majority of the elder persons said that they will appreciate it if this functionality could be implemented in future mobile phones. Around 75% of persons responded positively and suggested that it is important to include an emergency button in mobile phones for elder persons. Doctor said in large population it becomes difficult for health centers to take care of every elder person in hospitals or at their homes. So, a system is necessary which provides a trouble-free environment to elder persons. According to him an emergency button will help the elder person efficiently. Nurse explained that an emergency button could help the elder patients if it is implemented in a simple way.

### **7.2.3 Blood Sugar Check**

Another very important functionality which should be included in future mobile phones is the facility of blood sugar checking. It means that the mobile phone also works as a blood sugar checking device. In open-ended questions many elder people suggest this functionality. In informal discussion with the nurse, the nurse also suggested that mobile phones should include this functionality. She argued that implementation of this functionality is difficult. She said, if this functionality could be implemented, it is good but in case of non-implementation Sweden has enough resources to provide health care services to its citizens.

The second interviewee (Doctor) has another opinion for this functionality if the future mobile phone could have. According to him this functionality is very interesting and facilitating if it is implemented. The patients can hold only one device and take multiple benefits from it. He explained that due to a large number of patients, it becomes difficult to provide sufficient health care to every patient and with these kinds of facilities patients became habitual to take care of themselves. Mobile phone is a handheld device which patients mostly carry with them; having a blood sugar check facility in a mobile phone they can easily send updates about their sugar level to their doctors.

There is little variation in opinions of both interviewees. According to Lisbeth (Nurse) implementation of this functionality in future mobile phones is difficult and it is not much important. The reason behind this thought is that Sweden is a country which spends a huge amount on the welfare of its citizens. Sweden belongs to those countries that have enough resources to facilitate their citizens. Population of Sweden is small and it is possible for the government to provide health care facilities for every individual. But the opinion of Manzoor (Doctor) is different from Lisbeth's; the reason behind this is different culture and population. The second interviewee's (Doctor) belongs to Pakistan and he gave suggestions according to the culture of Pakistan. China, India, Pakistan is a region where population is very high compared to their resources. Individual care is not possible in these countries, so there is a need of some intelligent solutions that share the burden of healthcare departments.

According to Manzoor implementation of blood sugar check functionality in mobile phones will reduce the burdens of health care centers. If this could be implemented, the dependency of patients also minimizes and they can manage their diabetes easily. They can manage their previous records of sugar level and when they visit the doctor they can express about their disease easily. Although in Sweden where each individual is getting proper healthcare facilities, but the increasing ratio of elder persons is alarming in Sweden. So, there is a possibility that in the future individuals should have to be able to take care of themselves. Especially in the case of type 2 elderly they can be easily cured at home when their mobile devices will be connected with health care centers, and their sugar level could be monitored with active communication.

### **7.3 Answers of Research Questions**

For answering to the research questions, we adopted the stepwise approach throughout our thesis. First of all we studied the literature and understand the effects of diabetes on the patients. Moreover we studied the problems of diabetes type 2 elder persons facing in using of mobile phones. Then we studied the standards of mobile phone usability. In literature study we briefly described the attributes of usability and some important attributes which could be helpful in designing mobile phones with less complexity. If these attributes applies in initial phase of designing of mobile phones for elder persons, they could provide successful end product which can be acceptable by the elder persons.

We have also studied the factors that effects on bodies of elder persons either they are due to ageing or due to diabetes. This literature review helps us in developing the questionnaire for conducting the surveys and planning the interviews. We found that the elder people avoid to use those devices which have complex functionalities and hard to understand. Some important points about the functionality of mobile phones which we have raised during surveys and interviews were appreciated by the respondents and they answered closer to our study. We have tried to pull out the accurate results and statistics to answer the research questions.

### **7.4 Validation Assessment**

The validity assessment of the research work is most essential part to for completing any research report. Validation assessment depends on the methodology which could be used in research work. We have adopted mix research approach in completing the thesis. We have assessed our results according the criteria of Trochim [16]. According the Trochim validity can be assessed with four given criteria's: Credibility, Transferability, Dependability, and Conformability [16].

#### **7.4.1 Credibility**

Trochim describes the credibility as; the result of the research work must be accurate and acceptable to the participants [16]. We used the mix research approach to achieve the credibility. The research work is completed in different phases and steps. After defining the problems and research methodology we started to review the literature, informal discussions with BTH students and professionals who are working in this area. These discussions and literature review enables us to design the questionnaire for surveys and preparation for interviews.

We conducted interviews with two persons who are working with diabetes patients. The interviews recorded electronically and then translated in text format after translating we analyzed the text separately for the confirmation of credibility of interviews. The questionnaire designed and distributed to the elder person who are suffering from diabetes type 2. After completing the questionnaire we statistically analyzed the results. The detail of interviews and questionnaire is given in appendix A and B. after analyzing the results from questionnaire and interviews we are confident that our study is credible.

#### **7.4.2 Transferability**

Trochim defined the term transferability as; the possibility of the results of research works to generalization and transferring in some other environment or context [16]. Diabetes type 2 has many effects on the bodies of elder persons but we focused only those effects which create hurdles in using the wireless communication devices. The interviews and questionnaires give the better understanding about the problems of diabetes type 2 elderly.

In our surveys we distributed the questionnaire the elder persons form County Blekinge and the cultural background of all respondents were same. So, this might be a threat when we change the context then there is possibility of difference of opinion. Another possible threat is that we conducted survey on small basis so if it does on huge basis then there is possibility of changed results.

### **7.4.3 Dependability**

According to the Trochim dependability is occurrence of alteration in previous studies over time. Dependability also means the results of new research compared with previous research results in same context and altered [16].

Our study depends on the previous studies. The construction of the questionnaire and conduction of the interviews mainly depends on the literature review. Our targeted group in survey was Swedish speakers, so, we converted the questionnaires from English language to Swedish language. This conversion of the language and limited knowledge of elder person's can be a validity threat. Because it may be the respondents do not understand the logical terms appropriately. To overcome this threat it is necessary before conducting surveys all the necessary logical and technical terms should be understood by the respondents.

### **7.4.4 Confirmability**

Trochim defined the term confirmability as the degree of confirmation the research results with the previous studies [16]. First of all we detailed reviewed the literature and finds the problems of diabetes type 2 elderly. Furthermore we study the effects of these problems on the use of mobile phone. After that we designed the questionnaire and conducted interviews. The results of survey questions and the responses of the interviews helped us in confirming our study.

## 8 EPILOGUE

This chapter covers three parts conclusion, recommendation for the betterment of future studies and future work.

### 8.1 Conclusion

The main objective of our study was to find out the functionalities of the mobile phone for elder persons who facilitate them and give them a happier, independent, secure, and joyful life. This functionality evaluation is done by empirically and different methods were used to finish this report. This was not a simple topic which can cover with simple analysis. Diabetes is a disease which is growing rapidly all over the world and diabetes type 2 in elder people is also increasing with a high ratio. The elder population is rising fastly comparing to other ratios. So, it means the diabetes type 2 is also increasing in those elder persons.

For exploring all these issues we studied the previous research works in this field and identified the problems. The use of mobile phone in current elder person is not so good. Many issues are involved in this not using. One major factor is complex functionality of latest mobile phones. Another factor is if less technological awareness in elder persons. Physical effects of diabetes on elder persons are also hurdles in carrying of mobile phones. Weakness in motor function, cognitive impairment, and hearing problems in elder persons are also the causes of avoiding mobile phones.

All the issues and problems of diabetes type 2 elderly were identified through the literature review. On the basis of this study and informal discussions we designed the questionnaire for surveys and interviews. The surveys were conducted with the elder persons belongs to county of Blekinge for understanding the needs of elderly. The two interviews conducted with the health care professionals. The findings from the questionnaire is statistically analyzed and obtained the concrete and accurate results. The results from interviews and questionnaires validated with the previous studies in same context.

In response of the first research question we came to know that there are many communication technologies available in the market that is facilitating the elder persons. Although these technologies did not get full popularity in elder person but a little education and removal of complexity from them make popular in elder persons. The second research question was focused on those elderly who are facing diabetes type 2. We have asked the reasons from them why they do not use mobile phones in their regular life.

We came to know with the responses that some elder person do not like mobile phones where as some told that the complexity of mobile phone operating systems isolates them from mobile phones. The third and most important question of our study was about the functionality of mobile phone which elder people want in future mobile phones. The answers were quite similar about the functionality; most of them suggested that there should be less functional complexity in mobile phones. So, the elder people take interests in using mobile phone.

### 8.2 Recommendations

After studying the previous researches and with our empirical works we are able to give some suggestions which can be supportive in providing better services to elder persons. All these recommendations depend on the observations and findings from the literature study, interviews, and questionnaire results.

Elderly population and diabetes type 2 are growing rapidly but the use of mobile phones is not increasing at the same rate. So, it is necessary that mobile phone manufacturers pay interest in this area and invest resources for huge level research. According to our research it is important that mobile

phone companies should make special mobile phones that facilitate elderly. While they design mobile phones for elder persons, they should keep in mind some of the following points:

In modern age technology is getting advancement with every passing day. The popular history of mobile phone is not very deep only few years back majority of humans did not have mobile phones. So, currently the elder persons don't know about complex functions of mobile phones. It is recommended that the manufacturers should keep this thing in mind while they design mobile phones for elder persons.

Due to the visibility problems elder people's ability to focus on small things reduces. That's why they prefer medium or large size things. So, the size of mobile phone should be medium and it contains large font size inside of it. It is also important that mobile phone contain few operating buttons rather than one button for each function. Another problems associated with visibility of elder persons is color of mobile phone. Mostly elder people like bright colors, so it is good if the color should be bright.

In old age physical strength of the muscles weakens and elder people suffer from weak motor functions. In this case they need some special functions and buttons in mobile phone. There should be central locking buttons in mobile phones which save from accidental dialing. An emergency button is also very important for saving from critical situations. This emergency button should make contact with emergency centers when elder person push it.

Another very important functionality which future mobile phone should include is about the diabetes patients. Some of the respondents said that in this era it is not difficult to include many functions in one device. They suggested that mobile phone should hold functionality as blood sugar check machine. In this way mobile handsets will get more popularity in elderly.

### **8.3 Future Work**

This research work is an effort to participate in the area of eHealth. We believe that the given recommendations in this thesis might be supportive for understanding the requirements of elderly. Use of mobile phone will help the elder persons to integrate socially and also contact with health care centers in case of emergency. Overall there are so many issues and problems elderly facing in using mobile phone or why they are not using mobile phone. But in this research work we focused those problems which type 2 elderly facing. We identified the functionalities according to elder patients of diabetes type 2. We did a little part in this and we think there is a lot of work has to do.

Our suggestions about the implementation of functionality of mobile phone and future work we propose is depend on our analysis. Previous research work, analysis of questionnaires, and the results of interviews enable us to identify the further work needed in this area. One suggested future work is to identify the problems of deaf persons in using mobile phones and solutions of those problems. What are the effects of frequency variations of hearing device and mobile phones on deaf persons and what are their solutions? Another future study can be the usability of mobile phone in the elder person's perspective.

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# APPENDIX: A INTERVIEWS

## INTERVIEW 1

Name: - Lisbeth

Designation: - Nurse, with special competence of diabetes.

Q 1:- For how many years you are working with diabetes patients?

Ans: - Four years

Q 2:- How many patients are registered with your clinic?

Ans: - 650 patients and two nurses deal with them.

Q 3:- How many patients of type 2 are registered in Blekinge?

Ans:- No idea

Q 4:- How many patients visit you in a day?

Ans:- 6 to 7 patients in a day and it takes one hour to deal with one patient. In one week, three days are for visit, and in 2<sup>nd</sup> week, two days are for the visit of patient. Some of them are using insulin and some just tablets.

Q 5:- What is the effect of type 2 on the elder patients?

Ans:- They feel tired and thirsty, become arrogant because of their sugar level some time.

Q 6:- When doctor meet the patient?

Ans:- There is no any specific doctor to deal the patients of type 2, we nurses deal with the patients and they just meet the doctor once in a year on for a big test of diabetes, and from the next year we nurses are going to do these tests.

Q 7:- Do you feel any communication gap between you and patients?

Ans:- Yes, they mostly tell a lie about their diet, I get all truth from there test results.

Q 8:- How much visibility problem diabetes 2 patients feel?

Ans:- Not all of sudden, they lose their vision because of age, they don't take it serious in start, but after 5 to 10 years they come to know that they have this problem.'

Q 9:- Do you think the diabetes type 2 patients face vision problem?

Ans: - Yes, but it effects on type 1 more, people become blind with it.

Q 10:- What kind of physical impairments type 2 diabetes face?

Ans:- They suffer from kidneys problems, and they get foot sour, recovery is difficult and suffer from gangiria.

Q 11:- Do you think that type 2 patient have hearing problem?

Ans:- No

Q 12:- How much type 2 effects on color recognition sense of patients?

Ans:- As long as they have good condition of eyes, they don't feel it, they have eyes checkup after 3or 4 years, if they feel problem, they get laser operation and recover their sense of color recognition.

Q 13:- How much diabetes effect on touch sensitivity of patients fingers?

Ans:- They don't feel problem in hands, but their feet become senseless, they don't feel either

they are walking on glass or on stone. Once a patient came to me, he has a glass in his feet, he came by walk, but have no any feeling for that.

Q 14:- What do you think mobile phones help them to manage diabetes?

Ans:- I don't think so.

Q 15:- Do you think if we reduce functional complexity of mobiles, it will be helpful for the patients?

Ans: - If they could check the blood sugar with it, but I think it is a little bit harder.

Q 16:- Do you think mobile phone size matter, when diabetes patient will use it.

Ans:- Yes, it depends how often he use it, but I have seen that mostly who are not working, they don't have mobiles, and they don't want to use them because they have special alarms on their arms, means "hemtyanst". If they feel problems, they use them, and who are living in their home they have no so critical conditions.

Q 17:- Do you think an emergency button is useful on mobile phones to avoid critical conditions?

Ans: - Yes, but it is still not easy for patient to search the mobile in emergency, and find the number to call, so alarm is better. But if button is simple to use then may be it works.

Q 18:- Do you think that small and large size of screens effects patient's visibility?

Ans: - Patients never complain us about problems related to use of mobiles, as I told you mostly don't have it.

Q 19:- What is in your opinion that large text size will help type 2 patient?

Ans: - Yes, it is good to have large text for all elder people, not only for the diabetes patients, because vision lost by age increases.

Q 20:- When patients visit you, do they carry mobiles?

Ans: - Mostly don't have, but who works they have. But we don't notice about that if they carry mobile or not.

Q21:- Do you contact patients on their mobiles.

Ans: - Mostly who work they have mobile, but who stay home they don't have. We contact them through letters, but if we need to contact them immediately, then we have there numbers, not all of mobiles, also land line numbers, so we contact with them there.

## INTERVIEW 2

Name: - Manzoor Shahzad

Designation: - Senior Medical Officer

Q 1:- For how many years you are working with diabetes patients?

Ans: - From last 3 years dealing with diabetes patients, working in hospital from more than 29 years.

Q 2:- How many patients are registered with your clinic?

Ans: - In Punjab, population is half of the country, daily 250 patients get registered.

Q 3:- How many patients of type 2 are registered in Punjab?

Ans: - Not any proper figure, but the it is in hundred thousands.

Q 4:- How many patients visit you in a day?

- Ans:- 70 patient in a day, we work 8 am to 2 pm, and we 3 person 2 junior staff members write history and check the pulse, temperature, and me as a doctor finally examine patient and it all take 15 minutes by 3 persons. If patient is admitted then we conduct further tests.
- Q 5:- What is the effect of type 2 on the elder patients?  
Ans:- They feel hyper glycemia, in it glucose level increases, also suffer heart diseases, related to kidneys like renal failure or nephropathy, some time pus albumin in urine.
- Q 6:- Do you feel any communication gap between you and patients?  
Ans:- Yes because no proper awareness of disease, lack of education, they come with complains, and we take the test, mostly come at complicated stages, not in start, most of them use homeopathic medicines, and try to avoid the actual treatment.
- Q 7:- How much visibility problem diabetes 2 patients feel?  
Ans:- They feel refractive errors, suffer from retinopathy, it's a vascular problem of eyes.
- Q 8:- Do you think the type 2 patients face vision problem?  
Ans:- Yes eyes are also suffered here, most of them suffer from cataract, it is the condition lens cannot see properly, some time chances of vision loss, so they get operation for this.
- Q 9:- What kind of physical impairments type 2 diabetes faces?  
Ans:- They don't feel healthy, physically effect on feet, loss of sensation and pain.
- Q 10:- Do you think that type 2 patient have hearing problem?  
Ans:- No
- Q 11:- How much type 2 effects on color recognition sense of patients?  
Ans:- Yes they also suffer from color recognition problems, blurring of vision, retinopathy creates problem. If they feel problem, they get laser operation and recover their sense of color recognition.
- Q 12:- How much diabetes effect on touch sensitivity of patients fingers?  
Ans:- It has also some effect on hands, like feeling pins pinching hands, they don't differentiate between hot and cold Feet become senseless, no feeling of pain.
- Q 13:- What do you think mobile phones help them to manage diabetes?  
Ans:- Yes off course, person having the mobile phone can get help easily by contacting with us or communication gap will be decrease. It is difficult because of large population to manage the record of each patient, but they can get us by using mobiles.
- Q 14:- Do you think if we reduce functional complexity of mobiles, it will be helpful for the patients?  
Ans:- Yes, more the simple mobile is, patients will like to have it. Light weight, easy to use, simple buttons, large screen, all these functions will be helpful and attractive to the patients.
- Q 15:- Do you think mobile phone size matter, when diabetes patient will use it.  
Ans:- Yes, large screen, light weight, easy to understand functions: these all matter for the patients because patients don't like complexities.
- Q 16:- Do you think an emergency button is useful on mobile phones to avoid critical conditions?  
Ans:- Yes, in Punjab population rate is high, so providing quick response to everyone is not possible. Lack of education is also there, so this button will be effective to get help

quickly without delay. There should be additional function that patient just get his sugar level in his mobile just by pressing the button, so he can provide the correct information on time to the doctor.

Q 17:- Do you think that small and large size of screens effects patient's visibility?

Ans: - Yes, it also effects, but large screen is better.

Q 18:- What is in your opinion that large text size will help type 2 patient?

Ans: - Large text size is easy to read. They can feel problem with small text because of catric, so they may be avoid using the mobile. So I think better having large text on mobile.

Q 19:- When patients visit you, do they carry mobiles?

Ans: - Most of the old age has not and even they don't have idea to use mobile. But from the last 10 years trend is changed, people between 50 to 60 years mostly have it, as compare to even older.

Q 20:- Do you contact patients on their mobiles.

Ans: - No we don't contact here with the patients, all come to hospital and get here check up by us and get other appointment date from us. People who can afford to come to private clinics (very common in our country), we have their mobile numbers and we contact them if needed, but mostly we don't.

# APPENDIX: B QUESTIONNAIRE

## Questionnaire about the use of Mobile Phone

- e) What is your name?
- f) Gender
- g) What is your age?
- h) How many years you are using mobile phone?

Agenata

Female

50 – 64



About 6 Years.

Male

65+

Please specify at which level you are satisfy which following questions

S. No.	Questions	Agree	Level for agree or disagree					Disagree	N/A
			1	2	3	4	5		
<b>Acceptability of the Mobile Phone</b>									
1.	Do you prefer a single button for both connect and disconnect function?								
	Yes		No -----						
2.	Do you like to see all outgoing, incoming and missed calls shows together in call log?								
	Yes		No -----						
3.	Which characteristics you consider most when you purchase a new mobile phone?								
	f) Functionality	Agree	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	g) Brand	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
	h) Outer Look	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	i) Price	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	j) Fashion	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
4.	What type of mobile phone you like?								
	d) Flip	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	e) Straight	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	f) Slide	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
5.	What size of Mobile Phone you like?								
	d) Small	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	e) Medium	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	f) Large	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
6.	What should be written on call connect button?								
	c) Call	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>
	d) Send	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>
7.	What should be written on call disconnect button?								
	c) End	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>
	d) Stop	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>
8.	How would you like to see the main manu items display?								
	c) Names	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>

	d) Icons	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>	
<b>9.</b>	Which color of mobile phone you like?									
	c) Bright	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>	
	d) Dark	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>	
<b>10.</b>	What size of mobile phone buttons suits you?									
	d) Small	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>	
	e) Medium	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>	
	f) Large	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>	
<b>Functionality of the Mobile phone you prefer in your mobile phone</b>										
<b>11.</b>	Do you like a one locking button to avoid accidental dialing (rather than usual MENU and *)?									
	Yes -----		No							
<b>12.</b>	Would you prefer a special "emergency button" in future mobile to avoid any inconvenience ?									
	Yes -----		No							
<b>13.</b>	What size of screen would you like?									
	d) Small 1.4-2.4 inches	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>	
	e) Medium 2.5-3.5 inches	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>	
	f) Large 3.6-4.4 inches	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>	
<b>14.</b>	Which text size you like in mobile phone?									
	c) Medium	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>	
	d) Large	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>	
<b>Use of Mobile Phone</b>										
<b>15.</b>	Do you always carry mobile phone with you?									
	Yes		No -----							
<b>16.</b>	At what level you use mobile phone other than regular call?									
	d) Emergency	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>	
	e) SMS	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>	
	f) Games	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>	
<b>Visual effects of Mobile phone on elderly</b>										
<b>17.</b>	Do you face difficulties when you focus on small/large objects on mobile phone screen?									
	Yes		No -----							
<b>18.</b>	Can you easily distinguish colors?									
	Yes -----		No (if No please specify below which colors)							
<b>19.</b>	Does your Mobile Phone helps in managing diabetes?									
	d) Medication	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>	

	e) Maintain blood glucose level	Agree	<input type="radio"/>	Disagree					
	f) Physical activities	Agree	<input type="radio"/>	Disagree					
<b>20.</b>	Do you need any special service in your mobile phone regarding your disease?								
	Mobile phone should be multipurpose device, means mobile should be diabetes check device as well as mobile device.								
<b>21.</b>	What problems you are facing with your current mobile phone?								
	Not any special problem I have faced. Only I have faced problem due to non charging of battery.								
<b>22.</b>	What improved functionalities you want in future mobile phones?								
	Battery should be long time and also require less charging time.								

### Questionnaire about the use of Mobile Phone

- i) What is your name? Gina
- j) Gender Female  Male
- k) What is your age? 50 – 64  65+
- l) How many years you are using mobile phone? 6 Years.

Please specify at which level you are satisfy which following questions

S. No.	Questions	Agree	Level for agree or disagree					Disagree	N/A
			1	2	3	4	5		
<b>Acceptability of the Mobile Phone</b>									
1.	Do you prefer a single button for both connect and disconnect function?								
	Yes -----		No						
2.	Do you like to see all outgoing, incoming and missed calls shows together in call log?								
	Yes		No-----						
3.	Which characteristics you consider most when you purchase a new mobile phone?								
	k) Functionality	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>
	l) Brand	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	m) Outer Look	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	n) Price	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
	o) Fashion	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>
4.	What type of mobile phone you like?								
	g) Flip	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>
	h) Straight	Agree	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	i) Slide	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
5.	What size of Mobile Phone you like?								
	g) Small	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	h) Medium	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
	i) Large	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>
6.	What should be written on call connect button?								
	e) Call	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	f) Send	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>
7.	What should be written on call disconnect button?								
	e) End	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
	f) Stop	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
8.	How would you like to see the main manu items display?								
	e) Names	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	f) Icons	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>
9.	Which color of mobile phone you like?								
	e) Bright	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	f) Dark	Agree	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
10.	What size of mobile phone buttons suits you?								

	g) Small	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>	
	h) Medium	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>	
	i) Large	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>	
<b>Functionality of the Mobile phone you prefer in your mobile phone</b>										
<b>11.</b>	Do you like a one locking button to avoid accidental dialing (rather than usual MENU and *)?									
	Yes-----		No							
<b>12.</b>	Would you prefer a special “emergency button” in future mobile to avoid any inconvenience ?									
	Yes-----		No							
<b>13.</b>	What size of screen would you like?									
	g) Small inches	1.4-2.4	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	h) Medium inches	2.5-3.5	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
	i) Large inches	3.6-4.4	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
<b>14.</b>	Which text size you like in mobile phone?									
	e) Medium		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	f) Large		Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
<b>Use of Mobile Phone</b>										
<b>15.</b>	Do you always carry mobile phone with you?									
	Yes		No-----							
<b>16.</b>	At what level you use mobile phone other than regular call?									
	g) Emergency		Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	h) SMS		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
	i) Games		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>
<b>Visual effects of Mobile phone on elderly</b>										
<b>17.</b>	Do you face difficulties when you focus on small/large objects on mobile phone screen?									
	Yes		No-----							
<b>18.</b>	Can you easily distinguish colors?									
	Yes-----		No (if No please specify below which colors)							
<b>19.</b>	Does your Mobile Phone helps in managing diabetes?									
	g) Medication		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>
	h) Maintain blood glucose level		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>
	i) Physical activities		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input checked="" type="radio"/>
<b>20.</b>	Do you need any special service in your mobile phone regarding your disease?									

	Mobile should be like that it able to help me regarding my diabetes, it will be able to inform me all my medicines dosage time.
<b>21.</b>	What problems you are facing with your current mobile phone?
	Buttons of my mobile set are very hard to press, they should be so soft to press, and text written on the button is so small.
<b>22.</b>	What improved functionalities you want in future mobile phones?
	I cant say answer this

### Questionnaire about the use of Mobile Phone

m) What is your name?

Cary Akerstrom

n) Gender

Female

Male

o) What is your age?

50 – 64

65+

p) How many years you are using mobile phone?

5 Years.

**Please specify at which level you are satisfy which following questions**

S. No.	Questions	Agree	Level for agree or disagree					Disagree	N/A
			1	2	3	4	5		
<b>Acceptability of the Mobile Phone</b>									
1.	Do you prefer a single button for both connect and disconnect function?								
	Yes		No-----						
2.	Do you like to see all outgoing, incoming and missed calls shows together in call log?								
	Yes		No-----						
3.	Which characteristics you consider most when you purchase a new mobile phone?								
	p) Functionality	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	q) Brand	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
	r) Outer Look	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
	s) Price	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
	t) Fashion	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
4.	What type of mobile phone you like?								
	j) Flip	Agree	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	k) Straight	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
	l) Slide	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
5.	What size of Mobile Phone you like?								
	j) Small	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	k) Medium	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	l) Large	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
6.	What should be written on call connect button?								
	g) Call	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	h) Send	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
7.	What should be written on call disconnect button?								
	g) End	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>
	h) Stop	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
8.	How would you like to see the main manu items display?								
	g) Names	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	h) Icons	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
9.	Which color of mobile phone you like?								
	g) Bright	Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree	<input type="radio"/>
	h) Dark	Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree	<input type="radio"/>

<b>10. What size of mobile phone buttons suits you?</b>							
j) Small		Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree <input type="radio"/>
k) Medium		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree <input type="radio"/>
l) Large		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree <input checked="" type="radio"/>
<b>Functionality of the Mobile phone you prefer in your mobile phone</b>							
<b>11. Do you like a one locking button to avoid accidental dialing (rather than usual MENU and *)?</b>							
Yes-----		No					
<b>12. Would you prefer a special "emergency button" in future mobile to avoid any inconvenience ?</b>							
Yes-----		No					
<b>13. What size of screen would you like?</b>							
j) Small 1.4-2.4 inches		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree <input checked="" type="radio"/>
k) Medium 2.5-3.5 inches		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree <input type="radio"/>
l) Large 3.6-4.4 inches		Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree <input type="radio"/>
<b>14. Which text size you like in mobile phone?</b>							
g) Medium		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree <input type="radio"/>
h) Large		Agree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree <input type="radio"/>
<b>Use of Mobile Phone</b>							
<b>15. Do you always carry mobile phone with you?</b>							
Yes -----		No					
<b>16. At what level you use mobile phone other than regular call?</b>							
j) Emergency		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree <input type="radio"/>
k) SMS		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Disagree <input type="radio"/>
l) Games		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree <input type="radio"/>
<b>Visual effects of Mobile phone on elderly</b>							
<b>17. Do you face difficulties when you focus on small/large objects on mobile phone screen?</b>							
Yes		No-----					
<b>18. Can you easily distinguish colors?</b>							
Yes-----		No (if No please specify below which colors)					
<b>19. Does your Mobile Phone helps in managing diabetes?</b>							
j) Medication		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree <input checked="" type="radio"/>
k) Mainta in blood glucose level		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree <input checked="" type="radio"/>
l) Physical activities		Agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagree <input checked="" type="radio"/>
<b>20. Do you need any special service in your mobile phone regarding your disease?</b>							

	Yes, there must be record of blood pressure, and estimation of suger level. estimation of serum cholesterol.
<b>21</b>	What problems you are facing with your current mobile phone?
	I have no diagnostic facilities about my disease.
<b>22</b>	What improved functionalities you want in future mobile phones?
	Knowledge about disease, advancement updates about disease, and investigation facilities of disease

### Questionnaire about Not Using Mobile Phone

S.No.	Questionnaire		
23.	What is your name?		
	Oola		
24.	What is your age? 84	50 – 64 <input type="radio"/>	65+ <input checked="" type="radio"/>
25.	Gender	Male <input checked="" type="radio"/>	Female <input type="radio"/>
26.	Why you do not use mobile phone?		
	Very old, Vision, Very low		
27.	What is the motivational functionality that intends you to use mobile phone?		
	No need		

### Questionnaire about Not Using Mobile Phone

S.No.	Questionnaire		
1.	What is your name?		
	Margrita		
2.	What is your age?	50 – 64 <input checked="" type="radio"/>	65+ <input type="radio"/>
3.	Gender	Male <input type="radio"/>	Female <input checked="" type="radio"/>
4.	Why you do not use mobile phone?		
	I only use my mobile at home. It is disturbing me at work.		
5.	What is the motivational functionality that intends you to use mobile phone?		
	Not interested		