# A STUDY ON ISSUES OF ROMAN URDU TEXTING BY OLDER USERS

MUBBARA ZANEB

FACULTY OF ENGINEERING AND COMPUTER SCIENCES,
NATIONAL UNIVERSITY OF MODERN LANGUAGES, ISLAMABAD

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| Mubbara Zaneb | 32 MSSE/lbd /F 19 |
| Submitted by | Registration # |
| Master in Software Engineering (MSSE) | Software Engineering |
| Title of the degree | Name of Discipline |
| Dr Muzafar Khan | Signature _____ |
| Name of the Research Supervisor | |
| Dr Muzafar Khan | Signature _____ |
| Name of HOD (Head of Department) | |
| Dr Basit Shahzad | Signature _____ |
| Name of Dean (FE&CS) | |
| Prof. Dr Muhammad Safeer | Signature _____ |
| Name of Pro-Rector Academics | |

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"I hereby declare that I have read this thesis and, in my opinion, this thesis is sufficient in terms of scope and quality for the award of the degree of Masters of Science in *(Software Engineering)*"

Signature : _____

Name : Dr. Muzafar Khan

Date : _____

# A STUDY ON ISSUES OF ROMAN URDU TEXTING BY OLDER USERS

MUBBARA ZANEB

A thesis is submitted in fulfilment of the requirements for the award of the degree of the Masters of Science in (Software Engineering)

Department of Software Engineering
National University of Modern Languages

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## DECLARATION

I declare that this thesis “A Study on Issues of Roman Urdu Texting by Older Users” is the result of my research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in the candidature of any other degree.

Signature : _____

Name : Mubbara Zaneb

Date : 1st August 2022

*With massive love and gratitude, this thesis is dedicated to my respected great father who is insignia of faith and self-belief.*

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# ABSTRACT

As the development and utilization of technology is increasing rapidly. It identifies different experiences for older users. Most of the time, older users face issues in utilization of new interface. According to the United Nation world population report, the older people will become the main and largest part of the population in the coming era. With the increasing population of older people, Pakistan will also become an aging society. Older users are the late adopters of smart mobile phones technology. The older users in Pakistan are ready to use digital communication ways but they often face issues when they do Roman Urdu texting. Different factors are affecting their approval of Roman Urdu texting communication. The available smart mobile phones' texting applications do not fulfill the needs of older users because older users are minority of digital system and minorities are poorly represented in digital system. To make the human computer interaction community aware, there is need to take the older users into account. There is also need to take notice about very common feature of mobile phones which is texting. Texting is an important and mostly used feature of mobile phones. As compared to the other digital communication mediums, texting is adopted by large part of the population of the world. It is observed that older users do no use texting applications. They often face issues when they interact with texting applications. Thus, the aim of this research study is the investigation of Roman Urdu texting issues faced by older users of Pakistan. Two phase methodology is used to inquire the texting issues. The first phase of methodology is literature review, to the investigate of texting issues faced by older users worldwide. The second phase of methodology is survey, to the investigation of Roman Urdu texting issues faced by older users of Pakistan. The results of this study are the Roman Urdu texting issues faced by older users and guidelines. Guidelines are proposed in order to minimize the Roman Urdu texting issues. The results of this study may be helpful in the design of texting applications for the older users of Pakistan.

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# LIST OF SYMBOLS

| | | |
|---|---|---|
| $\chi$ | - | Chi-Square Symbol |
| α | - | Represent Alpha's Value |

# CHAPTER 1

# INTRODUCTION

In this chapter, section 1.1 background contains the importance of mobile phones texting communication and older users. The key research studies about Roman Urdu texting issues are reported in section 1.2 related work. Section 1.3 contains the problem statement. In section 1.4 research questions are reported. The aim of this research study is discussed in section 1.5. In section 1.6 research objectives are reported. Section 1.7 research methodology, is about two phased research methodology idea. Section 1.8 contains the summary of this chapter.

## 1.1 Background

Smart phone has appeared as a basic innovational device [1]. According to the report of Pakistan Telecommunication Authority that, in July 2020, there are 167 million mobile subscribers, 81 million 3G/4G subscribers in Pakistan and according to 2014 report that the text messages that were exchanged over the networks are above 301.7 billion [2,3].

Smart phones offer different functions for personal satisfaction of older users; however, these new functions are rarely used by older users [4]. The essential requirements of older users are generally not focused proper consideration. Older users recommend precise features as compared to for any feature which is present in smartphones [5]. But older users have disclosed that they faced trouble and disappointment during interaction with smartphones. Older users have school of thought that it is complex the utilization of new technology as compared to the younger ones [6].

it is inquired that older users showed very bad results as compared to the youngers one, while using smartphone [7]. Moreover, older users required supporting time for completion of tasks and took over 40% extra senseless steps as compared to the younger ones. They not want improvement and have pressure towards the use of new development. In addition, mobile industry now a days have mostly attentive towards youth who are ready to the use of smart appliances with different functions. There can be personal and external issues that affect the utilization of smartphones by older Users. Older users face trouble while using mobile phones when there is small size screen and content, buttons are small and complex features because older users have weak remembrance, visual potential, and hearing performance as compared to younger ones [8].

This is unclear that weather smart phones decrease the issues of older users or not because it is possible that mobile phones with fewer and easy features will not meet the user demands, on the other hand the cell phones which have extremely several functions will make the mobile phone more complex for older users [9]. It is observed that psychosocial and psychological characteristics are not same as compared to the younger ones on the requirement and the necessities of mobile phone utilization. So that's why, it is important to understand and recognize the features which are seen to be necessary for older users. For the older users' simple functions can increase the satisfaction and maximize the ratio of smartphone usage [10]. A study reported that with growing population of older people and amongst 15 countries which have older people population more than 10 million, in which seven are developing countries, including Pakistan [11]. The elderly of Pakistan is ready to practice mobile phones functions but advance smart phones are not addressing the needs of older users. Multiple factors are there that affect the approval of smart phones by older users. The available cell phones features didn't fulfill the needs of older users [12]. Texting applications are important applications of smart phone. Texting is a very cost-effective way of communication. Text messages has been a common feature of mobile phones and according to the research that amongst 21 countries, a median of 75% of cell phone owners say they text [13]. After the telecommunication technology in early 2000s in Pakistan, text messages have become a primary means of communication [14].

In Pakistan the most common language for texting is Roman Urdu language. Different researches have been under taken on Roman Urdu texts for example a researcher developed an instrument to report the Urdu words with accurate sense. They used collection of Urdu language words and 17006 different senses were identified and 2285 unique senses were identified with Urdu Words [15]. Another study worked on linguist polyglot classification and opinion analysis; Methodology

was applied on Tweets. In study they detached words of tweets in English and Roman Urdu and focused on important issues for example political tweets, social problems [16]. These researchers also gathered a collection of approximately 82000 tweets focusing on political perception of twitter users [17]. Another study gathered the collection of Urdu words and provided a technique for word prediction using Bigram Model [18]. Another study worked on the plagiarism of Urdu language and for this purpose they collected 160 documents [19]. Another study worked on Roman Urdu text collection of 5000 messages and inquired linguistic alteration in texts. This study performed verifiable analysis on text languages used in Pakistan [20]. Another study performed conversion from Roman Urdu to Urdu script. He investigated and examined Roman Urdu text and inquired writing guidelines. He used a wordlist approach for performing the conversion [21].

Another study gathered a collection of approximately 50,000 Roman Urdu text and planned a technique of SPAM filtering [22]. As other languages have standard writing format, Roman Urdu does not have any standard writing format and words arrangements and Roman Urdu does not have definite spelling principles [23, 24]. It is generally observed that a person can write a word of Roman Urdu with a variety of spellings. This variety of spelling is followed by not only different people but also the same person. Another research studied that Urdu language words, which are written in roman script, there is a possibility that these words have similar spellings like English words [25].

As many researches are available for Roman Urdu text issues but the focused group was younger ones and the researches about older people issues have been raised worldwide; however, no contribution has been inquired in Pakistan as the older users are minority of digital world and minorities are unwell characterized in systems [26]. To make the human computer interaction community aware, take the older people into account and there is also need to take notice about very common feature of mobile phones which is texting.

From Human Computer Interaction perspective there is need to identify that most of older people have access of smart phones but they don’t do texting and if they do texting using Roman Urdu language as their digital communication language what are the issues they face while texting.

## 1.2 Related Work

A study [27] identified that Roman Urdu script has no standardized spelling and this paper shows that there are three spelling variations. This study examined emergent user and inquired their texting behavior. Another study's result showed that due to the difficulty of Urdu Keyboard users adopt long term linguistic change. This study also examined the texting behaviors of Pakistani users. This study is limited to the younger users.

Another study [28] inquired typical terms, based on a term utility criterion (TUC) and spammed them to increase their typical power. Experiment was performed on large dataset. Result of this study showed that their technique performed well on the set of time-tested schemes. This study also improved the accuracy of classification of Roman Urdu words. In this study only negative set of features are considered.

A research study [29] is about refined assessment tools for understanding older adults' mobile device proficiency. Validation of previously involved assessment. This study represents validation of questionnaire on a sample of older smartphone users. Result of this study suggested that alteration is necessary to get a valid and reliable questionnaire. For this purpose, four important implications and suggestions are discussed for the application of questionnaire. This study is limited towards small and homogenous and non-probability sample of older users.

Research [30] in Pakistan reported that the dataset of the Urdu language which inquired hurtful words from the text. This study detected offensive words from the user's comments. Used different techniques to extract the different functions at character level and word level. Used different machine learning techniques to detect offensive words from the text. Designed dataset is available on GitHub. In this study techniques which are used for classification are not as good as many other models.

A study [31] investigated the usage patterns and preference of smart phone is specific function by older users of Pakistan. In this study two approaches are used to examine the outcomes. A focused group discussion examined and explored the utilization patterns and issues of usage of eight older smart phone users. The second method is a questionnaire survey, a questionnaire is managed to inquired the utilization patterns and issues of usage. 100 participants aged 45 and ended to understand their leaning of smart phone functions. This study reported that some precise mobile

phone functions were supposed to be more overbearing for older users. Limitation of this study is lack of local literature review because less contribution on this research in Pakistan.

The results of a research study [32] provided a report on an understudied group of people, thus the group of an original corpus from Pakistan. This study also analyses the procedures and purposes of the Roman Urdu language used in text messages with respect to demographic features of younger users. In this study data about mobile phones usability is gathered. Data consists of 346,455 text messages. Result showed that those young students who have friendly nature, often send text messages. This research study has the large population dataset however there is need to study the data of all groups of people behaviors.

Although all the existing literature significantly reported the various studies on Roman Urdu texting and older users separately. Some have showed their work only about Roman Urdu text, others have discussed the older peoples and usage of mobile phones. But this study is different in the way that there is the identification of older people texting issues using Roman Urdu language along with the proposed solution.

### 1.3 Problem Statement

Many studies have been conducted to address the issues related to Roman Urdu and older users. Such study includes texting behavior of Pakistani users [29], improve the accuracy of classification of Urdu words [30], detection of offensive words from the user's comments [31] and advance mobile phone usability criteria, patterns and preference of precise functions among older users of Pakistan [32]. No study is found to address issues of Roman Urdu for the older users. There is a need to study Roman Urdu text issues in the context of older users.

### 1.4 Research Questions

This study is grounded on the following two research questions**.**

**Question 1**

What are the issues faced by older users during Roman Urdu texting?

**Question 2**

What is the proposed solution of the issues faced by older users during Roman Urdu texting?

## 1.5 Research Aim

Older users are minority of digital systems and minorities are poorly represented in systems. Research studies about older users' issues have been raised worldwide; however, no contribution has been inquired in Pakistan. To make the human computer interaction community aware, there is need to take the older users into account and there is also need to take notice about very common and important application of mobile phones which is texting. The main aim of this study is to find out the list of issues from the older users during texting in Roman Urdu and suggest the solution to overcome the explored issues.

## 1.6 Research Objectives

This study has two following research objectives**.**

**Objective 1**

To investigate the Roman Urdu texting issues faced by older users.

**Objective 2**

To suggest guidelines in order to minimize the Roman Urdu texting issues faced by older users.

## 1.7 Research Methodology

The methodology of this study is based on two phases in order to find the texting communication issues faced by older users. The first phase of research methodology is literature review that is used for the investigation of texting issues reported by older people around the world. The second phase of research methodology is physical survey for the investigation of Roman Urdu texting issues faced by older users of Pakistan.

Literature Review is conducted to review the existing literature related to the texting issues faced by older users worldwide. This phase of research methodology offers a comprehensive evaluation, review and critical examination of associated existing studies. This phase of research methodology helps in conducting and organizing a reasonable literature review having a predefined search strategy in order to investigation of texting issues. The main objective of choosing literature review is the investigate of the issues that are faced during the utilization of texting applications in mobile phones. The appropriate keywords are used to generate the search query that are executed in various databases. Afterwards the data is organized in data extraction forms and the issues are reported. After the investigation of texting issues, those issues are categorized in an effective manner for accomplishing the better understanding. Through literature review mostly reported issues are investigated which are briefly discussed in chapter 3. From the categorization of the texting issues, major issues which are commonly observed are converted into the questionnaire in order to investigate that do older users of Pakistan face such issues during Roman Urdu texting?

Besides this phase of research methodology, a survey is also be conducted and selected as a second phase of research methodology, in order to investigation of the Roman Urdu texting issues faced by older users of Pakistan and solution is proposed against the identified and highlighted issues. In order to the investigation of Roman Urdu texting issues, a questionnaire is developed with the help of texting issues which are investigated through literature review. The basic purpose of selecting the survey is basically to identify the Roman Urdu texting issues faced by older users of Pakistan. For this purpose, guideline of Kasunic [33] are followed, published by Software Engineering Institute (SEI). Reason of following this guideline is that it is the most general reference guideline used worldwide for the purpose of conducting an effective survey in field of software engineering. Through survey this study investigated the Roman Urdu texting issues faced by older users of Pakistan which are briefly discussed in chapter 4.

After investigation of Roman Urdu texting issues, guidelines are also investigated in order to minimize Roman Urdu issues. Firstly, guidelines are investigated through literature review. Then guidelines are reviewed by some experts. For expert review, an expert review technique is followed which is discussed in chapter 3. After expert review updated guidelines are reported in chapter 4.

## 1.8 Summary

Mobile phone has appeared as a basic innovational idea. Older users rarely use the features of mobile phones such as texting feature. Research studies about Roman Urdu texting communication are reported in Pakistan in the context of younger population. For older users there is less contribution of research studies in Pakistan. Hence, the aim of this research study is to identify issues of Roman Urdu texting communication faced by older users of Pakistan.

# CHAPTER 2

# LITERATURE REVIEW

In this chapter, section 2.1 background contains the information about mobile phone technology and older users. This section also contains the investigation of older users' texting communication issues and their categorization. Section 2.2 is about Physical issues. Section 2.3 is about psychological issues. Section 2.4 is about technical issues. Section 2.5 is about socioeconomic issues. Section 2.6 contains the summary of this chapter.

## 2.1 Background

The word technology is taken from the Greek word "technologia" which refer the methodical learning of art. The usually denotation of technology is "the usage of all rational information to perform particular task". Any new invention or invented technology relies on psychology and sociology of individual person. Different researches demonstrated that some older persons showed a huge interest in accepting and adoption of mobile phone technology. Older users showed interest using new smart devices and digital communication. Older users also reported their dissatisfaction with the usage of mobile phones. Older users are considered late adopters of the digital communication tools due to fears for example digital communication tools reduced face to face communication. Researches stated that older persons are late adopters of the technology so they are a smaller number of users of smart mobile phones as compared to the youngers. It has seen worldwide that individuals under 30 probably

own the smart mobile phone. Older demographic should be considered in new inventions because they will be large population in the coming era [37].

A research in 2019,published by United Nations World Population, reported that the elderly will convert into the main and largest part of population [34]. As we are moving forward in our rapidly changing digital world, it is necessary that we should include and consider older persons. For this purpose, there is great need of our communities to take interest and protect and teach the older persons. Whenever we create or develop the technology or advanced or improved the technology, it is our duty to consider these twenty-eight million persons. Moreover, older persons cannot be divided into on homogeneous category. It is widely recognized that usage of technology helps to increase the quality life of older person. There is a great need of design the technology according to the needs of older persons [35]. Involving them in the usage of advanced technology can helps the developers to develop technology according to them.

When we talk about researches and studies about digital communication tools or text messages, the majority of researched has focused group was young users and they paid less attention on older users. There is a lack of researches which are examining the older users and their texting habits or texting usage patterns or texting issues. According to the information communication technologies reports that most frequently used mobile phone application is texting application among elderly users as compared to e mail [35].

According to the research question of this study older people often face issues while talking over texting and there is need of addressing these particular issues. This research reviewed different studies which investigated the older people issues while texting using smart mobile phones and specifically when they talk over texting. In this research work 40 issues are investigated after literature review. This chapter provides the list of issues identified by literature. In the next step these issues have been categorized in four sections physical issues, psychological issues, technical issues and socioeconomic issues. After categorization each category is discussed briefly with the support of different literatures. In last section all issues are converted into major issues and these major issues became the questions of questionnaire. The questionnaire that was used for survey, developed with the help of these investigated issues.

## 2.2 Physical Issues

Due to the failing of physical condition designing of technology for the older persons is considered most apparent issue. With the age reading of text and listening to audio text and accurate movements on the mobile screen are often unreliable [36]. Physical issues include dexterity, vision and physical health.

Studies reported that instead of using innovative functionality the older users only use specific functions due to the physical and mental barriers. Elderly users basically own smartphones for communication but they prefer call functionality [37]. Elderly can have superior physical and mental limitations as compared to the younger ones [34]. Other than advanced technology usage their daily routine life can also be tethered due to physical and mental restrictions with a loss of social interaction and work activities which reason to the isolation. But these complications can be decreased with digital communication tools because they improve the connectivity to others [43]. For making the physical activities more attractive and desirable for older users advance technology inventors and health industry are working together in order to overcome their physical limitations [34]. Exercise games are growing in the acceptance for the elderly users. There are many online or virtual games available that can increase physical and cognitive stamina. [43]. Figure 2.1 shows the result of one study which ranked some physical limitations of older users out of ten. These physical limitations are the barriers in the usage acceptance of digital communication tools [34].

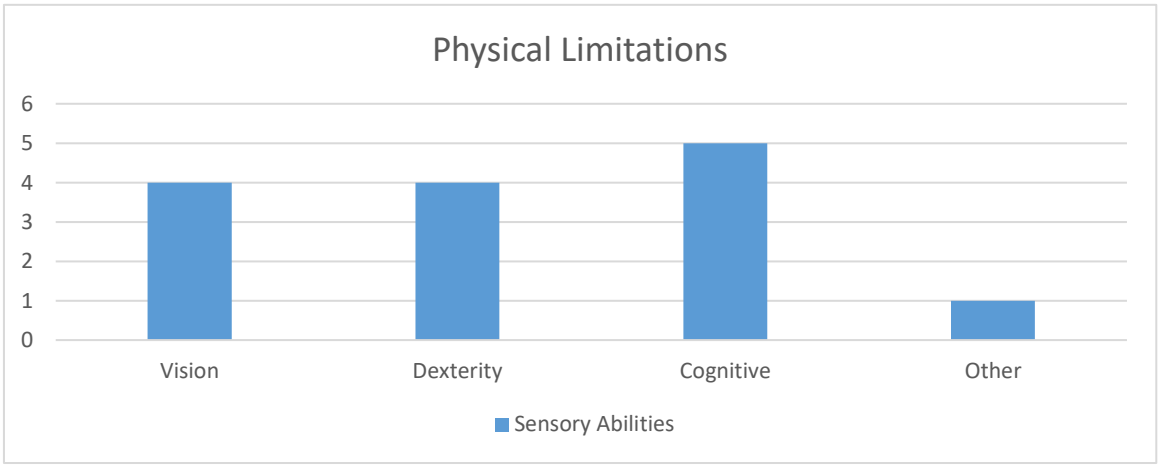


**Figure 2.1:** Physical Limitations [34]

The digital enclosure can improves the elderly mental and physical capabilities, contributes their physical and psychological health, and offers an chance for them to have an self-determining technologies of life [40].

### 2.2.1 Vision

As compared to the youngers older users often face troubles when they smart mobile phones with trivial size screen, menus, content, complicated functionalities and small buttons because elderly have weak visual competences, memory and physical stamina [37]. It is observed that many elderly users have weakened vision. For the older persons the speed of processing information decreases because they required extra light for reading and writing the text messages and at that time vision become smaller. Due to reading small text, positioning the objects visually and seeing the people located closely, we often face vision problems [39]. These problems are present in younger around 15-20% but almost all older persons need glasses over the age of 60 [40].

Human sensory abilities change over the time. For example, with the growing age, starting from 35 or 40 years the vision ability and hearing aptitudes start decreasing [40]. The following table shows an overview of the human capacities of vision, how they rapidly decrease with the passage of time [40].

**Table 2.1:** Vision Abilities [40]

| **Sr.** | **Vision abilities** | **Age at which sensory ability starts to change.** |
|---|---|---|
| 1 | Enhanced need for light | 35 |
| 2 | Decreasing accommodation width | 40 |
| 3 | Increase glare sensitivity | 40 |
| 4 | Reduced depth perception | 40 |
| 5 | Reduced eyesight | 50 |
| 6 | Reduce adaptation to darkness | 55 |
| 7 | Restricted visual field | 55 |
| 8 | Diminished color perception | 70 |

### 2.2.2 Dexterity

Studies reported that unavoidable decrease in physical dexterity is examined in older users so they required large buttons in mobile phones. Older users has negative impact on the comfort of the usability of smart mobile phones because of the effects of growing age, for example reduced hearing, vision loss and loss of physical dexterity [38]. Smart mobile phones and usage of texting applications required more dexterity and the older users have not enough dexterity to deal with touch screen, to press a button or to write something on touch screen or write something with small buttons [41]. Older users can pressurize to be active with less dexterity when they interact with complex functionality [34]. A study reported that vision, dexterity and cognitive issues are the barriers of using texting applications. These barriers may relay on the older adult's involvement in new technology, independence, and comfort level, than actual barriers [34]. The dexterity and cognitive barriers may cause the only use of specific functions of the mobile phones and less adoption of new technology [42]. It is difficult for older users to articulate the texting input schemas of smart phones because it relies on smart hand movement [34]. Aging effects lead to the dexterity and cognitive limitations which cause the undeniable lack of potential to interact advance technology. Due to which it is observed that older users use fewer mobile phone features as compared to the younger ones [38]. Studies investigated that physical dexterity is one of the major problem in the situation of elderly users in the domain of mobile interfaces [36]. Table 2.2 contains the physical issues.

**Table 2.2:** Physical Issues

| Sr. | Physical Issues | References |
|---|---|---|
| 1 | Physical limitations | [34, 37, 40, 43] |
| 2 | Vision | [37, 39, 40] |
| 3 | Required dexterity | [34, 36, 38, 41, 42] |

## 2.3 Psychological Issues

It is observed that physiological and psychosocial characteristics of older people and the younger groups are not closely the similar in the usage and requirements of smart mobile phone devices

[37]. Due to the difference of these characteristics, it is difficult to understand and observe functionalities which are understood to be valued for elderly users [37].

### 2.3.1 Cognitive and Memory

In 1985 a theory was represented by Kieras and Polson which identified the cognitive complexity by the number of production rules that have to be distinguished by users when they operate the devices. Furthermore, this theory pursued as the model which provides a platform for defining major cognitive complexity and minimize the difficulty of using the phones in terms of effectiveness and efficiency by allowing the prediction [44]. In general, it is observed that precise mobile phone applications have high importance for elderly users like calendar and alarm. Due to the physical and psychological limitations older users use the precise applications instead of all advanced applications [37]. In order to fulfill the older users perceptual, psychological and unique needs, a user-friendly mobile phone design is required. The ideal mobile phones for the older users are those which have large size buttons (icon size), high volume, large content, easy to understandable menu etc. [37]. It is observed that often the usage of modern technical devices are not perceived to be easy, due to enforce considerable cognitive load on older users [44]. There are several characteristics of older users that can be referred to as being critical for the usage and acceptance of mobile phones. Generally, sensory performance has vital importance in terms of the technology usage. Including the cognitive factors, the loss of memory functions and decreasing of cognitive abilities with age is observed [44]. Table 2.2 enlists the issues that are the barriers in the acceptance of technology. It is also observed that not only the age is barrier technology acceptance but the interest in innovation also a barrier [45].

**Table 2.3:** Factors influencing technology acceptance [45]

| **Sr.** | **Factors influencing technology acceptance** |
|---|---|
| 1 | Cost |
| 2 | Compliance with individual needs |
| 3 | Personal experience with technology usage |
| 4 | Accessibility barriers |
| 5 | Psychological or cognitive |

Studies reported that one's liquid intelligence starts decline at the age of 25 in terms of ability to process incoming information flexibly. After that the memory slowly deteriorates and divided or focused attention also becomes a challenge. Normally growing age involves required slight changes that include hearing, vision, physical stamina and cognitive [45]. Due to the cognitive and memory weakness older user make usage of rarer smart mobile phone features as compared to the younger users [38].

### 2.3.2 Trust

Older persons are the late adopters of the smart mobile phones due to the lack of understanding of their functionalities and trust issues while communicating to other person because face to face communication and digital communication are two different things. While texting others older users often do not feel secure. They do not prefer the conversation in which they do not see or hear the expressions of other. This is a faraway diverse world for the individuals who born before 1950. For the effective use of texting features there is a great need to trust the people in digital life. Older people mostly have vulnerable nature. It is difficult to teach them that to protect themselves while texting and using smart devices. This study also reported that older users suffer while using smart mobile phones due to physical limitations and lack of trust on the internet with personal information [34]. Another study reported that even the design of the texting applications is trustworthy and acceptable, older users often rejected the usage of texting application [63]. Another study reported that older adults often show the distrust when discussing digital tools and this distrust is a barrier in the acceptance of advance technology [64].

### 2.3.3 Controllability

Texting applications provide control of buttons and place of text for data input in order to speed up input elements. One another barrier in the usability of texting applications is that the older users and those persons who are unfamiliar with advance technology they often have problems in understanding the complex controls of texting applications [36]. A study reported that older users' requirements for the acceptance of smart mobile phones are low-cost technology, easy to use and specific and controllable features. In this study older users highlighted design elements of advanced

technology including size, grip and controllability and developers must consider the physical and mental changes with age [65].

### 2.3.4 Simplicity

Mobile phones have useful applications but some of the applications' features have difficult operation interface that may leads toward the barriers in the acceptance of smart phones for older users. smartphones including the simple operation interface may improve the acceptance of device for older users [37]. Applications with the concurrent features and choices is another issue in the acceptance of smart mobile phones as they offer the older users too many options and older users often feel overloaded and it is difficult for them to pick the correct option [52]. Another study reported that older users stated that in terms of usability they prefer the simpler and easier to use system. Older users showed less interest due to the complex functionality [65].

### 2.3.5 Familiarity

Although new technology and advanced mobile phones (smartphone) are common now a days and offer various functionalities to improve life style and gratification of elderly users, nevertheless, these new functionalities are rarely employed by elderly users [37]. It is observed that as compared to the younger population it is harder to accept and use the smart mobile phones [37]. A study of the Mexico, reported that 34.7% population out of total population 130,222,815 is experiencing the digital elimination. In Mexico, one survey's reports investigated that 55 and over the age of 55, 78.4% of older users do not know or use the Internet [46]. There are numerous challenges that older users often face when they interact with typical user interfaces and a younger user do not experience those challenges, it could be either as a result of the effects of ageing or unfamiliarity with modern technology [36].

### 2.3.6 Privacy

For the older user's technology approval depends on the helpfulness in supportive self-determining living and the level of interruption into isolated life, particularly the major fear is the privacy. With the concept of privacy older users tend to accept the smart phone in positive manners [34]. A study reported that modern technology including mobile phones are not often designed considering the older users' needs and requirements and elderly can have thoughtful privacy and safety challenges due to their uniqueness and difficulty to collect and communicate vast amount of information. This study also investigated that older user have usability issues or technical worries and managing security and privacy concerns lead towards limiting or avoiding mobile phone usage [66].

### 2.3.7 Unfavorable attitude

A study reported that individual's attitude towards accepting the mobile phone technology depends on his personal and social life. Older users personal and social life can cause negative attitude towards the acceptance of mobile technology [38]. Another study reported that older adults have favorable attitude towards those technology that helps them to remain independent [65]. Another study reported that age related barriers include (Mental and physical problems) and to have unfavorable attitude towards the technology [68].

### 2.3.8 Mental Health

In cognitive or memory section the mental stress is described that is the major problem for the older mobile phone users. With the growing age people accomplish extra deliberately and with less accuracy, due to which mostly older users use fewer mobile phone features and often older persons seem to have trouble in practicing that how to use a new mobile phone [38]. A study indicated that the growth of new memory cells is decreased with age. Therefore, it is necessary to develop the smart application design that allow the older users to adjust their own rate of processing [38]. Another study reported virtual interactions and communication are not beneficial for the older users' mental health as they often feel pressure while communicating remotely. This study reported that as we are living in digitalized world, the benefits of face-to-face communication on older

people mental health are not denied [69]. The digital enclosure can improves the elderly mental and physical capabilities, contributes their physical and psychological health, and offers an chance for them to have an self-determining technologies of life [40].

### 2.3.9 Focus Issue

Studies reported that individual's memory and focused attention becomes worsens slowly after reaching on 65. At the time dealing with (multiple) information may cause focus distraction. Texting application's designers focused on important aspects while designing or developing the interface such as simplicity of interfaces that it should be familiar with older users. Attention is a multidimensional construct (Parasuraman and Davies, 1984) that categorizes a variety of processes distributing elaboration resources on several dimensions. Selecting the certain information to explain it and filtering unnecessary information is the process of selective attention. By increasing familiarity with smart mobile phones and by changing those signs in which attention need from selective to focused age related selective attention differences can be reduced. Older users can increase focus with increment in the amount of rehearsal in the task and decrease when mobile phones have complex interfaces. Studies reported that due to the challenge of focused attention issue the amount of information is presented in organized and simple way [55].

### 2.3.10 Task Completion Time Required

It is observed that as compared to the younger ones the older users demonstrated low performance while using texting applications. On the other hand older users often take extra time to complete a task while interacting with smart mobile phones [37]. Thus, in the case of texting older users often face issues such as fast input required (e.g., double click) and at the same time pressing one or more buttons [40]. A study investigated five characteristics of using technology such as the difficulty level of learning (the needed time to complete an activity), efficiency (the degree to which the applications fulfill the needs of the individual, thus avoiding lost time and frustration), errors (the degree to which certain applications give errors and the degree to which the individual is capable of solving them), and satisfaction (the satisfaction related to the use of a certain device or application) [56]. It is observed that during navigation older users often face issues and they required more time on a task in order to complete it as they often found to be lost in menus and

they do not use ant short method to return and navigate from one menu to another. This study reported that younger users required average 2 minutes 22 seconds on each task, on the other hand older users required 4 minutes and 32 seconds on each task almost double than younger users [44].

### 2.3.11 Extra Steps

It is investigated that elderly users often required additional time to accomplish a task and took over 40% extra silly steps as compared to the younger users. While interacting with new advancements they often feel pressure [37]. A study tested the older user's mental capability and reported that during the mental assessment of elderly none of the older user used a correct way to be taken to solve a problem and some of them were not even aware of the classified nature of the mobile phone features [57]. This study also reported that for the number of extra silly steps and returns to higher levels in the different menus, older users made 113.6 extra silly steps and return with 16.2 returns in the menu while the younger participants made, on average 79 extra silly steps and went back 11.4 times in menus [44] .

### 2.3.12 Texting Communication Issue

Normally text message social habits point of view the people use texting communication for businesses, demonstrative or emotional support, relationship preservation and coordination in different events. For those purposes older users tend to do calls rather than text. A study in China reported that texting communication is the primary way of the formation and maintenance of personal relationship among youngers [34]. It is investigated and reported in different studies that older users expected better users of writing free text-to-speech functionalities in the coming era. This study also investigated that for the older users texting is fast and efficient way of communication, but mostly it is found to be an annoying and getting out of hand activity. According to the older users texting is useful but annoying, good way to communicate, but we should do it less and should talk on calls more [47]. A study investigated that texting communication is not positively correlated with the face-to-face communication but video call can be positively correlated [68].

### 2.3.13 Socio Phobia

Advanced technology and smart mobile phones show a huge part in the raise of societal interaction and pride [48]. A sociologist Daniel Bell (1977), was the first sociologist who defined the social effects of digital media communication, he measured that the technology has major social values. Whether the people rich in information sharing or the people poor in information sharing in every nation there is a social divide that highlights the gap between these two groups of people. He also reported about a democratic divide that suggests differences between those who do and those who do not use technology in order to involve and contribute in public life [40]. The older users are considered a complex public categorized by medium and sometimes low income, fewer financial demands and plenty of relaxation time. Hence, they need social incorporation. The psychological, physical and emotional and social changes occur with the growing age. However, in respect to sensory changes, both physical and psychological perception is reduced and can affect the way the information is perceived [58].

### 2.3.14 Prioritizing Calls Over Texting

Some researchers reported a tendency towards mobile phone calls largely swapped by the text messages [35]. A study investigated that older people reported that mobile phones or smart mobile phones were frequently used for phone calls and less for social media [47]. This study also identified that older users want to talk on calls more than they text. According to the facts in the last 3-5 years, texting communication has enlarged quite a bit due to the pressure from their children [47].

### 2.3.15 Stay Up to Date Pressure

A study reported that older users often feel pressure when they have to keep updates on security, backups and upgrades. They often found them difficult rather than the actual use of the smart mobile phones. Older users indicated that after retirement, in such cases they found no one to help them [47].

### 2.3.16 Dual Tasking

It is investigated that older users are late adopters of the advance technology and they have less experience and they could lack some basic information and knowledge which is required to effectively interact with the smart mobile phones. Hence to perform a task correctly and immediately related information should be display on the interface and this will avoid the memorizing of long sequence of operations and rely on the perception. Mistake in the organize sequence of interface can affect the overall goals so that's why in order to complete a task designers should decrease the number of steps and controls. It is observed that as compared to the younger users older users often make errors during the long sequence of operations and long number of steps or dual tasking [48].

### 2.3.17 Receive Low Quantity of Text

A study in America is investigated in October 2014, 90% older Americans have ownership of smart mobile phone and from those using these devices, 21% use them to send or receive text messages [38].

### 2.3.18 Access and Encouragement Issue

National Telecommunications and Information Administration of the United States developed the studies which investigated that those individuals who have high education, with average and above average incomes, under 55 years old and mostly male gender group from urban areas, are using the smart mobile phone technologies [40]. Technology can facilitate older users to contact with their families and friends, they can build a harmless environment, facilitate medical care, introduce new motivations in a person's life, produce a larger access to information, and increase the level of social communication, confidence, life fulfillment and self-sufficiency. Thus, by having access to technology, the elderly can be more independent and more socially involved but there is a lack of access to technology [34].

Table 2.4 contains the psychological issues.

**Table 2.4:** Psychological Issues

| Sr. | Psychological Issues | References |
|---|---|---|
| 1 | Cognitive or memory | [37, 38, 44, 45] |
| 2 | Trust | [34, 63, 64] |
| 3 | Controllability | [36, 65] |
| 4 | Simplicity | [37, 52, 65] |
| 5 | Familiarity | [36, 37, 46] |
| 6 | Privacy | [34, 66] |
| 7 | Unfavorable attitude | [38, 65, 68] |
| 8 | Mental health | [38, 40, 69] |
| 9 | Focus issue | [55] |
| 10 | Task completion time required | [37, 40, 44, 56] |
| 11 | Extra steps | [37, 44, 57] |
| 12 | Texting communication issue | [34, 47, 68] |
| 13 | Socio phobia | [40, 48, 58] |
| 14 | Calls over texting | [35, 47] |
| 15 | Stay up to date pressure | [47] |
| 16 | Dual tasking | [48] |
| 17 | Receive low quantity of text | [38] |
| 18 | Access and encouragement issues | [34, 40] |

## 2.4 Technical Issues

Technical issues are those issues which are unexpectedly happens for example hardware failure and software errors that makes it is problematic or incredible to achieve a chosen task [68]. Older users often face technical issues while texting which are the following.

### 2.4.1 Texting Interface

Sometimes advance technology such as smart mobile phones are frightening and apparent as a sensitive issue for the mostly older user, especially if it is disturbing, complex, environmental troublemaking and embarrassing. Considering the elderly user as apart of digital communication world now a days awareness with the interface and design of application is a very expressive issue and there is great need to address it. The perception of mobile usability of an individual is strongly influence by way of the organization of mobile interface. The supposed excellence of a mobile interface design depends on the level of difficulties and complexities, entertainment, navigation, easy to use and how informative it is. While navigation difficulties or accessibility regard timeliness, convenience, interpretability, and completeness, being informative implies accuracy, relevance, comprehensiveness, recentness, and credibility [40]. Another study found that there are variety of elements, such as dialog boxes and menus on which the interface functionality depends, which are technical features that the older users are not familiar with them [40].

### 2.4.2 Screen Issue

A study investigated that several older users reported that they prefer the bigger screens on their tablets and laptops due to the advantages of a bigger screen such as easy to handle the features. It is reported by older people that the small screens and buttons are difficult to use. It is reported that the laptops and tablets are very desirable among older users. Mobile phones with bigger screens and keyboards are most preferred by older users. Older users accepts the mobile phone technology as they are relaxed to transfer around and appreciated especially when traveling [34]. For exploring the internet and social media and reading the news, older users over the age of 65 often prefer to use the tablets because they have big screens. Tablets have greater screens and buttons so the tablets are helpful to visual weakness and to many physical limitations. A study reported the interview of 17 elderly users and asked them to name the most favorite features of a mobile phone, which they use frequently. Along with large screen and buttons, easy menus were stated most preferable [34].

### 2.4.3 Icon Size

A study reported that the ideal mobile phones for older users are those which have bigger buttons, Large screen (icon size), high volume, easy to understandable menu etc. [37]. The use of icon and other symbolic representation of the menus is highly desirable for elderly. Without any misunderstanding or ambiguity, the older users just recognized the icon and select the icon and the icon should convey the information in a simple and direct way [48].

### 2.4.4 Color Scheme Issue

Due to decreased visual field, older users often face problems in pattern recognition, in visual search, in perception, in color recognition, in the light sensitivity and in the searching and processing the information [40]. The sensitivity of light, color and pattern recognition problems occur due to the limitations of the field of [34].

### 2.4.5 Input location Issue

A study reported that in the last few years the main challenge observed that is smart mobile phone designers and developers presently have less understanding of how to design and develop improved touchscreen interfaces for elderly. The adoption of basic input operations such as tapping, dragging, and pinching, based on touch screen smartphones, is observed in the last few years [49].

A study found that input with two-handed in the touchscreen is difficult for older user. This study investigated that as compared to the younger users' older users slower when they have to input multiple things. For the investigation they experimented old users and young users in which 42 different gesture inputs for touch surfaces are given to measure the accuracy and speed. This study investigated those elderly users often favor accuracy rather than speed that's why they found that older users are a little slower but there was no significant difference in accuracy [46].

A study observed the small tapping targets problems during a practical. In this practical the contestants failed to tap the appropriate key on the application keyboard or unsuccessful in pointing the cursor to exact position in a text input area. Furthermore, this study found that traditional user

interface have some common problems and the participants often face these general user interface problems [49]. A study investigated that physical QWERTY keyboards have a lower word error rate and a very usable input method but in the comparison of input methods for older and younger users, voice is the fastest method overall [50].

### 2.4.6 Virtual Keyboard Utilization

In the design of smart mobile phones technology, the virtual keyboard functionality has some barriers in the context of elderly users and disabled users. Virtual keyboard issues are related to the physical issues such as size of keyboard and size of screen are observed in older users [35]. A study reported that the older people often face incidental dialing due to inability of locking the virtual keyboard [37].

### 2.4.7 Buttons Over Glass Screen

Due to the weak memory, mental limitations as compared to the younger users older users often face issues when they use smart mobile phones with trivial size screens and content, minor size buttons and complex features [37]. Another study reported that for various functions there are several buttons a mobile has, handling with multiple buttons if often difficult. And the older users rarely use test message feature of a mobile because they do not know how to input some text using buttons and perceived it is difficult to learn. A study reported that the ideal mobile phones for older users are those which have big size buttons, Large screen (icon size), high volume, easy to understandable menu etc. [37]. Small buttons crowded together and can hinder many operations, and in this case for older users it is difficult to perform an easy task also even a simple answering a call. Small and crowded buttons loss the main purpose of mobile phones to older users (i.e., for emergency). It is observed be difficult for older users to dial an emergency number with small buttons, especially in the case stressful situations [51]. Based on the older users' physical features and capabilities, the devices should contain big size buttons, be more appropriate for shaky hands and provide warnings in the case of a perceived emergency [51].

### 2.4.8 Unexpected Response

It is observed that working and memory capabilities decrease with the growing age. In order to investigate the correct data and information from the memory, older users often rely on environmental support and exterior signs. Thus, for those elderly users who face some barriers in quick learning, it is important to give them more signs to deal with unexpected responses from the smart mobile phones [48].

### 2.4.9 Complex Functionality

As compared to the younger users' older users have weak memory and visual capabilities, due to which elderly users often face issues when they use smart mobile phones with complex functionalities. Elderly users can gain various advantages from the smart mobile phone technology. Mobile phones have useful applications but some of the applications' features have difficult operation interface that may leads toward the barriers in the acceptance of smart phones for older users. Smartphones which have simple interface and easy to use menus and easily understandable working, may improve the acceptance of device for elderly users [37].

### 2.4.10 Auto Fill or Auto Correct Issue

A study investigated that One 65-year-old often feel frustration when he tries to guess in auto fills or auto corrects in order to write the text in correct form [34].

### 2.4.11 Cyber-Attacks

Cybercrime is a term for any illegal activity that uses a device as a primary means. Older users can become attractive target of the cybercrime in the area of internet and digital communication because this is the vulnerable group which are poor in any information regarding advance technologies and innovation. Study investigated that there are more chances for older users to become the victims of cybercrime because it is observed that older users are found to have more free time to spend on internet and they excessively affected by the cybercrime [59]. Another study

reported that among older female users the knowledge of cybercrime is low because of lack of availability of internet facilities to them as compared to older males [60].

### 2.4.12 Different Versions

A study reported that the tablets and smart mobile phone devices are not common among the older users because of their applications' features. In the social context of the older users, the acceptance of mobile technology is depended on the elderly physical health, interface design and reviewed versions, [39]. According to the result of a study older users specified that security updated, backups, and upgrades are more complex [40].

### 2.4.13 Technology and Daily Routine Coherence

Specific functions of smart mobile phones are used by older users that indicated their routine life such as alarm, calendar. When technology does not fit in the daily routine life of older users, they less likely to use technology, and when they came to know the advantages, they show some frustration of learning how to use it [61]. A study investigated that that the elderly is ready to use technology particularly in certain circumstances. Hence, older users are more confident when advance technology is well-matched with their routine [62]. Barriers to the usage of advance technology by the older users are lack of information, need for training and assistance, lack of necessity in daily lives, and design problems [46].

### 2.4.14 Translation Issue

A study investigated that as compared to the younger users older users have lack of knowledge about smart mobile phones and lack of education which cause the poor understanding of their meanings, probably it cause the poor translation of meaning full information provided by the smart mobile phones interface [48].

Table 2.5 contains the technical issues.

**Table 2.5:** Technical Issues

| Sr. | Technical Issues | References |
|---|---|---|
| 1 | Texting interface | [40] |
| 2 | Screen issue | [34] |
| 3 | Icon size | [37, 48] |
| 4 | Color scheme issue | [34, 40] |
| 5 | Input location issue | [46, 49, 50] |
| 6 | Virtual keyboard utilization | [35, 37] |
| 7 | Buttons over glass screen | [37, 51] |
| 8 | Unexpected response | [48] |
| 9 | Complex functionality | [37] |
| 10 | Auto fill or auto correct issue | [34] |
| 11 | Cyber attacks | [59, 60] |
| 12 | Different versions | [39, 40] |
| 13 | Technology and daily routine life coherence | [46, 61, 62] |
| 14 | Translation issue | [48] |

## 2.5 Socioeconomic Issues

Sociological studies favor a strategical approach, in which expecting the acquiring choice as part of a procedure of technology acceptance and it also include the acceptance and rejection of the user on the adaptation of technology i.e. the acceptance process [38].

### 2.5.1 Lack of Knowledge

It is observed the knowledge about the technologies is associated with the desire of interacting and using new technologies. Younger people are involve in this association more than older age group [46]. A study reported that the older persons have less awareness about some of the modern technologies as compared to the younger ones. In addition, the older persons have less desire for

the smart mobile technologies as compared to the younger adults [54]. Older users often do not gain the comfort from the technology due the bad experiences which come from the deficiency of knowledge and inadequate societal and institutional support. It is great responsibility of sustenance systems, such as household and friends that can provide assistance to elderly users to reduce unwillingness with technology. It is essential for the older users gaining of digital literacy skills and awareness and their acceptance and usage may have real benefits to their lives [53]. It is observed that during text messages lack of knowledge regarding the common abbreviations such as LOL and IDK cause the barrier towards texting [53].

### 2.5.2 Education

It is investigated that there is an association in between level of education and usage of advanced mobile phone technology [34]. The desire and ability in the acceptance of smart mobile phones can increase by level of education. This research reported an association between level of education and acceptance of advance technology. Level of education mostly influence the attitudes toward learning, and acceptance of advance technology. The older users who have more positive attitude toward digital communication tools are also more highly and better educated [34]. National Telecommunications and Information Administration of the United States developed the studies which investigated that those individuals who have high education, earn average and above average incomes, under 55 years old and mostly male gender group from urban areas, are using the smart mobile phone technologies [40].

Those people who are aged over 50 years were educated in times when technology was not developed and complex than current smart mobile phones, this education level can be the factor that is likely to severely influence older adults' performance [44]. A psychological model of how technology works, shows that currently available devices are not adequate for appropriate collaboration rather than the technology built in previous time [44]. There are the needs of older users to get the advance greater digital knowledge and literacy [69]. It is observed that the older users are technology inexpert and illiterate [69]. There is a great digital literacy that cause key problem to older adults utilizing the Internet [69]. Although one study investigated that the present generation of older people are aware that with education, they can build satisfied life style and can improve the quality of living standards. It is also investigated that older users wishes to continue education, they have a greater commitment towards learning [69].

Table 2.6 contains the socioeconomic issues.

**Table 2.6:** Socioeconomic Issues

| Sr. | Socioeconomic Issues | References |
|---|---|---|
| 1 | Lack of knowledge | [46, 53, 54] |
| 2 | Education | [34, 40, 44, 69] |

## 2.6 Summary

In this chapter, first phase of methodology is reported which is literature review. Texting communication issues faced by older users are investigated through literature. After investigation issues are categorized in four categories i.e., physical issues, psychological issues, technical issues and socioeconomic issues. Each category is discussed briefly with their related issues. Mainly reported issues are used in the development of questionnaire.

# CHAPTER 3

# METHODOLOGY

In this chapter, section 3.1 contains the research strategy of this research study. In research strategy section research flow is discussed. Section 3.2 contains the first phase of research methodology which is Literature review. Section 3.3 contains the second phase of research methodology which is survey. In this section Kasunic guidelines for effective survey are reported.. Section 3.4 is about hypothesis testing. Section 3.5 is about reliability and validity threats. Section 3.6 contains the expert review technique.

## 3.1 Research Strategy

In this research study two phased methodology, Literature review and the survey are used to investigate the Roman Urdu texting issues faced by older users of Pakistan. First phase of research methodology is literature review. Trough literature review texting issues faced by older users worldwide are investigated. The second phase of research methodology is survey. In this phase, on the basis of investigated texting issues, a questionnaire is designed. Then survey is conducted. Survey results are the Roman Urdu texting issues faced by older users of Pakistan. On the basis of reported Roman Urdu texting issues guidelines are investigated. In figure 3.1, there is a graphical representation of research Methodology.

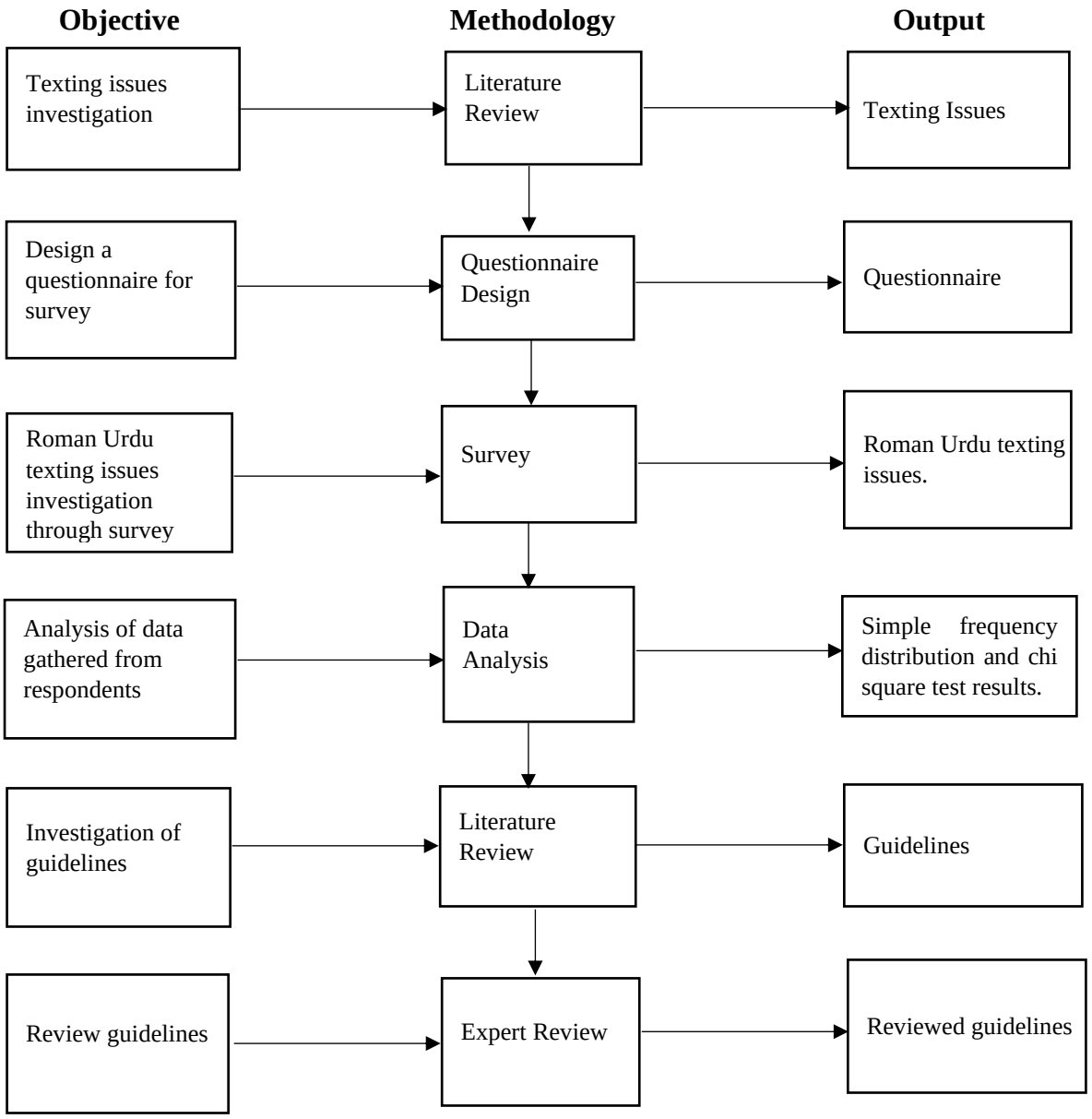


**Figure 3.1:** Research Methodology

### 3.2 Literature Review

According to the first research question of this study, what are the issues faced by older users of Pakistan during Roman Urdu texting? As in Pakistan a smaller number of research studies are done in the context of older users' texting issues. However, worldwide research studies are available. Hence, an effective literature review method is the best option for investigating the texting issues. Different literatures are reviewed and investigated texting issues which were faced by older users worldwide. This method enhanced the thinking and provided more detailed investigations about

texting issues. This phase of methodology provided the strength to this study as literature brought more explanation and cleared the objectives of this study. After investigation texting issues are categorized into four categorizes based on their characteristics. Texting issues are categorized as socioeconomic issues, phycological issues, technical issues and physical issues.

### 3.3 Survey

For survey, guidelines of Kasunic are followed [33]. Reason of following these guidelines is that these are the most general reference guidelines used worldwide for the purpose of conducting an effective survey in the field of software engineering. Kasunic guidelines for survey are consist of number of steps. Step 1 is about identification of research objectives. Step 2 is about identification and characterization of audience. Step 3 is about sample designing. Step 4 is about how to design a questionnaire. Step 5 is about pilot testing of the questionnaire. Step 6 is about distribution of the questionnaire. Step 7 is about result analysis and report writing. Figure 3.2 shows Kasunic guidelines.


**Figure 3.2**: Kasunic Guidelines for Survey [33]

#### 3.3.1 Identify research objectives

The first main objective of this study is to find Roman Urdu texting issues faced by older users of Pakistan. For this purpose, literature is reviewed and investigated different texting issues faced by

older users worldwide. After issues investigation, issues are categorized into four categories. With the help of mostly reported issues, a questionnaire is designed and responses are analyzed. The second objective of this research study is the investigate of a solution in the context of investigated texting issues. According to the second objective guidelines are investigated. These guidelines may be helpful for the HCI team to design and develop texting applications according to the requirements of the older users.

### 3.3.2 Identify and Categorize Target Audience

This research study is about Roman Urdu texting issues faced by older users of Pakistan. Hence, the target audience are the older users having age greater than 60 years.

### 3.3.3 Design Sample Plan

According to the 2019 census, the elderly having age over 60, are 7% of country's total population. Almost 15 million older people are living in Pakistan [70]. In this research study total population is assumed 16 million people. For sample size calculation Slovin's formula is used. According to the slovin's formula, sample size is calculated (n=100) [Appendix A]. However, 120 responses are recorded from older users of Pakistan.

Snowball sampling technique is used which is one of the non-probability sampling techniques. Snowball sampling is suitable for this research study because when the sample units are rare or hard to find, this technique is appropriate. One theory is fundamental with this method is that people with similar features or qualities or characteristics are likely to know each other. A more universal statement is that individuals without the characteristic may know others who have such characteristics. According to the nature of this study older people are rare or hard to find who use mobile phones as well texting applications and it is a very small percentage of the total population.

### 3.3.4 Design questionnaire

A questionnaire is designed on the basis of investigated issues through literature review. Through literature review issues are investigated and categorized into four different categories. Mostly reported issues are taken from each category and questionnaire is designed. Questionnaire design guidelines are used in order to design an effective questionnaire for this research study [71]. The purpose of using these guidelines is that they provide evidence-based recommendations for researchers who frequently have to make decisions about questionnaire design.

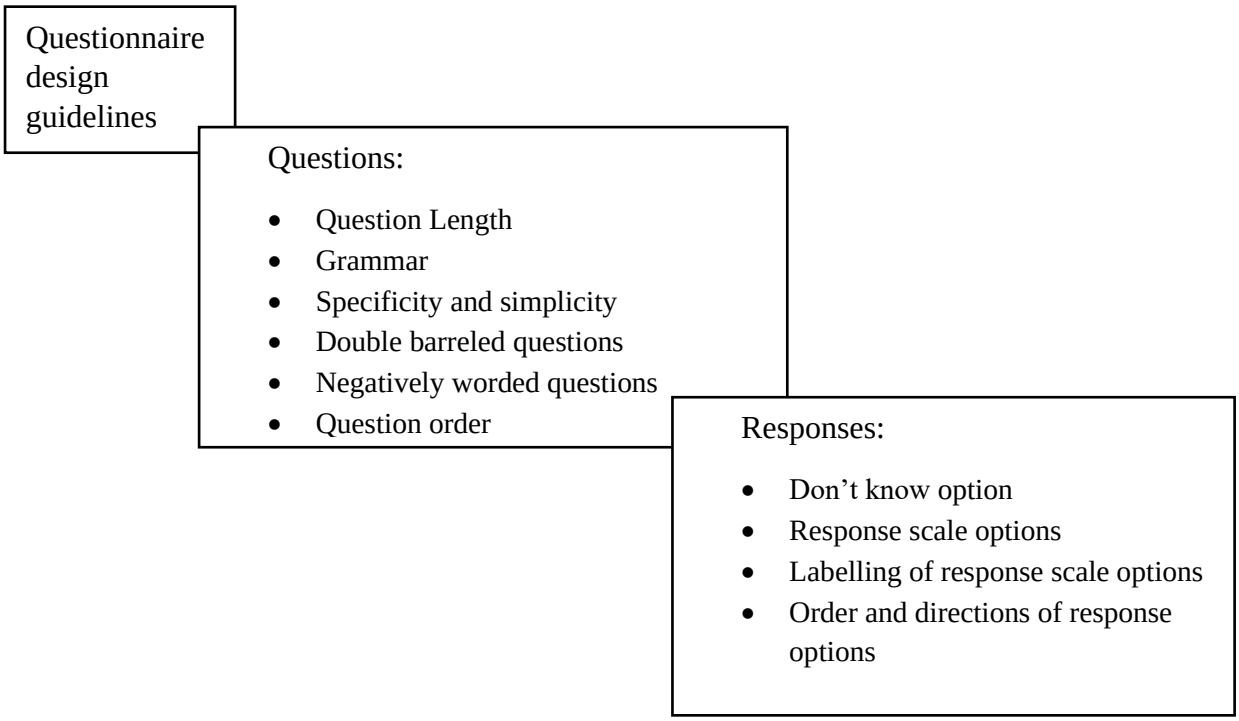


**Figure 3.3**: Questionnaire design Guidelines [71]

#### 3.3.4.1 Questions

Different research studies highlighted the importance of questions. In market research a successful communication process is question which is asked in the language of respondents

[72]. Therefore, this research study focused on the characteristics of the question, such as question length, question wording, question order, in order to avoid negative impact on sample quality due to non-response.

**Question Length**

Research studies advised to keep question as short as possible. Short length questions increase respondent comprehension. For English language, studies recommend a maximum number of 16 words per sentence [73]. In this research study, each question's length is less than number of 16 words per sentence.

**Grammar**

Research studies emphasized to keep the grammar complexities minimum. The question should employ the active voice rather than passive voice [72]. The questions of this research study are simple and have not any grammar complexities such as passive voice statements.

**Specificity and Simplicity**

It is necessary to use specific terms instead of general terms in any question. For that reason, it is necessary to break a complex question into multiple simple question. Avoid those words that indicate ambiguity such as "probably", "maybe" or "perhaps" [74]. Studies reported that invalidity of responses increase when the question is about the recall of events that have occurred not in immediate past (more than a week/month ago) [75]. In this research study, questions are specific and simple.

**Double Barreled Questions**

A research study advised, avoiding the ambiguity of double-barreled question. Double barreled questions contain two different verbs and two different concepts [76]. In this research study, there is no question which have two concepts. No question is asked about two aspects.

**Negatively worded questions**

According to the research study negatively worded questions have to be found to take longer to process. These questions have a greater likelihood of respondents making mistakes. The use of words no/not in a question have negative meaning. This study confirmed the undesirability of negatively worded questions. It is reported that analysis of negatively worded questions is less reliable than positively worded questions [77]. The questionnaire of this study has no negative worded questions.

**Question Order**

According to research study question order effects when there are both general and specific types of questions. In questionnaire general questions should be properly placed before the specific questions. The reason is that specific questions contain certain aspects out of the concept [78]. The questionnaire of this research study, has general questions (demographic questions) before the specific questions (actual questions).

**3.3.4.2 Responses**

In the questionnaire communication method, the second main part is the responses that are given to answer a question.

**Don’t Know Option**

According to research study it is important to identify that whether respondent should answer all question or not. In the context of interview that is conducted, either face to face or telephonic, response scale should offer don’t know option. Study reported that agree and disagree responses have reliable results instead of don’t know options [79]. Questionnaire of this study has agreed and disagree options.

**Response Scale Options**

Research study investigated that between 5-points and 7-points scale response options are the most commonly used options. 7-point scale has been shown more reliable as it allows greater differentiation of responses. Large scale options usability is effective when they applied to customer satisfaction measurements. Studies advised that instead of relating the length of response scale to the respondents, it relates to the content of the questionnaire. Study suggested that short scales such as 5-points scale, are preferable where respondents are asked about absolute judgement [72]. Questionnaire of this study used 5-points scale options.

**Labelling of Response Scale Options**

Study investigated that labelling of response scale options include unipolar (scale from 0 to 10) or bipolar (from -5 to +5) or verbal scale (disagree, neutral, agree). Study suggested verbal scale labelling in order to get reliable results. However, in the case of unipolar or bipolar labelling scales, study have shown a greater likelihood for respondents to choose positive rating on the bipolar numeric scale. These scales are appropriate for satisfaction related topics [80]. The questionnaire of this study has verbal scale labelling i.e., Strongly disagree, disagree, neutral, agree and strongly agree.

**Order and Direction of Response Options**

Study investigated that the primary effect of ordering that the respondents will select earlier options more frequently than later options. Study suggested to put those options first (on left) that convey less socially desirable responses. This technique is used to prevent respondents from making a choice without reading all options. On the other hand, direction of the responses effects the mean scores and standard deviation when the strongly agree has the highest value and strongly disagree the lowest value. Lower mean is observed in the case of assigning strongly disagree a highest value and strongly agree a lowest value. Studies investigated that direction of responses is negligible in various cases but the lowest value should assign to strongly disagree [81]. In this research study while designing the questionnaire the order of option is from strongly disagree to strongly agree. As strongly disagree has value 1, disagree has 2, neutral has 3, agree has 4 and strongly agree has value 5.

**Pilot Test Questionnaire**

It is important to test the questionnaire before conducting the actual survey. After questionnaire design, questionnaire is checked by few English language and Urdu language experts. Table 3.1 contains updated questions.

**Table 3.1:** Pilot Test Questionnaire

| Sr. | Old questions | Updated Questions |
|---|---|---|
| 1 | Do you often face interface issues? | Do you have texting applications interface issues? |
| 2 | Do you have less mental capacity towards texting? | Does texting increase a mental work load? |
| 3 | کیا فزیکل ستیمنا میسج کرنے کو متاثر کرتا ھے؟ | کیا محدود جسمانی صلاحیت میسج کرنے کو متاثر کرتی ہے؟ |

When updated questionnaire is reviewed by experts, they showed better understanding. Thus, the reviewed questionnaire is used for survey [Appendix B].

**Distribute the Questionnaire**

Questionnaire is distributed among 120 older users of Pakistan. The survey is conducted physically between June 2021 and July 2021, in Rawalpindi and Islamabad, twin cities of Pakistan. The calculated estimated time to fill the questionnaire was 10 minutes. This time is calculated in the phase of pilot test questionnaire, when questionnaire is distributed among some older users.

**Analyze results and write report**

Respondents were firstly asked about their demographic information. Demographic information includes 4 sections i.e.; age, gender, qualification and occupation respectively. Each section contains different attributes which shows the broad view of particular demographic information. Respondents are categorized according to their demographic information. Respondents were firstly asked about their age. This was done to see if there is possible relationship between texting and age or which age group mostly do text. Second demographic information was about their education level. This was done to see if there is any correlation between texting and education level or literacy. Next another demographic information was about occupation just to find out the correlation between texting and occupation as we find working users use more mobile application other than non-working users. Most important demographic information is Gender as it investigated which gender mostly use the texting application.

In questionnaire first two questions are about socioeconomic issues, from question number 3 to 10 are about psychological issues, from question number 11 to 16 are about technical issues and question number 17 is about physical issues. Demographic questions are also asked in the questionnaire including the questions about gender, age, qualification and occupation.

After survey the respondents' responses are put in Excel file to analyze the results. Chi-square test of independence is used to test the hypothesis. After hypothesis testing reliability test is used to check the reliability of responses. Guidelines are investigated in order to overcome the Roman Urdu texting issues [Chapter 4].

### 3.4 Hypothesis Testing

Hypothesis testing is very important phase of statistical interpretation. Hypothesis is a procedure which decide to accept or reject a statement on the basis of information obtained from sample data [82].

#### 3.4.1 Chi-Square Test

In 1875 a Germen Physicist F.R. Helmert (1843-1917), firstly invented the chi square distribution. Later in 1900, Karl Pearson (1857-1936) showed that a chi-square test approach is made up of n approaches infinity, due to which a discrete multinominal distribution may be transformed. This calculated approximation has broad applications such as test of goodness of fit, test of independence, test of homogeneity [82]. For testing hypothesis this study used test of independence.

#### 3.4.2 Testing Hypothesis of Independence

Testing hypothesis the test of independence can used on the data which two or more than two variables of classification. The two variables of classification are determined not independent if this hypothesis is rejected and there is some association and interaction between two variables of classification [82].

The chi square test of independence is statistical hypothesis test that is used to regulate whether two categorical and nominal variables are probably to be related or not. This study has two nominal variables older users and Roman Urdu texting issue. Test of independence is appropriate if there is Likert scale data and this study has 5 points Likert scale data value [82].

### 3.5 Reliability and Validity Test

Reliability is a concept used to evaluate the quality of research. Reliability is about consistency of measure. Reliability indicate how well is the method, technique or test measure. Validity tells you how accurately the methods are measured [83].

### 3.6 Expert Review

Results of this research study are the Roman Urdu texting issues. This research study investigated guidelines from literature review in order to minimize Roman Urdu texting issues. The investigated guidelines list needs to be evaluated by some experienced mobile phones' user interface designer who are expert in mobile applications' designing domain. To achieve this goal an expert review technique is adopted for expert review [98].

The expert review is conducted to confirm the list of guidelines. The expert review methodology is in figure 3.4.

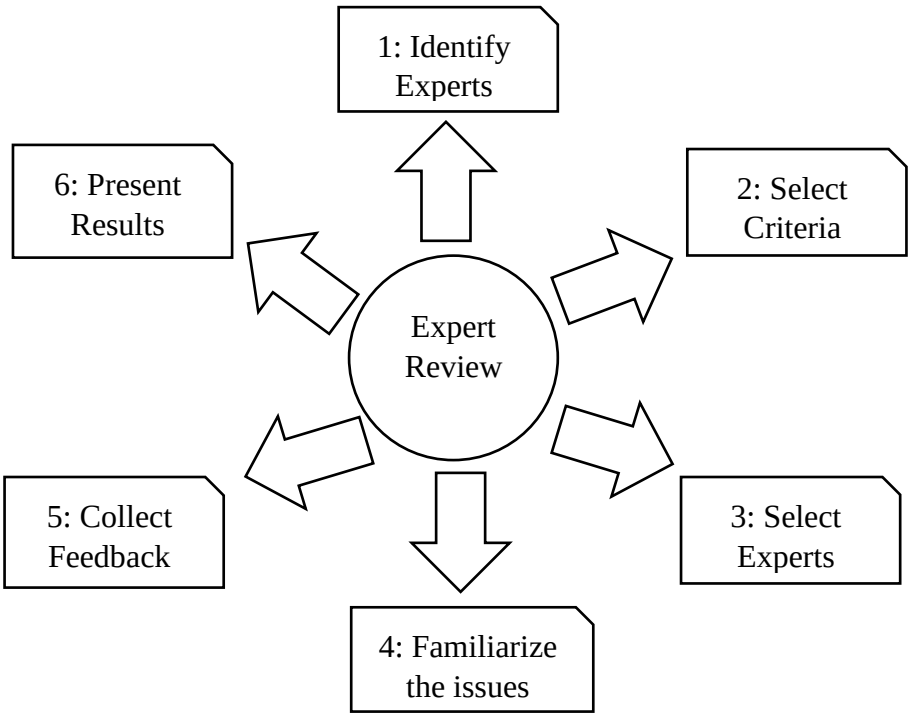


**Figure 3.4**: Expert Review Technique [98]

#### 3.6.1 Expert Identification

The first step is very crucial step, as expert must be carefully identified and carefully selected before they can be confirmed to be involved in tasks. It is need to be very certain that right expert must be chosen who can accurately validate the investigated guidelines.

### 3.6.2 Selection Criteria

This step defines the criteria under which the experts are selected to review the task. Table 3.2 contains the defined criteria to choose the experts for expert evaluation. Table 3.2 shows the experience and expertise that are required for evaluating the list of guidelines

**Table 3.2: Criteria for Expert Selection**

| Experience | Expertise |
|---|---|
| At least 5 years, At most 15 years | Front end designer/ Mobile Application designer, Mobile interface designer |

.

Table 3.2 shows clearly that it would be necessary for the reviewers for validating guidelines to have specialized skill in mobile applications' designing. This means that they must have at least 5-10 years of experience.

### 3.6.3 Expert Selection

Research studies should have one to four experts for expert's validation [99]. To conduct an official expert opinion, an expert review form is designed [Appendix D]. Three experts showed their willingness to participate for expert opinion. This research study fulfils the basic requirements of expert selection.

### 3.6.4 Issues Familiarization

It could be difficult to discuss the research problem, research questions and data collection with experts for reviewing and validating the task. So, it is necessary to briefly explain and familiarize the experts with our research problem. After that move on the next step once the problem is well explained to the interested experts.

### 3.6.5 Collect Feedback

When the experts are familiarized with the issues the next step is collecting and quoting the comments from those specialists. The responses of experts are attached in appendix section D.

### 3.6.6 Presentation of Results

Once the feedback is accumulated, the final results are presented in tabular form. The final validated list of guidelines is reported in section expert review in Chapter 4.

**Table 3.3: Personal Detail of Experts**

| **Experts** | **Organization' Name** | **Designation** | **Experience** |
|---|---|---|---|
| A | Pakistan Ordnance Factories WahCantt (POF Wah) | Assistant Manager | +5 years |
| B | MTBC | Senior android developer | 5 years |
| C | E-axon System | Product designer/ front end designer | +5 years |

# CHAPTER 4

# RESULTS, DISCUSSION AND GUIDELINES

In this chapter, section 4.1 contains the demographic information about respondents. A quantitative analysis is executed in section 4.2. In this section, on the basis of highest frequency, issues are analyzed as agreed or disagreed. In section 4.3, a hypothesis is formed and chi square test of independence is performed in order to analyze the result statistically. Section 4.4, contains the Reliability test which calculated alpha's value. Section 4.5 contains the validity threats. In section 4.6, results of this study are compared with literature review through discussion. Section 4.7 contains the guidelines investigated through literature review. Guidelines after expert review are represented in section 4.8. Section 4.9 contains the summary of chapter 4.

## 4.1 Demographic Information

Table 4.1, contains the demographic information of the respondents. Demographic information includes gender, education, occupation and age of the respondent.

**Table 4.1:** Demographic Information

| **Gender** | **Education** | | | | **Occupation** | | **Age group** | |
|---|---|---|---|---|---|---|---|---|
| Male | Matric | Intermediate | Graduation | Master | Working | Not working | (60-70) | (71-80) |
| 84 | 43 | 21 | 6 | 4 | 25 | 59 | 79 | 5 |
| Female | Matric | Intermediate | Graduation | Master | Working | Not working | (60-70) | (71-80) |
| 36 | 23 | 7 | 5 | 1 | - | - | 35 | 1 |

Table 4., shows that total participants were 120 older users (84 identified as male and 36 as female whose mostly age ranged from 60-70. From 120 participants 114 participants were from age group (60-70) and 6 participants were from age group (71-80). This information shows that males are greater part of population who use texting applications as females. Participants reported their education level and from both males and females, mostly older users are having matric degree. From 84 males, 30% males reported that they are still working in private sectors however 70% older users are not working above the age of 60 years. No female reported herself as a working lady above the age of 60 years. All participants reported owing a cell phone with texting capabilities having Roman Urdu texting issues.

### 4.2 Data Analysis

This section contains the statistical analysis on quantitative data. Data is gathered from 120 respondents through survey. 17 questions are evaluated on five-point Likert scale. Questions are categorized into four categories.

#### 4.2.1 Socioeconomic Issues

In the questionnaire first two questions are about socioeconomic issues. Table 4.2 contains the frequencies of socioeconomic issues.

**Table 4.2:** Socioeconomic Issues

| Sr. | Questions | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | Does lack of technology knowledge is a challenge for texting? | 1 | 9 | 6 | 70 | 34 |
| 2 | Does illiteracy is a challenge for texting? | 0 | 12 | 10 | 52 | 46 |

Lack of technology knowledge is an issue for older users because they don't know abut technology as they did not adopt technology earlier. Table 4.2 shows that 104 older users out of 120 (86.6%) responded that lack of technology knowledge is a challenge for Roman Urdu

texting. Illitercay is a major barrier towards texting in order to read and writeRoman Urdu text messages. 96 Older users (81.6% ) responded that illiteracy is a challenge for Roman Urdu texting.

### 4.2.2 Psychological Issues

In the questionnaire, questions from 3 to 10 are about psychological issues. Table 4.3 contains the frequencies of psychological issues.

**Table 4.3:** Psychological Issues

| Sr. | Questions | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 3 | Do you have trust issues while texting? | 4 | 19 | 34 | 51 | 12 |
| 4 | Does texting is waste of time, bad and annoying activity? | 4 | 37 | 14 | 41 | 24 |
| 5 | Does texting communication is weird? | 1 | 34 | 28 | 43 | 14 |
| 6 | Does texting fit in your daily routine life? | 7 | 40 | 24 | 44 | 5 |
| 7 | Do you receive low encouragement from society towards texting? | 5 | 24 | 26 | 50 | 12 |
| 8 | Do you receive smaller number of texts from friends and family? | 2 | 14 | 9 | 64 | 31 |
| 9 | Does texting increase mental workload? | 3 | 13 | 17 | 53 | 34 |
| 10 | Do you require extra time or steps for writing a text? | 2 | 12 | 11 | 68 | 27 |

It is observed that older users are often not confident in the acceptance of technology, it is because of lack of understanding of their media tools. Elderly has great trust issues that they are secure or not while using digital communication tools.  63 older users (52.5% ) that they have trust issues while Roman Urdu texting.

According to the older users texting is useful but annoying, texting is a better technique to communicate, but we should do it less, and we should talk more on calls. 65 older users (54.2%) responded that texting is bad and annoying activity.

According to the older users comunication in which they can not see the expressios of others are weird for them and they can not handle the conversersation [34]. 57 older users (47.5%) responded that Roman urdu texting communication is weird.

When smart mobile phone technology fits in the daily routine of the people having age 65 and older, there are more chances in the usability of smart mobile phone technology and compensates the possible frustration of learning how to use it. 49 older users (40.8%) responded that texting fit in their daily routine life. Which shows for majority older users there is Roman urdu texting and daily routine coherence issue.

Older users can become more independent and more socially involved, if they have access to advance technology but there is a lack of access to technology. 62 older users (51%) responded that they receive low encouragement from society towards texting.

It is investigated that older users receive less number of messages from friends and family. 95 older users ( 79% ) responded agreed which shows that mostly older users are agreed that they receive smaller number of texts from friends and family.

Elderly users appear to have difficulty learning how to use a new mobile phone and use fewer of the available features. 87 older users (72.5%) responded that texting increase mental work load. Older users often use extra time to accomplish a mission and as compared to the younger users.

It is reported that older users almost take over 40% extra meaningless steps. 95 older users (79.2%) responded that older users are agreed that they require extra time or steps for writing a Roman Urdu text.

### 4.2.3 Technical Issues

In the questionnaire, questions from 11 to 16 are about technical issues. Table 4.4 contains the frequencies of technical issues.

**Table 4.4:** Technical Issues

| Sr. | Questions | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 11 | Do you have texting application interface issues? | 2 | 20 | 15 | 53 | 30 |
| 12 | Do you prefer calling over texting? | 1 | 7 | 10 | 40 | 62 |
| 13 | Do you prefer buttons over virtual keyboard? | 5 | 19 | 08 | 53 | 35 |
| 14 | Do you like auto fill and auto correct features? | 17 | 44 | 18 | 28 | 13 |
| 15 | Do you like updates in texting applications? | 25 | 44 | 20 | 21 | 10 |
| 16 | Do you prefer simple functionality of texting applications? | 2 | 7 | 12 | 60 | 39 |

Menus and dialog box are the main interface functions and interface utilization and acceptance depend on variety of such elements, and the older users are not familiar with new advancements. 83 older users (69.2%) responded that they have texting applications interface issues.

The primary usage of mobiles by older users is answering to family and friends on calls, preparation of medical appointments and veterinary appointments, and for receiving signals from healthcare centers. 102 older users (85.0%) responded that they prefer calling over texting.

Those mobile phones are the ideal for elderly, which have bigger size buttons (icon size), great volume, large content, easy to understandable menu etc. 88 older users (73.4%) responded that they prefer buttons over the virtual keyboard.

It was frustrating for older person when “it tries to guess what you want to say and auto fills or auto corrects”. 41 older users (34.1%) responded agree, which shows that older users do not like auto-fill and auto-correct features of texting application.

Several older users specified that security updates, backups, and upgrades are often more difficult. 31 older users (25.8%) responded agree which shows that older users do not prefer updates of texting application.

Older users often face issues when they interact with smart mobile phones with complicated features because they have weak memory, visual capabilities, and limited physical stamina rather than the young population. 99 older users responded (82.5%) agree which shows that older users prefer simple functionality of texting applications.

### 4.2.4 Physical Issues

In the questionnaire, question number 17 is about physical limitation. Table 4.5 contains the frequencies of physical issue.

**Table 4.5:** Physical Issue

| Sr. | Question | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 17 | Does limited physical stamina affect texting? | 1 | 17 | 16 | 56 | 30 |

The physical and psychological challenges often cause of the only the usage of precise functions instead of advanced functions. It is observed that older users have greater physical and psychological restrictions. 86 older users (71.7%) responded agree which shows that limited physical stamina affect texting.

**4.3 Hypothesis Testing** Since the calculated p value is less than significant level 0.05 so this study rejects null hypothesis of independence. Data provides evidence of statistical association between older users and Roman Urdu texting issues. This statistical test concluded that older users often face Roman Urdu texting issues. [Appendix C].

### 4.4 Reliability Test

Reliability is a concept used to evaluate the quality of research. Reliability is about consistency of measure. Reliability indicate how well is the method, technique or test measure [83].

**Table 4.6:** Reliability Test

| | |
|---|---|
| Total questions | 17 |
| Sum of variances | 18.20861 |
| Variances of total | 40.02689 |
| Cronbach Alphas' value | 0.579159 |

### 4.5 Validity Test

In quantitative research, there is a need to check reliability and validity of measurements. Validity tells you how accurately the methods are measured. If a method measures and the results closely correspond to real-world values, then it can be considered valid. There are four main types of validity i.e., construct validity, content validity, face validity and criterion validity [83].

#### 4.5.1 Construct validity

Construct is a concept that cannot be measured directly. Construct can be an individual characteristic such as height, weight, intelligence etc. Construct validity evaluates that whether measurement tool really represent the thing which is supposed to be measure. In this research study "Roman Urdu texting issues" is a construct that cannot be measured directly. Roman Urdu texting issues can be

measured based on existing texting issues and collection of texting issues through survey. Construct validity is also about ensuring the method of measurement. In this study a questionnaire is developed to investigate Roman Urdu texting issues. To achieve construct validity there is necessary to ensure that indicators or measures are based on existing theory. In this research study the indicators of questionnaire are mostly reported issues of literature review. However, this research study can have construct validity about method of measurement. Roman Urdu texting issues can be identified using other method of measurement rather than survey.

### 4.5.2 Content Validity

Content validity is about whether the measurement is representative of the construct or not. To produce valid result survey or any measurement method must cover all relevant parts of the construct. Content validity is threatened if some aspects are missing in the measurement and irrelevant aspects are included. In this research study texting issues are categorized in four major categories. Roman Urdu texting Issues are investigated in all aspects including physical issues, psychological issues, technical issues and socioeconomic issues. In this research study, cultural related issues are missing. So, this research study has content validity threats about cultural issues.

### 4.5.3 Face Validity

Face validity shows how suitable the content of the test. It is similar to the content validity. Face validity is a subjective measure. Face validity checks on surface that survey questionnaire seems like a good representation of what you want to test. In this research study texting issues are asked category wise including physical issues, psychological issues, technical issues and socioeconomic issues. This research study has face validity threats in terms of cultural issues.

### 4.5.4 Criterion Validity

Criterion validity is about the outcome of the test. To ensure criterion validity there is need to calculate the correlation between the results of measurements and the result of criterion measurement. Criterion validity ensure that how well the results of test approximate the results of

another test. The results of this research study are verified by two different tests. Firstly, simple mode value is evaluated which option has highest mode values. Results showed that mostly questions have mode value 4 (Agree). Secondly chi-square test of independence value showed that older users often face Roman Urdu texting issues. There is a correlation between statistical test mode and chi-square test of independence. This research study has no criterion threat.

### 4.6 Discussion

In the section 4.5, there is a detailed discussion about Roman Urdu texting issues. The discussion is a comparison between the literature review and results of this study. Whether texting issues are correlated or not.

#### 4.6.1 Socioeconomic Issues

According to different studies, it is observed that the knowledge about the technologies is associated with the desire of interacting and using new technologies. Younger people are involve in this association more than older age group [46]. A study reported that the older persons have less awareness about some of the modern technologies as compared to the younger ones. In addition, the older persons have less desire for the smart mobile technologies as compared to the younger adults [54]. According to the results of this study, lack of technology knowledge is an issue for older users because they don't know abut technology as they did not adopt technology earlier. Table 4.2 shows that 104 older users out of 120 (86.6%) responded that lack of technology knowledge is a challenge for Roman Urdu texting.

According to different studies, the desire and ability in the acceptance of mobile phones can increase by level of education. This research reported an association between level of education and acceptance of advance technology. Level of education mostly influence the attitudes toward learning, and acceptance of advance technology. The older users who have more positive attitude toward digital communication tools are also more highly and better educated [34]. National Telecommunications and Information Administration of the United States developed the studies which investigated that those individuals who have high education, earn average and above average incomes, under 55 years old and mostly male gender group from urban areas, are using

the smart mobile phone technologies [40]. According to the results of this study, illitercay is a major barrier towards texting in order to read and write Roman Urdu text messages. 96 Older users (81.6% ) responded that illiteracy is a challenge for Roman Urdu texting.

### 4.6.2 Psychological Issues

According to the literature, a study reported that even the design of the texting applications is trustworthy and acceptable, older users often rejected the usage of texting application [63]. Another study reported that older adults often show the distrust when discussing digital tools and this distrust is a barrier in the acceptance of advance technology [64]. According to the results of this study, older users have trust issues that they are secure or not while using digital communication tools. 63 older users (52.5% ) responded that they have trust issues while Roman Urdu texting.

According to the literature, it is investigated and reported in different studies that older users expected better users of writing free text-to-speech functionalities in the coming era. This study also investigated that for the older users texting is fast and efficient way of communication, but mostly it is found to be an annoying and getting out of hand activity. According to the older users texting is useful but annoying, good way to communicate, but we should do it less and should talk on calls more [47]. A study investigated that texting communication is not positively correlated with the face-to-face communication but video call can be positively correlated [68]. According to the result of this study, 65 older users (54.2%) responded that texting is bad and annoying activity.

While texting others older users often do not feel secure. They do not prefer the conversation in which they do not see or hear the expressions of other. This is a faraway diverse world for the individuals who born before 1950. According to the older users comunication in which they can not see the expressios of others are weird for them and they can not handle the conversersation [34]. 57 older users (47.5%) responded that Roman urdu texting communication is weird.

According to the literature, when mobile phone technology does not fit in the daily routine life of older users, they less likely to use mobile phone technology, and when they came to know the advantages, they show some frustration of learning how to use it [61]. A study investigated that

that the elderly is ready to use technology particularly in certain circumstances. Hence, older users are more confident when advance technology is well-matched with their routine [62]. According to the results of this study, 49 older users (40.8%) responded that texting fit in their daily routine life. Which shows for majority older users there is Roman urdu texting and daily routine coherence issue.

According to the literature, technology can facilitate older users to contact with their families and friends, they can build a harmless environment, facilitate medical care, introduce new motivations in a person's life, produce a larger access to information, and increase the level of social communication, confidence, life fulfillment and self-sufficiency. Thus, by having access to technology, the elderly can be more independent and more socially involved but there is a lack of access to technology [34]. According to the result of this study, 62 older users (51%) responded that they receive low encouragement from society towards texting.

According to the literature, a study in America is investigated in October 2014, 90% older Americans have ownership of smart mobile phone and from those using these devices, 21% use them to send or receive text messages [38]. According to the results of this study, 95 older users ( 79% ) responded agreed which shows that mostly older users are agreed that they receive smaller number of texts from friends and family.

According to the literature, it is observed that often the usage of modern technical devices are not perceived to be easy, due to enforce considerable cognitive load on older users [44]. According to the results of this study, 87 older users (72.5%) responded that texting increase mental work load. Older users often use extra time to accomplish a mission and as compared to the younger users.

According to the literature, it is investigated that elderly users often required additional time to accomplish a task and took over 40% extra silly steps as compared to the younger users. While interacting with new advancements they often feel pressure [37]. According to the results of this study, 95 older users (79.2%) responded that older users are agreed that they require extra time or steps for writing a Roman Urdu text.

### 4.6.3 Technical issues

According to the literature, there are numerous challenges that older users often face when they interact with typical user interfaces and a younger user do not experience those challenges, it could be either as a result of the effects of ageing or unfamiliarity with mobile technology [36]. According to the results of this study, 83 older users (69.2%) responded that they have texting applications interface issues.

According to the literature, some researchers reported a tendency towards mobile phone calls largely swapped by the text messages [35]. A study investigated that older people reported that mobile phones or smart mobile phones were frequently used for phone calls and less for social media [47]. According to the results of this study, 102 older users (85.0%) responded that they prefer calling over texting.

According to the literature review, based on the older users' physical features and capabilities, the devices should contain big size buttons, be more appropriate for shaky hands instead of virtual keyboard [51]. According to the results of this study, those mobile phones are the ideal for elderly, which have bigger size buttons (icon size) instead of glass screen. 88 older users (73.4%) responded that they prefer buttons over the virtual keyboard.

According to the literature review, a study investigated that One 65-year-old often feel frustration when he tries to guess in auto fills or auto corrects in order to write the text in correct form [34]. According to the results of this study, 41 older users (34.1%) responded agree with auto-fill and auto-correct feature. This shows that older users do not like auto-fill and auto-correct features of texting application.

According to the literature, a study reported that older users often feel pressure when they have to keep updates on security, backups and upgrades. They often found them difficult rather than the actual use of the mobile phones. Older users indicated that after retirement, in such cases they found no one to help them [47]. According to the result of this study, 31 older users (25.8%) responded agree which shows that older users do not prefer updates of texting application.

According to the literature, a study reported that older users stated that in terms of usability they prefer the simpler and easier to use system. Older users showed less interest due to the complex functionality [65]. According to the results of this study, 99 older users responded (82.5%) agree which shows that older users prefer simple functionality of texting applications.

### 4.6.4 Physical Issues

According to the literature, studies reported that vision, dexterity and cognitive issues are the barriers of using texting applications. These barriers may relay on the older adult's involvement in new technology, independence, and comfort level, than actual barriers [34]. According to the results of this study, it is observed that older users have greater physical and psychological restrictions. 86 older users (71.7%) responded agree which shows that limited physical stamina affect Roman Urdu texting.

## 4.7 Guidelines

Section 4.7, contains the guidelines for Roman Urdu texting issues. There are numerous convenient guidelines that can provide assistance to design a texting application. Some psychological issues need further investigation in order to provide effective solution. Different medical or health care centers and developers together can address the psychological requirements of the older persons and can design and develop the texting applications according to their psychological perception.

- Provide hardware keyboard facility to enter long text sequences [84,85].
- The device should be big, enable a comfortable grip, and be lightweight [84,85].
- To prevent cognitive overload, introduce simple features [84].
- Present the information in blocks to minimize working memory load [84].
- Facilitate with text to speech feature [84].
- Avoid distracting visual stimuli and non-relevant information [85].
- Provide language-based error correction facility [85].
- Avoid features which decline visual capacity [85].
- Zoom options and font size increase option is desired for older users [86].

- The keys of a software keyboard to enter textual data should be wider than taller [86,87].
- Simple and meaningful icons without decoration and animation [88].
- Use appropriate colors with high contrast [86,89].
- Menu structure must be simple and consistent [90,91].
- Small size of a phone's display may hinder navigation [90,92].
- Foreign expressions, abbreviations, and technical terms should be avoided in menus [93,94].
- The spacing between adjacent buttons in a row should 6,35 mm maximum. As this is appropriate for dexterity issues [85,90].
- Minimize the number of steps to complete a task [95].
- Don't force the user to keep information in mind for too long [90,96].

### 4.8 Findings from Expert Review

Based on standard criteria [99], 3 experts were chosen for evaluating the investigated guidelines. All of them gave some suggestions which are presented in tabular form

**Table 4.7:** Expert Opinion

| Experts | Comments | Action |
|---|---|---|
| A | • Keep familiar user interface for older users to easily navigate through application. | • Include recommended guideline. |
| B | • Discovery feature in application i.e., when user login for the first time.<br>• Application flow should be clear and easy.<br>• Discard first two guidelines as they are related to operating system development. | • Include recommended guidelines.<br>• Categorize guidelines. |
| C | • Use image, icon and animations to describe app functionality.<br>• Interactive user guideline at fresh install.<br>• Keep users interface screen simple and clean.<br>• Application actions should trigger the | • Exclude guideline 11.<br>• Include recommended guidelines. |

| | | | |
|---|---|---|---|
| | | relevant functionality which are described on action. e.g., button clicked. | |

**Table 4.8:** Guidelines after Expert Review

| Sr. | Category | Guidelines | References |
|---|---|---|---|
| 1 | Operating System Design and Development Guidelines | Provide hardware keyboard facility to enter long text sequences. | [84,85] |
| 2 | | The device should be big, enable a comfortable grip, and be lightweight. | [84,85] |
| 3 | | Small size of a phone's display may hinder navigation. | [90,92] |
| 4 | | The keys of a software keyboard to enter textual data should be wider than taller. | [86,87] |
| 5 | | The spacing between adjacent buttons in a row should 6.35 mm maximum. As this is appropriate for dexterity issues. | [85,90] |
| 6 | Texting Application Design and Development Guidelines | To prevent cognitive overload, introduce simple features. | [84] |
| 7 | | Present the information in blocks to minimize working memory load. | [84] |
| 8 | | Minimize the number of steps to complete a task. | [95] |
| 9 | | Facilitate with text to speech feature. | [84] |
| 10 | | Provide language-based error correction facility. | [85] |
| 11 | | Zoom options and font size increase option is desired for older users. | [86] |
| 12 | | Use appropriate colors with high contrast. | [86,89] |
| 13 | | Menu structure must be simple and consistent. | [90,91] |
| 14 | | Avoid distracting visual stimuli and non-relevant information. | [85] |

| | | | |
|---|---|---|---|
| 15 | | Avoid features which decline visual capacity. | [85] |
| 16 | | Foreign expressions, abbreviations, and technical terms should be avoided in menus. | [93,94] |
| 17 | | Don't force the user to keep information in mind for too long | [90,96] |
| 18 | | Keep familiar user interface for older users to easily navigate through application. | [A] |
| 19 | | Discovery feature in application i.e., when user login for the first time. | [B, C] |
| 20 | | Application flow should be clear and easy. | [B] |
| 21 | | Use image, icon and animations to describe app functionality. | [C] |
| 22 | | Application actions should trigger the relevant functionality which are described on action. e.g., button clicked. | [C] |

### 4.9 Summary

In this chapter data is analyzed and guidelines are investigated. Demographic information includes gender, education, occupation and age. Frequency distribution of each response stated that older users often face such issues. Chi square test of independence report reject the null hypothesis and accept that there is high correlation between older users and Roman Urdu texting issues. Test of reliability value shows the reliability of survey. Discussion section includes the comparison between issues investigated by literature review and issues investigated through survey. Guidelines are investigated through literature. Last, reviewed guidelines from experts are presented in this chapter.

# CHAPTER 5

# CONCLUSION

In this chapter, section 5.1 contains the findings of this study. In section 5.2, limitations of this study are discussed. Section 5.3 contains the future work.

## 5.1 Findings

The findings of this study uncover the Roman Urdu texting issues faced by older users. In this study two phased methodology is used in order to investigate Roman Urdu texting issues. With the help of first phase texting issues are investigated through literature review. Issues are categorized in four categories i.e., Socioeconomic issues, psychological issues, technical issues and physical issues. Frequently repeated issues are highlighted from each category. 17 highlighted issues include lack of knowledge, education, trust, waste of time, weird communication, daily routine life coherence, low encouragement from society, receive smaller number of texts, mental workload, need extra time, interface issues, calling over texting preference, buttons over virtual keyboard preference, auto correct features, texting application updates, simple functionality and limited physical stamina. These issues are part of questionnaire. Questionnaire guidelines are used to design a questionnaire. Kasunic guidelines are used for survey. After survey results are analyzed. Results of this study investigated, older user preferred calls over Roman Urdu texting in every situation. Older users clearly denied the updates or new versions of texting applications. Older users have lack of technology knowledge. Due to the lack of education older users often frightened to use digital communication tools. For older users' simple functionality is desirable. Guidelines are investigated in order to overcome Roman Urdu texting issues.

## 5.2 Limitations

In this research study, survey is done in Rawalpindi and Islamabad twin cities of Pakistan.

## 5.3 Future Work

Future work of this research study is the identification of cultural related issues which are the barriers in Roman Urdu texting. Future research studies may investigate Roman Urdu texting issues through open ended questionnaire survey.

## REFERENCES


[1] "Invention & Adoption—The History of the Mobile Phone.Mobilephones.umwblogs.org (2017)," http://mobilephones.umwblogs.org/invention/. [Accessed 29-07-2022].

[2] "Telecom indicators," PTA, Available: http://www.pta.gov.pk/index.php. [Accessed 29 -07-2022].

[3] "Pakistan Telecommunication annual Report," 2019. [Online]. https://www.pta.gov.pk/assets/ media/pta_ann_rep_2019. [Accessed 29-07-2022].

[4] Joe, Demiris, Biomed: "Older adults and mobile phones for health": a review. J. Biomed, Volume 46, Issue (5), Pages: 947-954, doi: 10.1016/j.jbi.2013.06.008, October 2013.

[5] Mohiuddin, Hazwani., Nazlena Mohammad Ali, "A study of smartphone usage and barriers among the elderly," In:2014 3rd International Conference on User Science and Engineering, doi: 10.1109/IUSER.2014.7002686, IEE publication 2015.

[6] Jia Zhou, Pei-Luen Patrick Rau, Gavriel Salvendy, "Older adults' use of smart phones: an investigation of the factors influencing the acceptance of new functions," Volume 33, Issue 6, pages 552-560, 2013.

[7] Martina Ziefle, Susani Bay, "How older adults meet complexity: aging effects on the usability of different mobile phones," Volume 24, Issue 5, Pages 375-389, doi:10.1080/0144929042000320009, 2013.

[8] Sri Kurniawan," Older people and mobile phones: multi-method investigation International Journal of Human Computer Studies, Volume 66, Issue 12, Pages 889-901, 2008.

[9] Jaquelinne Fontes, Luis Castro,"Towards the design of trouble-free smartphones for middle-aged adults in Mexico," In: Mexico 2016 Proceedings of the 6th Mexican Conference on Human- Computer Interaction, Colima, Mexico, ISBN: 978-1-4503-4782-2, 2016.

[10] Diana Rieger, Dorothee Hefner, Peter Vorderer,“Mobile recovery? The impact of smartphone uses on recovery experiences in waiting situations,” Mobile Media Communication, Volume 5, Issue 2, doi:10.1177/2050157917691556, 2017.

[11] Syed Mohammad Ali, "Pakistan aging's population, Express news report," https://tribune.com.pk/story/464108/pakistan%E2%80%99s-aging-population, [Accessed 27-07-2022].

[12] Zunaira Ilyas Bhutta, Javed Anjum Sheikh, and Azeem Yousaf, “Usage of mobile phones amongst elderly people in Pakistan,” Conference Paper in Advances in Intelligent Systems and Computing, doi:10.1007/978-3-319-60582-1_62, July 2018.

[13] "Global Digital Communication,"2011. [Online].Available: //www.pewresearch.org/global-digital-communication-texting-social-networking-popular-worldwide,,[Accessed 27-07-2022].

[14] "Telecom indicators," PTA, [Online]. Available: Available: http://www.pta.gov.pk/index.php, [Accessed 29-07-2022].

[15] Saba Urooj, Sana Shams, Sarmad Hussain, Farah Adeeba, “tagged urdu digest corpus,” Conference on Language and Technology (CLT) at Karachi, 2014.

[16] Iqra Javed, Hammad Afzal, Awais Majeed, Behram Khan, "Towards creation of linguistic resources for bilingual sentiment," In International Conference on Applications of Natural Language to Data Bases/Information Systems, Volume 8455, Pages 232-236, 2014.

[17] Iqra Javed, Hammad Afzal, "Creation of bi-lingual social network dataset using classifiers.," In International Workshop on Machine Learning and Data Mining in Pattern Recognition, Lecture Notes in Computer Science book series (LNCS, Volume 8556",2014.

[18] Sana Shahzadi, Beenish Fatima, Kamran Malik and Syed Mansoor Sarwar, "Urdu word prediction system for mobile phones.," World Applied Sciences Journal, Volume 2, Issue 1, Pages 113-120, doi : 10.5829/idosi.wasj.2013.22.01.142, 2013.

[19] Muhammad Sharjeel, Paul Rayson, Rao Muhammad Adeel Nawab, “Urdu paraphrase plagiarism corpus,” Proceedings of the Tenth International Conference on Language Resources and Evaluation (LREC'16), Pages 1832-1836, 2016.

[20] Malik Naseer Hussain, "Language of Text Messages A Corpus Based Linguistic Analysis of SMS In Pakistan,” PhD thesis, International Islamic University, Islamabad, 2013.

[21] Tanveer Ahmed, "Roman to urdu transliteration using wordlist," In Proceedings of the Conference on Language and Technology, doi:10.18653/v1/D15-1097, 2015.

[22] Kashif Mehmood, Hammad Afzal, Awais Majeed, Hassan Latif, "Contributions to the study of bi-lingual roman Urdu SMS," National Software Engineering Conference (NSEC), IEEE, Rawalpindi, doi: 10.1109/NSEC.2015.7396343, 2015.

[23] Abdul Rafae, Abdul Qayyum, Muhammad Moeenuddin, Asim Karim, Hassan Sajjad, Faisal Kamiran, "An unsupervised method for discovering verbal variations in roman Urdu informal text," Proceedings of the 2015 Conference on Empirical Methods in Natural Language Processing, doi:10.18653/v1/D15-1097, 2015.

[24] Tafseer Ahmed, "Roman to Urdu transliteration using wordlist," pages 8, 2012.

[25] Ali Daud, Wahab Khan, Danial Chaudhry, "Urdu language processing: a survey," Artificial Intelligence Review, Volume 47, Pages 279-311, 2017.

[26] Andrea Rosales, Mireia Fernández-Ardèvol, "Smart phone usage diversity among older people: Movement disorder evaluation and deep brain stimulation systems," In Perspectives on Human-Computer Interaction research with older people in Switzerland, Springer, 2019.

[27] Anas Bilal, Aimal Rextin, Ahmad Kakakhel, Mehwish Nasim, "Analyzing Emergent User's Text Messages Data and Explore its Benefits," Digital Object Identifier IEEE Access, Volume 1, Issue 1, Pages99, DOI:10.1109/ACCESS.2018.2885332, 2019.

[28] Khawar Mehmood, Daryl Essam, Kamran Shafi, Muhammad Kamran Malik, "Discriminative Features Spamming for Roman Urdu Sentiment Analysis," Digital Object Identifier IEEE, Volume 7, 2019.

[29] Walter R. Boot, Toma Burnik, Vesna Dolnicar, Andraz Petrovic, "Improving the Measurement of Older Adults' Mobile Device Proficiency," Digital Object Identifier IEEE, Volume 1, Issue 1, Pages 99, doi:10.1109/ACCESS.2019.2947765, 2019.

[30] Zheng Jiangbin, Muhammad Pervez Akhter, Irfan Raza Naqvi, Mohammed Abdelmajeed "Automatic Detection of offensive Language for Urdu and Roman Urdu," Digital Object Identifier IEEE Access, Volume 8, 2020.

[31] Javed Anjum Sheikh, Zunaira Ilyas Bhutta, Azeem Yousaf, "Usage of Mobile Phones Amongst Elderly People in Pakistan," Advances in Intelligent Systems and Computing, Conference: International Conference on Applied Human Factors and Ergonomics doi:10.1007/978-3-319-60582-1_62, July 2018.

[32] Aimal Rextin, Ahmad Kakakhel, Mehwish Nasim, Anas Bilal, "Roman Text: Forms and Functions of Roman Text," Information Interfaces and Presentation, Conference: 19th International Conference on Human-Computer Interaction with Mobile Devices and Services, Vienna, doi:10.1145/3098279.3098552, 2017.

[33] M. Kasunic, “Designing an Effective Survey,” Carnegie-Mellon University Pittsburgh of Software Engineering, The Software Engineering Institute is a federally funded research and development center sponsored by the U.S. Department of Defense. doi: 10.1184/R1/6573062.v1, 2005.

[34] S. Quatro, “Digital Communication Tools Used by Those 65 and Older : The Benefits and Barriers of Use,” Rochester Institute of Technology School of Communication College of Liberal Arts, Phd Thesis, Google scholar, 2020.

[35] Daniel Wayne Long, “Exploring generational differences in text messaging usage and habits,” Dissertation Abstracts International Section A: Humanities and Social Sciences, College of Engineering and Computing Nova Southeastern University, Phd Thesis, 2019.

[36] Connor Dodd, Rukshan Athauda, Marc Adam, “Designing user interfaces for the elderly: A systematic literature review,” Proceedings of the 28th Australasian Conference on Information Systems, doi:10.5772/intechopen.96775, 2017.

[37] Zunaira Illyas Bhutta, Javed Anjum Sheikh, Azeem Yousaf, “Usage of mobile phones amongst elderly people in Pakistan,” Advances in Intelligent Systems and Computing, Conference: International Conference on Applied Human Factors and Ergonomics doi:10.1007/978-3-319-60582-1_62, March 2018.

[38] Karen Renaud, Judy Van Biljon, “Predicting technology acceptance and adoption by the elderly: A qualitative study,” ACM International Conference Proceeding Series, doi:10.1145/1456659.1456684, 2008.

[39] Amanada Lenhart, “Teens, Smartphones & Texting,” Pew Research Center 2012, https://www.pewresearch.org/internet/2012/03/19/teens-smartphones-texting-2, Accessed [29-07-2022].

[40] Ioana Iancu and Bugdan Iancu, “Elderly in the Digital Era. Theoretical Perspectives on Assistive Technologies,” Technologies, volume5, Issue 3, Page, 60, 2017.

[41] Miguel Gómez Hernández, Elena Villalba-Mora, and Xavier Ferre, “Use of mobile phones and tablets amongst Spanish seniors: Barriers and motivations,” Proceedings of the 6th International Conference on Information and Communication Technologies for Ageing Well and e-Health, Spain doi: 10.5220/0009570400500058, 2020.

[42] Alexish Kuerbis, Adina Mulliken, Frederick Muench, Alison A. Moore, Daniel Gardner, “Older adults and mobile technology: Factors that enhance and inhibit utilization in the context of behavioral health,” Mental Health and Addiction Research, Volume 2, Issue 2, 2017.

[43] Ellen Brox, Luis Fernandaz Luque, Gunn J. Evertsen, Juan Hernandez, " Exergames for elderly: Social exergames to persuade seniors to increase physical activity," 2011 5th International Conference on Pervasive Computing Technologies for Healthcare and Workshops, doi:10.4108/icst.pervasivehealth.2011.246049, June 2011.

[44] Martina Ziefle and Susanne Bay, "How older adults meet complexity: Aging effects on the usability of different mobile phones," Behaviour and Information Technology, Volume 24, Issue 5, Pages 375-389, doi:10.1080/0144929042000320009, 2005.

[45] Christoph Nedopil, Cornelia Schauber, and Sebstian Glende, "Knowledge base stakeholders and their requirements," A collection of characteristics and requirements of primary, secondary, and tertiary users of AAL solutions, and a guideline for user-friendly AAL design, Publisher: Ambient Assisted Living Association 3, Rue de Luxembourg 1000 Brussels Belgium 2013.

[46] Shang Fen Chien, "Probing elders' needs for smart technologies in the domestic environment," The Association for Computer-Aided Architectural Design Research in Asia: Beyond Computer-Aided Design, Department of Architecture, National Cheng Kung University, Taiwan, 2008.

[47] Jorge Martin-Gutierrez, Martia Sylvia, "Analysing touchscreen gestures: A study based on individuals with down syndrome centred on design for all Sensors," Switzerland, Volume 21, Issue 4, Pages 13-28, 2021.

[48] "Telecom indicators, PTA," [Online]. Available: http://www.pta.gov.pk/index.php, [Accessed 27-07-2022].

[49] "Pakistan Telecommunication annual Report,"2019. [Online]. Available: https://www.pta.gov.pk /assets/media/pta_ann_rep_2019_27032020.pdf, [Accessed-29-07 2022].

[50] Mohiuddin, Hazwani., Nazlena Mohammad Ali "A study of smartphone usage and barriers among the elderly," In 2014 3rd International Conference on User Science and Engineering, IEEE, doi: 10.1109/IUSER.2014.7002686, 2014.

[51] Jia Zhou, Patrick Rau, Gavriel Salvendy, "Older adults' use of smart phones: an investigation of the factors influencing the acceptance of new functions,"Volume 33, Issue 6, Pages 552-560, doi: 10.1080/0144929X.2013.780637, 2013.

[52] Balakrishnan, "Does Tax Aggressiveness Reduce Corporate Transparency?", doi:10.2139/ssrn.1792783, SSRN Electronic Journal, 2012.

[53] Damasceno, Text neck and neck pain in 18-21-year-old young adults, Volume 27, Issue 6 doi: 10.1007/s00586-017-5444-5, 2018

[54] Jonathan Joe，George Demiris, "Older adults and mobile phones for health", Volume 46, Issue 5, Pages 947-954, doi: 10.1016/j.jbi.2013.06.008, 2013.

[55] Christopher Nedopil, Cornelia Schauber, Sebastian Glende, "A Collection of Characteristics and Requirements of Primary, Secondary, and Tertiary Users of AAL Solutions, and a Guideline for User-Friendly AAL Design," Available online: http://www.aal-europe.eu/wp-content/uploads/2015/02/AALA_Knowledge.pdf, 2017.

[56] Luciano Gamberini, Mariano Luis Alcañiz Raya., " Cognition, technology and games for the elderly," An introduction to ELDERGAMES Project, PsychNology Journal Volume 4, Issue 3, Pages 285-308, 2006.

[57] Martina Ziefle and Susanne Bay, "Mental models of a cellular phone menu. Comparing older and younger novice users," Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), LNCS 3160, Pages 25–37, 2004.

[58] "Public Health Agency of Canada, Division of Aging and Seniors, Age-Friendly Communication. Facts, Tips and Ideas," Available online: www.publichealth.gc.ca/seniors, 2016, Accessed [29-07-2022].

[59] Shalini Agarwal "Internet crime and the Elderly", New Jersey Law, International Journal of Scientific & Engineering Research, Volume 4, Issue 7, 2011.

[60] Nabat Arfi, Shalini Agarwal, "Assessment of knowledge of Cybercrime among Elderly across Residence", International Journal of Innovative Research &Studies, Volume 4, Issue 7, 2013.

[61] Ioana Iancu and Bugdan Iancu, Elderly in the Digital Era. Theoretical Perspectives on Assistive Technologies,Volume 5, Issue 3, doi: 10.3390/technologies5030060, 2017.

[62] Chernbumroong, ; Atkins.; Yu, Perception of Smart Home Technologies to Assist Elderly People. In Proceedings of the 4th International Conference on Software, Knowledge, Information Management and Applications, Paro, Bhutan, Pages 25–27, August 2010.

[63] Bran Knowles, Vicki L. Hanson, "The wisdom of older technology," ACM, 21 February 2018.

[64] Bran Knowles, Vicki L. Hanson, "Older Adults' deployment of distrust," Volume 6, Issue 3, Pages 72-77, doi: 10.1145/3179995, ACM, 09, August, 2018.

[65] Maldan Jovanovic, Antonella De Angeli, "User requirements for inclusive technology for older adults," Department of Psychology, North Umbria University, UK, Volume 37, Issue 20, Pages 1947-1965, doi: 10.1080/10447318.2021.1921365, 2021.

[66] Alisa Frik, Leysan Nurgalieva, Julia Bernd, Joyce S. Lee, Florian Schaub, Serge Egelman, "Privacy and Security Threat Models and Mitigation Strategies of Older Adults," Proceedings of 15th Conference on Usbale privacy and security, Santa Clara, CA, USA, 2019.

[67] Yang Hu, Yue Qian, "Protecting older adults mental health in pandemic," Springer, doi: 10.1136/bmj.o256, 28 -January-2022.

[68] Malihe Yazdani-Darki, Zahra Rahemi, Mohsen Adib-Hajbaghery, Fatemeh Sadat Izadi-Avanji, "Older Adults' barriers to use technology in daily life," Volume 9, Issue 4, Pages 229-236, November 1, 2020.

[69] Jackie Rubenson, "With older African Americans," 2018.

[70] "Ageing population in Pakistan | HelpAge Asia," https://ageingasia.org › Ageing population, [Accessed June, 2021].

[71] Petra Lietz , "Research into questionnaire design: A summary of the literature International Journal of Market Research Volume 52, Issue 2, 2010.

[72] Brace Ian, "Questionnaire Design. How to Plan, Structure and Write Survey Material for Effective Market Research", London, 3rd edition, 2004.

[73] Holbrook, Johnson, "The impact of question and respondent characteristics on comprehension and mapping difficulties", Public Opinion Quarterly, Volume 70, Issue 4, Pages 565-595, 2006.

[74] Zoltan Dörnyei," Questionnaires in Second Language Research. Mahwah", Lawrence Erlbaum, doi: 53407-1001, 2003.

[75] White, Jennings, Renwick, Barker, "Questionnaires in ecology: a review of past use and recommendations for best practice", Journal of Applied Ecology, Volume 42, Issue 3, Pages 421–430, 2005.

[76] Bhandari, Wagner, "Self-reported utilization of health care services: measurement and accuracy", Medical Care Research and Review, Volume 63, Issue 2, Pages 217–135, 2006.

[77] Weems, Onwuegbuzie, Lustig, "Profiles of respondents who respond inconsistently to positively and negatively worded items on rating scales", Paper presented at the Annual Meeting of the Mid-South Educational Research Association, Chattanooga, Volume 6, Issue 8, Pages 33, November 2002.

[78] Baker, “Data collection – questionnaire design”, Marketing Review, Volume 3, Issue 3, Pages 343–370, 2003.

[79] Fife-Schaw, Smith, “Questionnaire design. In Research Methods in Psychology”, Thousand Oaks, 3rd edition, Pages 210–231, 2006.

[80] O’Muircheartaigh, Gaskell, Wright, Weighing anchors, “verbal and numeric labels for response scales”, Journal of Official Statistics, Volume 11, Issue 3, Pages 295–307, 1995.

[81] Rammstedt, Krebs, “Response scale format and answering of personality scales”, European Journal of Psychological Assessment, Volume 23, Issue 1, Pages 32–38, 2007.

[82] Prof. Sher Muhammad Chaudhry, Dr. Shahid Kamal, “Introduction to statistical theory,” 6th edition, 2015-2016.

[83] Fiona Middleton, “The four types of validity”, Scribbr, https://www.scribbr.com/methodology/types-of-validity/, February 24, 2022.

[84] Andraž Petrovčič, Sakari Taipale, Ajda Rogelj & Vesna Dolničar, “Design of Mobile Phones for Older Adults: An Empirical Analysis of Design Guidelines and Checklists for Feature Phones and Smartphones”, International Journal of Human–Computer Interaction, Volume 34, Issue 3, Pages 251-264, doi: 10.1080/10447318.2017.1345142, 2017.

[85] Karoline Blendinger, Prof. Dr. Manfred Reichert, Dr. Vera Künzle, “Tablet-Applications for the Elderly: Specific Usability Guidelines”, Faculty of Engineering and Computer Science Institute of Databases and Information Systems Ulm University, Germany, 2015.

[86] Caprani, O’Connor, Gurrin, “Touch screens for the older user”, Assistive technologies, Centre for Sensor Web Technologies Ireland, Pages 104–128, 2012.

[87] Abdul Razak, Adnan, Ahmad, “How simple is simple: Our experience with older adult users”, In Proceedings of the 11th Asia Pacific Conference on Computer Human Interaction Pages379–387. New York, NY: ACM, doi:10.1145/2525194.2525307, 2013.

[88] Boustani, “Designing touch-based interfaces for the elderly, Bachelor’s thesis,” Sydney, Australia: University of Sydney, 2010

[89] Gao, Ebert, Chen, Ding, “Design of a mobile social community platform for older Chinese people in Urban Areas”, Human Factors and Ergonomics in Manufacturing & Service Industries, Volume 25, Issue 1, Pages 66–89, 2015.

[90] Zhou, Rau, Salvendy, “Use and design of handheld computers for older adults: a review and appraisal”, International journal of human–computer interaction, Volume 28, Issue 12, doi: 10.1080/10447318.2012.668129, 13 December 2017.

[91] Sulaiman, Sohaimi, “An investigation to obtain a simple mobile phone interface for older adults, In 2010 International Conference on Intelligent and Advanced Systems (ICIAS) Pages 1–4, Kuala Lumpur, Malaysia, doi: 10.1109/ICIAS.2010.5716254, 2010.

[92] Armstrong, Nugent, Moore, Finlay, “Using smartphones to address the needs of persons with Alzheimer’s disease”, Annals of Telecommunications, Volume 65, Pages 485–495, doi: 10.1007/s12243-010-0165-3 , 2010.

[93] Chen, Chan, Tsang, “Usage of mobile phones amongst elderly people in Hong Kong”, Proceedings of the International Multi Conference of Engineers and Computer Scientists March 13–15, 2013, Hong Kong, Volume 2, Pages 1016–1019, 2013.

[94] Pijukkana, Sahachaisaeree, “Factor determining functional perception on technology-driven product design: A case study on mobile phone for the elderly”, Procedia - Social and Behavioral Sciences, Volume 5, Pages 1288–1293, 2010.

[95] Rafael Xavier E. de Almeida, Simone Bacellar Leal Ferreira, Horacio Pastor Soares, “Recommendations for the development of Web interfaces on Tablets/iPads with Emphasis on Elderly Users”, Science direct , Volume 67, Pages 140-149, doi: S187705091503104X, 2015.

[96] Motti, Vigouroux, Gorce, “Interaction techniques for older adults using touchscreen devices: A literature review”, In Proceedings of the 25th IEME Conference Francophone on L’Interaction Homme-Machine, Pages 125–134, New York, ACM, 2013.

[97] Anshebo Mekonnen ,90% Confidence Interval Acceptable?. Addis Ababa University 2019, https://www.researchgate.net/post/90-Confidence-Interval [Accessed 29-07-2022].

[98] Ayyub, “A practical guide on conducting expert-opinion elicitation of probabilities and consequences for corps facilities,” Inst. Water Resour. Alexandria, VA, USA, Phd Thesis, January, 2001.

[99] Experience ux, “What is an expert review?” https://www.experienceux.co.uk ›, Accessed [27-07-2022].

## APPENDIX A

### SBVIN'S FORMULA FOR SAMPLE SIZE

$$n = \frac{N}{(1 + Ne^2)}$$

Where,

n=Sample size

N=Total population

e=Tolerance level (error)

If we take 90% confidence interval

e=1-0.90

e=0.1

$$n=\frac{16{,}000000}{(1+16000000(0.1)^2)}$$

$$=\frac{16000000}{(1+160000)} \qquad =\frac{16000000}{(160001)}$$

n=100

if we take 95% or 98% confidence interval than the sample size will be 300 and above. But this study used 90% confidence interval. 95% confidence interval is widespread but in social sciences 90% confidence interval can also be used especially when the population size is small. Decreasing confidence level below 90% is not recommended [97].

## APPENDIX B

### SURVEY: ROMAN URDU TEXTING ISSUES FACED BY OLDER USERS

Please take a few minutes to complete this survey. This research data is being collected by Mubarra Zainab, MS Software Engineering Student, Department of Software Engineering, National University of Modern Languages Islamabad for her thesis. Your participation in data collection is worthy and considerable. Your information would remain anonymous during research data compilation, but your views, in combination with those of others, are extremely important. So, your response will be very valuable to us. The estimated completion time of this survey is 10 minutes.

**Demographic Questions**

**1. Gender**

**O** Male

**O** Female

**2. Occupation**

**O** Working

**O** Not working

**3. Age**

**O** 60-70

**O** 71-80

**O** 80+

**4. Qualification**

**O** Matric

**O** Intermediate

**O** Graduation

**O** Master

**Core Questions**

1) Does lack of technology knowledge is a challenge for texting?

1) کیا ٹیکنالوجی کے علم کی کمی میسج کرنے میں رکاوٹ ہے؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

2) Does illiteracy is a challenge for texting?

2)کیا ان پڑھ ہونا میسج کرنے میں رکاوٹ ہے؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

3) Do you have trust issues while texting?

3) کیا آپ کو میسج کرتے وقت اعتماد کے مسائل ہیں؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

4) Does texting is waste of time, bad and annoying activity?

4) کیا میسج کرنا وقت کا ضیاع، فضول اور پریشان کن کام ہے؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

5) Does texting communication is weird?

5) کیا میسج پر بات چیت کرنا عجیب ہے

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

6) Does texting fit in your daily routine life?

6) کیا میسج کرنا آپ کی روز مرہ زندگی میں موزوں ہے؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

7) Do you receive low encouragement from society towards texting?

7) کیا آپ کو میسج کرنے کیلیئے معاشرے کی طرف سے کم حوصلہ افزائی ملتی ہے؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

8) Do you receive a smaller number of texts from friends and family?

8) کیا آپ دوستوں اور خاندان کے افراد کی طرف سے بہت کم میسج وصول کرتے ہیں؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

9) Does texting increase a mental work load?

9) کیا میسج کرنے سے دماغی کام بڑھ جاتا ہے؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

10) Do you require extra time or steps for writing a text?

10) کیا آپ کو میسج لکھنے کیلئے اضافی وقت اور اقدامات کی ضرورت ہوتی ہے؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

11) Do you have texting applications interface issues?

11) کیا آپ کو میسج ایپلیکیشنز کے ڈیزائن کے مسائل کا سامنا ہے؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

12) Do you prefer calling over texting?

12) کیا آپ میسج کرنے کی نسبت کال کرنے کو ترجیح دیتے ہیں؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

13) Do you prefer buttons over the virtual keyboard?

13) کیا آپ بٹن کی بورڈ کو ٹچ کی بورڈ پر ترجیح دیتے ہیں؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

14) Do you like auto-fill and auto-correct features?

14) کیا آپ کو خود کار درستگی کی سہولت پسند ہے؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

15) Do you like updates in texting application?

15) کیا آپ کو میسج ایپلیکیشن میں نئی تبدیلیاں پسند ہیں؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

16) Do you prefer simple functionality of texting applications?

16) کیا آپ میسج ایپلیکیشن کی سادہ خصوصیات کو ترجیح دیتے ہیں؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agree

17) Does limited physical stamina affect texting?

17) کیا محدود جسمانی صلاحیت میسج کرنے کو متاثر کرتی ہے؟

**O**Strongly Disagree **O**Disagree **O**Neutral **O**Agree **O**Strongly Agre

## APPENDIX C

## CHI-SQUARE STATISTICS

### Chi -square test of independence

This study collected data from 120 older users of Pakistan. For each person this study investigated the usage of mobile phone texting applications and whether or not they have Roman urdu texting issues (agreed/disagreed).

The observed frequencies are given in the following table.

**Table 4.6:** Observed Frequency

| Older users | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 | Q16 | Q17 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Strongly Disagree | 1 | 0 | 4 | 4 | 1 | 8 | 5 | 2 | 3 | 2 | 2 | 1 | 5 | 17 | 25 | 2 | 1 | 83 |
| Disagree | 9 | 12 | 19 | 37 | 34 | 40 | 24 | 14 | 13 | 12 | 20 | 7 | 19 | 44 | 44 | 7 | 17 | 327 |
| Agree | 70 | 52 | 51 | 41 | 43 | 43 | 50 | 64 | 53 | 68 | 53 | 40 | 53 | 28 | 21 | 60 | 56 | 846 |
| Strongly Agree | 34 | 46 | 12 | 24 | 14 | 5 | 12 | 31 | 34 | 27 | 30 | 62 | 35 | 13 | 10 | 39 | 30 | 458 |
| Total | 114 | 110 | 86 | 106 | 92 | 96 | 91 | 111 | 103 | 109 | 105 | 110 | 112 | 102 | 100 | 108 | 104 | 1759 |

i. The null and alternative hypothesis of this study are

$H_0$: Older users have not Roman Urdu texting issues. (Independent)

$H_1$: Older users have Roman Urdu texting issues. (Dependent)

ii. The significance level at $\alpha = 0.05$

iii. The test statistics to use is

$$\chi^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{(oij - eij)^2}{eij}$$

Where degree of freedom (4-1) (17-1) = 3x16=48

iv. At first this study calculated the expected frequencies under the null hypothesis of independence for each cell by the formula.

$$\mathbf{e}_{ij} = \frac{(Ai)(Bj)}{n} = \frac{(ith\ Row\ total)(jth\ Column\ total)}{total\ number\ of\ observations}$$

The expected frequencies are given in the following table.

**Table 4.7:** Expected Frequency

| Older users | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 | Q16 | Q17 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Strongly Disagree | 5.3 | 5 | 4.2 | 5 | 4.3 | 4.5 | 4.2 | 5.2 | 5 | 5.1 | 5 | 5.1 | 5 | 5 | 5 | 5 | 5 | 83 |
| Disagree | 24.1 | 23 | 18.2 | 22 | 19.4 | 20.3 | 19.2 | 23.4 | 22 | 23.2 | 22.2 | 23.2 | 24 | 21.5 | 21 | 23 | 22 | 327 |
| Agree | 55 | 53 | 41.3 | 51 | 44.2 | 46.1 | 44 | 53.3 | 49 | 52.4 | 50.5 | 53.1 | 54 | 49 | 48 | 52 | 50 | 846 |
| Strongly Agree | 29.6 | 29 | 22.3 | 28 | 24.1 | 25.1 | 23.6 | 29.1 | 27 | 28.3 | 27.3 | 28.6 | 29 | 26.5 | 26 | 28 | 27 | 458 |
| Total | 114 | 110 | 86 | 106 | 92 | 96 | 91 | 111 | 103 | 109 | 105 | 110 | 112 | 102 | 100 | 108 | 104 | 1759 |

Chi-square statistics are in table 4.8.

**Table 4.8:** Chi-square Calculation

| oij | eij | oij-eij | $(oij-eij)^2$ | $(oij-eij)^2$ / eij |
|---|---|---|---|---|
| 1 | 5.3 | -4.3 | 18.4 | 4 |
| 0 | 5 | -5 | 26 | 5 |
| 4 | 4.2 | -0.2 | 0.04 | 0 |
| 4 | 5 | -1 | 1 | 0 |
| 1 | 4.3 | -3.3 | 10.8 | 3 |
| 8 | 4.5 | 3.5 | 12.2 | 3 |
| 5 | 4.2 | 0.8 | 0.6 | 0 |
| 2 | 5.2 | -3.2 | 10.2 | 2 |
| 3 | 5 | -2 | 4 | 1 |
| 2 | 5.1 | -3.1 | 9.6 | 2 |
| 2 | 5 | -3 | 9 | 2 |

| oij | eij | oij-eij | $(oij-eij)^2$ | $(oij-eij)^2$ / eij |
|---|---|---|---|---|
| 1 | 5.1 | -4.1 | 16.8 | 3 |
| 5 | 5 | 0 | 0 | 0 |
| 17 | 5 | 12 | 144 | 31 |
| 25 | 5 | 20 | 400 | 87 |
| 2 | 5 | -3 | 9 | 2 |
| 1 | 5 | -4 | 16 | 3 |
| 9 | 24.1 | -15.1 | 228 | 9 |
| 12 | 23 | -11 | 125.4 | 5 |
| 19 | 18.2 | 0.8 | 0.64 | 0 |
| 37 | 22 | 15 | 213.1 | 9 |
| 34 | 19.4 | 14.6 | 213.1 | 11 |
| 40 | 20.3 | 19.7 | 388 | 19 |
| 24 | 19.2 | 4.8 | 23 | 1 |
| 14 | 23.4 | -9.4 | 88.3 | 4 |
| 13 | 22 | -9 | 81 | 4 |
| 12 | 23.2 | -11.2 | 125.44 | 5 |
| 20 | 22.2 | -2.2 | 4.8 | 0 |
| 7 | 23.2 | -16.2 | 262.4 | 11 |
| 19 | 24 | -5 | 25 | 0 |
| 44 | 21.5 | 22.5 | 506.4 | 23 |
| 44 | 21 | 23 | 524.4 | 25 |
| 7 | 23 | -16 | 256 | 11 |
| 17 | 22 | -5 | 25 | 1 |
| 70 | 55 | 15 | 225 | 4 |
| 52 | 53 | -1 | 1 | 0 |
| 51 | 41.3 | 9.7 | 94.09 | 2 |
| 41 | 51 | -10 | 100 | 2 |
| 43 | 44.2 | -1.2 | 1.44 | 0 |
| 43 | 46.1 | -3.1 | 9.61 | 0 |
| 50 | 44 | 6 | 36 | 1 |
| 64 | 53.3 | 10.7 | 11.49 | 2 |
| 53 | 49 | 4 | 16 | 0 |
| 68 | 52.4 | 15.6 | 243.36 | 5 |
| 53 | 50.5 | 2.5 | 6.25 | 0 |
| 40 | 53.1 | -13.1 | 171.61 | 3 |
| 53 | 54 | -1 | 1 | 0 |
| 28 | 49 | -21 | 441 | 9 |
| 21 | 48 | -27 | 729 | 15 |
| 60 | 52 | 8 | 64 | 1 |
| 56 | 50 | 6 | 36 | 1 |
| 34 | 29.6 | 4.4 | 19.36 | 0 |
| 46 | 29 | 17 | 289 | 10 |
| 12 | 22.3 | -10.3 | 106.09 | 5 |
| 24 | 28 | -4 | 16 | 0 |
| 14 | 24.1 | -10.1 | 102.01 | 4 |
| 5 | 25.1 | -20.1 | 404.01 | 16 |
| 12 | 23.6 | -11.6 | 134.56 | 6 |
| 31 | 29.1 | 1.9 | 3.61 | 0 |

| oij | eij | oij-eij | $(oij-eij)^2$ | $(oij-eij)^2$ / eij |
|---|---|---|---|---|
| 34 | 27 | 7 | 49 | 2 |
| 27 | 28.3 | -1.3 | 1.69 | 0 |
| 30 | 27.3 | 2.7 | 7.29 | 0 |
| 62 | 28.6 | 33.4 | 1115.56 | 39 |
| 35 | 29 | 6 | 34.8 | 1 |
| 13 | 26.5 | -13.5 | 182.2 | 7 |
| 10 | 26 | -16 | 256 | 10 |
| 39 | 28 | 11 | 118.8 | 4 |
| 30 | 22 | 3 | 9 | 0 |
| ∑=1759 | ∑=1759 | | | $\chi^2$=435 |

v. **Calculation of p value.** Using chi square value $\chi^2$=435 and degree of freedom df=48 at significant level 0.05 the calculated p value is 0.00001. p value of this study 0.00001 (0.001%) shows that there are 0.001% chances that results could be random (i.e., happened by chance).

vi. **Conclusion.** Since the calculated p value is less than significant level 0.05 so this study rejects null hypothesis of independence. Data provides evidence of statistical association between older users and Roman Urdu texting issues. This statistical test concluded that older users often face Roman Urdu texting issues.

## APPENDIX D

## EXPERT REVIEW EVALUATION FORM

### SECTION I

### INVITATION LETTER

Respected Sir,

It is stated that my name is Mubbara Zaneb and I am doing Masters in Software Engineering from the National University of Modern Languages, H-9, Islamabad. I am a research student and my research is based on a topic titled: "A Study on Roman Urdu Texting Issues Faced by Older Users". My first research question is about the investigation of Roman Urdu texting issues So, for that purpose, firstly i have conducted literature review and investigated a list of approximately 40 texting issues. Secondly, I have conducted survey for the investigation of Roman Urdu texting issues. The second research question is about the investigation of guidelines. For that purpose, I have conducted literature review and investigated a list of 18 guidelines. For investigated guidelines, Expert Review is needed. So, please kindly, spare some time for validating my second research question. I shall be very thankful to you.

Yours' sincerely;

Mubbara Zaneb

Department: Software Engineering

### SECTION II

### PERSONAL INFORMATION OF EXPERT REVIEW

**Name:**

**Designation:**

**Year of Experience:**

**Domain:**

## SECTION III

### TASKS TO BE PERFORMED BY REVIEWEE

**Task 1:** To validate the investigated guidelines from the literature.

## SECTION IV

### Guidelines

- Provide hardware keyboard facility to enter long text sequences [84,85].
- The device should be big, enable a comfortable grip, and be lightweight [84,85].
- To prevent cognitive overload, introduce simple features [84].
- Present the information in blocks to minimize working memory load [84].
- Facilitate with text to speech feature [84].
- Avoid distracting visual stimuli and non-relevant information [85].
- Provide language-based error correction facility [85].
- Avoid features which decline visual capacity [85].
- Zoom options and font size increase option is desired for older users [86].
- The keys of a software keyboard to enter textual data should be wider than taller [86,87].
- Simple and meaningful icons without decoration and animation [88].
- Use appropriate colours with high contrast [86,89].
- Menu structure must be simple and consistent [90,91].
- Small size of a phone's display may hinder navigation [90,92].
- Foreign expressions, abbreviations, and technical terms should be avoided in menus [93,94].
- The spacing between adjacent buttons in a row should 6,35 mm maximum. As this is appropriate for dexterity issues [85,90].
- Minimize the number of steps to complete a task [95].
- Don't force the user to keep information in mind for too long [90,96].