



Designing User Interface for an Elderly-Muslim-Friendly Mobile Application

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Abstract. There are many mobile applications that are used in the daily lives of Muslims to fulfill their obligations and Islamic lifestyle. However, the user interface of most of these mobile applications has been found to have certain issues with elderly users, in other words, not elderly-friendly. The usability challenges that are faced by older adults when using regular applications include physical challenges, visual problems and issues related to their cognitive ability at their age. This study aims to derive the design guidelines from past studies focusing on addressing common physical and cognitive challenges for elderly people in using regular mobile applications to be implemented in the user interface design of an Islamic mobile application. Several existing Islamic mobile applications are analyzed before developing a prototype of an elderly-Muslim-friendly mobile application based on the design guidelines. Usability evaluation of this prototype is conducted to provide empirical findings on such design guidelines that can be implemented in designing an elderly-Muslim-friendly mobile application. The results affirmed the design guidelines that can be used in the development of Islamic mobile applications that cater for the elderly people. This study contributes in providing a better understanding of the design guidelines that can be implemented in such applications.

Keywords: Design guidelines · Mobile application · Elderly-Muslim-Friendly · Usability evaluation

1 Introduction

It is much easier nowadays to go through daily life with the advancement of technology such as smartphones. The development of mobile applications throughout recent years has been so significant as many of the software applications are helpful in assisting daily routine or tasks. As smartphones are easy to navigate for the young generation, it might be a bit difficult for the elderly to adapt and navigate themselves using the mobile application that is made suitable for most of the younger ones. The reason is because the younger generations are born in the era where most people have access to at least a device, referred as digital native whereby they are better at handling and

adapting to modern technology such as smartphones and mobile applications [1]. As for the elderly, they are called digital immigrants as they have been so much familiar with the old technology such as radio and classic television for a longer period and now, they need to get familiar with more advanced modern information technology systems [1]. Thus, this has been keeping them from getting out of their comfort zone. Such a barrier of different technology appeared between modern devices and classic devices.

Mobile applications are made available for most of the people but the elderly people have some challenges to get along with the functionality of the applications. The percentage of old age is increasing globally. As mentioned in [2], the percentage will increase by 14.5% in Year 2040 in Malaysia with the majority of its population are Muslims. Therefore, this study aims to derive the design guidelines from past studies focusing on addressing some of the challenges for elderly people in using mobile applications to be implemented in Islamic mobile application design. A prototype of an elderly-Muslim-friendly mobile application is developed based on these guidelines and usability evaluation is conducted to provide empirical findings on such design guidelines that can be implemented to overcome the challenges faced by Muslim elderly people.

2 Literature Review

The existing guidelines for user interface design is based on the younger people or people that are aged 60 years or younger. This issue is getting a lot of attention because the elderly people also need to have the same experience of the usability of a mobile application. Thus, the literature is initially surveyed in finding proper guidelines in designing the user interface of an Islamic mobile application for elderly people. As research in Islamic mobile application is scarce and many usability problems of mobile applications are also faced by older adults when using Islamic mobile applications as found in [3], the literature is reviewed for design guidelines of mobile applications not focusing on the Islamic ones. The review will help to grasp more understanding in developing suitable applications that can be focused on the Muslim elderly. Several existing Islamic mobile applications are also analyzed to determine suitable features that can be implemented in our prototype.

2.1 Impact of the Current Design Guideline for Elderly

A good design guideline is crucial to develop a good application especially for a development team that consists of novice developers [4]. Thus, design guidelines specialized for elderly is much needed to facilitate developers to design user interface that can help elderly to have a better interaction with the mobile applications [5]. Biljon and Renaud [6] stated that several guidelines have been developed for designing interfaces for older mobile phone users, but there is little evidence that they can be used successfully.

Difficulties in understanding a guideline and contradictions between existing guidelines [4] are the challenges that need to be confronted. Chang et al. [5] stated that challenges of designing mobile application for elderly must be identified first before setting a guideline to overcome them during the application development. Developers

Table 1. Summary of challenges for elderly [5]

Challenges	
Physical	Visual impairments
	Haptic deterioration
	Reduced hearing
Cognitive	Memory
	Speed
	Coordination of mental services

need to be more aware of elderly cognitive ability when they are using mobile application [4]. Generally, user interface designers do not have the chance to include elderly as one of the considerations [7]. This led to failure in designing elderly-friendly interfaces. Therefore, a better designed user interface is crucial to overcome this matter. It is also important such that it will help elderly to have better interaction when using the mobile application [5].

Understanding the concept of human-computer interaction (HCI) can help to solve these challenges [7] since this concept can be described as a discipline that exercises software engineering practices in terms of design, evaluation, and implementations of interactive computer system and human use.

2.2 Challenges of Designing Mobile Application for Elderly

Several challenges have been identified by several studies regarding developing applications for elderly. Designing mobile user interface for elderly is challenging in terms of accessibility as well as usability [4].

The important part is to tackle the problems that are related to elderly when they are using mobile applications that are developed without considering their limitations. Chang et al. [5] stated in their findings that designing user interface for elderly can be categorized as physical and cognitive issues. It is well known that a person's physical ability will decline proportionally to growth. While most studies address at least two major challenges in designing applications for elderly, [8] listed three challenges namely physical issues, computer experience and cognitive issues. Iancu and Iancu [9] also stated three major problems similar with [8]. In [9], they divide physical issues into two categories; sensory problems and motor problems and the cognitive issues as the third problem in common.

2.2.1 Physical Challenge

Physical challenges are easier to handle compared to cognitive challenges [5]. However, design guidelines related to cognitive ability are not completely studied. Summary of challenges in designing for elderly is shown in Table 1.

Older adults commonly will experience worn physical conditions that affected their daily life such as visual problems, worsen sense of touch, and problems in listening.

For example, it is harder to tap on icons with decreasing motor skills and holding a device with only a hand makes it uncomfortable with rheumatoid arthritis disease [10]. Multiple sclerosis, Parkinson's disorder, Huntington's disease is some of the example [9] illness due to aging that affected elderly in their movement control. These diseases caused their movement to be less precise and decrease in the muscle mass and strengths is also contributed to this case.

Changes in muscle movement, sensory processing, and cognitive function will be essential for effective technology design [8]. Older adults with a change in motor behaviour take longer to perform the same movements than younger adults. These changes affect the elderly's ability to control or operate the device.

2.2.2 Cognitive Challenge

Cognitive changes affect the ability to learn and retain information [8]. The declining ability of cognitive in the elderly can make it difficult to learn new features and steps. Cognitive problems are more difficult to handle than physical problems. For example, listening difficulties can be resolved easily by adjusting the volume of the phone.

Older adults commonly having cognitive impairment is a typical symptom in older adults before they are diagnosed with cognitive mental illness [10]. Existing mobile app interfaces follow a universal design concept and are not specifically designed to accommodate older users. Wildenbos et al. [10] stated in their study that elderly's ability to use new technology are affected when there is a decline in their own perception and effectiveness. Mostly, elderly people face more and more age-related problems in their daily lives.

Cognitive decline is inevitable with aging. The elderly is at an increased risk for cognitive decline such as Alzheimer's disease. Early symptoms of the disease include loss of memory, difficulty in decision making, and dementia. At the cognitive level, especially attention, working memory (ability to keep information active) and potential memory (the ability to do something in the future) of time-based tasks, are affected by age [9]. It is obvious from these characteristics of elderly that the challenge for them to understand large amounts of information at once or changes in screen is not a small problem.

Cognitive function is crucial to navigate through menu selections successfully. Elderly people have degenerative diseases that can affect their physical and cognitive abilities [11]. It is a hassle to design an interface that suits older people's usability, especially for those who are not familiar in using such technology. This cannot be the obstacle that will remove the effort to create a design which is also fit for elderly's use. Restyandito et al. [11] mentioned that a lot of novices and seniors' designers might not have sufficient awareness with the degenerative cognitive capacity of older adults.

Elguera Paez and Zapata Del Río [7] mentioned in their study that it is generally accepted that the capacity of working memory significantly declines with age. When it comes to long-term memory, however, this decline is not global. While semantic memory is negligible, age-related loss is episodic, and procedural memory is common. In addition, deficits in the ability to remember to carry out an intended action are common in older people. In the situation of unfamiliar layout of user interface, it causes many people to get confused when processing the displayed information. As a consequence, user blame

themselves to be problematic rather than blaming the application itself [7]. An effective interface is the one that helps users to achieve their goals with a little confusion and as few errors as possible.

2.3 Existing Islamic Mobile Applications

Existing Islamic-related mobile applications are analyzed to determine suitable features and content before developing a prototype of an elderly Muslim friendly mobile application. These apps are searched from Google Play Store for an android based application.

2.3.1 The Noor

The Noor app is a Muslim lifestyle application developed to ensure Muslims around the world use the features of the application for their daily routine to embrace the Islamic lifestyle. It enables users to listen to their favourite Surah on the go player. It also helps to find the Qiblah with real-time location detection guide to the nearest mosque or musolla.

2.3.2 Raudhah

Raudhah is an app developed by Media Prima Digital with unique features compared to other Muslim-related applications, namely the in-app video access of religious television program such as Al Kuliyyah and Halaqah. Other than that, this application also provides features such as prayer time based on user specific location, adzan notifications, zikir as an act of remembrance and nearest mosques and halal restaurants recommendation and directions.

2.3.3 Muslim Go

This is an app that provides accurate local prayer time and adzan, qiblah direction and even able to read the Quran online and offline.

2.3.4 Muslim Pro

Muslim Pro is an application that consists of features such as adzan with notifications, Quran and zikir for users to recite. This application aims to connect Muslims Worldwide and to create positive impact on the lives of Muslims in their daily life.

3 Methodology

In this study, the mobile application design guideline is refined from literature review as depicted in Table 2. Bong et al. [12] covers the literature review of studies focusing on tangible user interface for elderly's social interaction where some of these findings could be applied in the prototype development. Another comprehensive analysis of design guidelines of mobile phones for elderly people has been done by [13] that constitutes many citations and can be considered in the prototype development. Aranyanak and

Table 2 Mobile Application Design Guidelines

Proposed guidelines		Sources
Visual		
Font Style	Arial, Courier, CMU, Helvetica, Verdana	[12–14]
Font Size	12-16pt	[12]
Icon	<ul style="list-style-type: none"> • 48dp • 72 pixels and 96 pixels • Labelled icon and concrete icon • Big size icon • Simple and meaningful icon • Proper spacing between icons (avoid pressing the wrong icon) 	[12, 13]
Colour	<ul style="list-style-type: none"> • High colour contrast between background and foreground • Avoid the use of blue, green and yellow adjacently • Achieve balanced design of user interface with sufficient white space 	[13, 14]
Navigation		
<ul style="list-style-type: none"> • Clear navigation on every page • Explicit and consistent step-by-step navigation • Easy-to-understand navigation cues and easy for users to detect and fix errors (if any) • Provide errors message which notifying the errors are not caused by the user • Permit easy reversal of actions (e.g., undo icon) • Grid menu • No scrolling 		[14]
Content		
<ul style="list-style-type: none"> • Design for top-down interaction • Simple and well-organized content • No unwanted information on the screen • Updated content for user • Consistency in content making for easy understanding • Give specific and clear instructions • An action with explicit meaning of words or verbs 		[13]

(continued)

Charoenporn [14] has proposed the UX-based design of mobile application for Thai elderlies that is also considered in the prototype development since it is the neighbouring country with possibly similar attributes. Some of these guidelines are implemented in the development of a prototype of an elderly-Muslim-friendly mobile application called Telunjuk, utilizing common features that are found in existing Islamic mobile applications that have been analyzed. Subsequently, a usability evaluation technique of user-based method is conducted to affirm the design guideline for such application [15].

Table 2 (continued)

Proposed guidelines	Sources
Cognitive	
Memory	<ul style="list-style-type: none"> ● Direct design, avoid any recall activity(s) (to reduce short term memory load) ● Use simple words and vocabulary that suit the elderly understanding ● No parallel information at the same time ● Focus on one activity at a time ● Avoid the use of animation
Speed	<ul style="list-style-type: none"> ● Provide enough time to process the information ● Provide less option to select from so that it is easier to recognize the menu direction ● Avoid the use of fast-moving objects
Coordination and mental activities	<ul style="list-style-type: none"> ● Avoid pop-up notifications ● Regular feedback

3.1 Prototype Development

From the analysis of the four apps that has been conducted, a prototype is developed with the common features derived from existing Islamic mobile applications namely prayer time, Quran, zikir, qiblah direction, mosque/musolla finder and adzan. The prototype is developed according to the proposed design guideline which comprised design elements of cognitive, visual and navigation. All these elements are refined from the literature review and analysis of existing applications to design better experience to the elderly so that they can use the application to the full extent of the features and benefits of using mobile application to help them fulfill their daily routine and obligations as a Muslim.

3.2 Usability Evaluation

After the prototype has been developed, a usability evaluation technique of user-based method is conducted to affirm the design guideline for such application. It is conducted in the form of interview session to gauge users' perceptions on the usability of such application. Proper ethical guidelines were followed in this study.

Three elderly people aged between 60 and 65 years old (two males and one female) participated in this study. Then two participants of the same age range (one male and one female) have also participated in another session but following the same procedure as before. Therefore, a total of five participants took part in the evaluation and as recommended in [16], having five participants can identify issues in a design. Participants were first provided an informed consent form about the conduct in terms of handling data privacy and all of them have agreed.

They were briefed regarding the interview session details to make sure that they understand the purpose of the study and know the tasks that they had to perform.

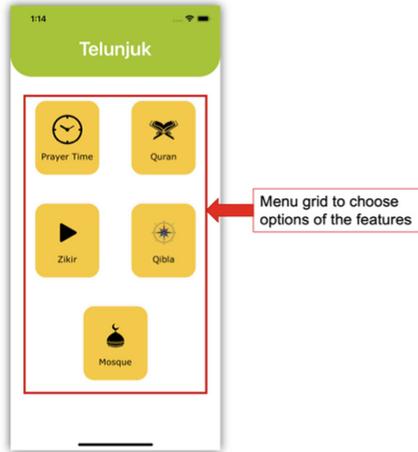


Fig. 1. Menu grid

Later, the elderly were asked to use *Telunjuk* without any guidance beforehand. Findings from the observation are noted and recorded for further data refinement.

After they have finished going through it, they were interviewed in the effort to comprehend the level of their cognitive, visual and navigation capabilities during the usability evaluation. The interview was semi-structured whereby an interview guide has been prepared based on common attributes in usability evaluation such as ease of use, efficiency and satisfaction.

4 Result and Discussion

The results of the usability evaluation will be analyzed in this section with further discussion.

It is found that the elderly does not have any difficulty in understanding that the grid menu (Fig. 1) is the option for the features of the application. They instantly know that they need to choose from the menu grid to get into specific features.

They responded well to one of the interview questions which asks about the visibility of the icon and feature that the icon represents as depicted in Fig. 2. All of them indicate that it is much easier to identify the function by representing them with simple icon and label them accordingly.

From the observation made at the time when they came across the *Zikir* function or screen, it was a surprise for them to see a button for scrolling purpose (Fig. 3). In the interview afterwards, they mentioned that usually they need to move their fingers up and down to navigate from top to bottom which also caused confusion and made them forget where they were at before that. The same observation and feedback was obtained with the other two participants as they found the scroll button as something handy (Fig. 4).

A font family that is recommended in the guideline is *Verdana*. This font family proves to be suitable for the elderly to read. The font size recommended by the guideline is

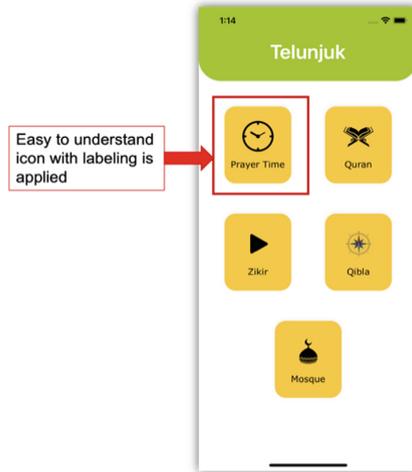


Fig. 2. Labelled icon

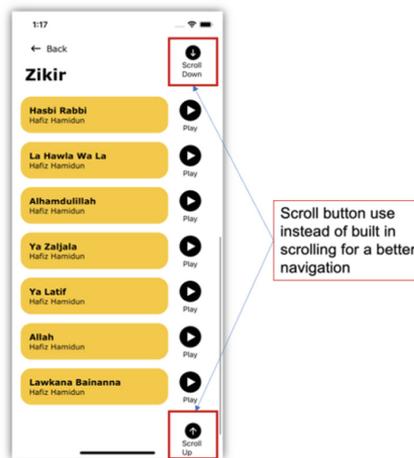


Fig. 3. Scroll button

between 12–16pt which 16pt is used as it is the largest font recommended. All participants were satisfied with this. All of them stated that they had trouble using other applications as some of those applications use fancy type of fonts and smaller in sizes. As such, it has been difficult for them to understand the words in these other applications.

Overall, the elderly people found the application to be having the desired usability attributes. They seemed to have better understanding of the application without taking too much time to think and adapt. This shows that elderly people were able to use the application with ease. They had no complaint on having difficulty to read the words or to understand them. The consistency in labelling all the icons guided them well to

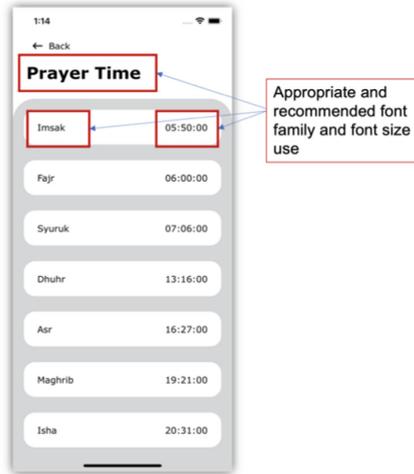


Fig. 4. Font family and size

choose and navigate through the application. This shows that the navigation structure is able to be followed by the participants. Additionally, they felt that there was not much thinking and remembering needed with less options that are placed in the screen one at a time that is found to be suitable since their cognitive ability to process many things and remembering them in short period has decreased with old age.

5 Conclusion

The elderly-Muslim-friendly application can be designed based on the design guidelines focusing on addressing common physical and cognitive challenges for the targeted group of users. The result affirmed the design guideline of mobile application user interface that caters for elderly found in [12–14] to be used in designing an elderly-Muslim-friendly mobile application. The design guidelines are not uniquely for Muslim elderly people but these guidelines can also be used in any Muslim mobile application development. This study contributes in providing a better understanding of the design guidelines that can be implemented in such applications which is still scarcely reflected. Although the study has been conducted with a small number of participants due to the pandemic situation, the total number of participants is recommended for such qualitative user-based method with the effort to identify any design issue and improve on it. However, future studies should aim to replicate the result with a higher number of participants as other studies have also recommended for more research participants to make the results more robust.

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