ASM Sc. J., 16, 2021

https://doi.org/10.32802/asmscj.2021.686

Usability Features to Improve Mobile Apps Acceptance among the Senior Citizens in Malaysia

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Mobile apps are designed and specifically developed for a specific purpose. They are widely used nowadays as they benefit many users of different age groups, both the old and young. Although various apps caters to the different needs of the senior citizen users are available, there is a lack in understanding of how usability features of these apps influence the acceptance among the senior citizens. Though many of the existing studies proposed several features that may be beneficial to older users, it is unclear how these features promote the acceptance of mobile apps for older users in countries like Malaysia. Aiming to address this inadequacy, the current study investigate the needs, expectations, and usability features of several mobile apps that are relevant for the Malaysian senior citizen people, aged 65 years and above. The usability evaluation of the developed prototype was performed by using the System Usability Scale (SUS). Based on results of the evaluation, it was concluded that the inclusion of an elder-friendly usability feature can increase the acceptance of mobile apps among the senior citizens.

Keywords: usability features; senior citizen; system usability scale; Mobile app; acceptance

I. INTRODUCTION

Mobile technology has changed the global society tremendously, thereby improving people's lifestyles. However, it appears that technology had neglected the senior citizen population as the current technological advances had overlooked their limited skills and knowledge on modern technology advancement (Pethig, & Kroenung, 2019). As the number of senior citizen will be increasing from 350 million today to 1500 million by 2050 according to the United Nations, they will be more dependent with mobile technology. Despite being technologically savvy in term of mobile apps usage, the physical limitation of the older user's need to be considered when developing those apps (Darvishy & Hutter, 2017).

Several existing works (Wildenbos *et. al.,* 2018; Petrovčič *et al.,* 2017) have observed that developers of mobile apps, who were mainly from a younger age group, normally will not consider the senior citizen users preferences as well as issues faced by the senior citizens. In our study, the senior citizens refer to individual aged 65 and above (Almao & Golpayegani 2019).

Soh, Heng, Selvachandran, Anh, Chau, and Son (2020) state that function and features of mobile apps often led to fear, anxiety and consequently, rejection among the senior citizens in Malaysia , hence their refusal to use these mobile apps. To date, no studies were carried that examine how apps that match the needs and requirements of the senior citizens will influence their acceptance of mobile app.

Acceptance of technology is a domain that is well studied in the literature and one of the most well-known model is the technology acceptance model (Davis, Bagozzi, & Warshaw, 1989), which emphasises on two fundamental

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factors; perceived ease of use and perceived usefulness. Many researchers have found that these two factors has a strong influence on the acceptance of technology (for more example refer to Alsharida, Hammood, & Al-Emran, 2021). The model shows that the increase in the It found that the increase in the perceived ease of use and perceived usefulness increases the acceptance of technology by the users.

The study measures the usability of the existing apps and identify the limitation in term of the usability by the by the senior citizen users in using mobile apps. We have also developed a prototype app to achieve the research objective. The improvement in the usability score can signal the improvement in the acceptance of the prototype app.

The rest of the paper is organised as follow: section II provides background of the research and the issues on the development of mobile apps for senior citizens. Section III covers the survey conducted to understand the difficulties faced by the senior citizen users in using mobile apps as well as the development of the app prototype in this study. Section IV presents and discusses the major findings, while section V concludes the study.

II. RESEARCH BACKGROUND

Several of previous studies agree that mobile apps were developed for the senior citizens to assist their daily life routines, with the majority of these being used for managing their health (Bourouis *et. al.,* 2011; Grindrod *et. al.,* 2014; Lee, *et. al.,* 2014; Lv *et. al.,* 2010; Nahm *et. al.,* 2004; Scandurra & Marie, 2013; Scheibe *et. al.,* 2015; Sun & Patricia, 2010). Most of the specifically designed mobile apps developed for senior citizen are general health monitoring and management features while some apps were mainly for managing chronic diseases, such as heart disease, cancer, and diabetes. However, Gordon *et al.* (2019) showed that the senior citizens usage of such mobile apps was limited, which could be due to many reasons such as (1) issues with the user interface design, (2) lack of digital literacy among the senior citizen, and (3) technology availability. Clearly, when a mobile app is designed without any senior citizens' friendly features, it is likely to be abandoned by them. Several researchers have attempted to identify the usability features that could enhance the acceptance of mobile app among the senior citizens (Díaz-Bossini & Moreno, 2014; Gao & Andy, 2010; Wong *et al.,* 2018).

Harrison *et al.* (2013) define mobile apps usability as the measure of the ease of the mobile apps to be used. Mobile apps usability plays an important role for the acceptance among the users including the senior citizens (Admin, 2016). Yusof *et al.* (2014) suggested two types of essential functions for mobile phones, such as making and receiving of calls, and the non-essential functions that make life easier for the senior citizens, such as calendar, address book, notes, reminder alarms, and handling emergencies.

Usability of apps may not necessarily be the same with the usability of computers (Alturki & Gay, 2019). There have been numerous works that look at the usability of apps for a wide range of users. Majority of the works focuses on efficiency (Aryana & Clemmensen, 2013; Hao, Li, Halfond, & Govindan, 2013; Harrison, Derek, & David, 2013; Wei, Chang, & Cheng, 2015), satisfaction (Aryana & Clemmensen, 2013; Hao *et. al.,* 2013; Harrison *et. al.,* 2013; Wei *et al.,* 2015), effectiveness (Harrison *et. al.,* 2013; Wei *et al.,* 2015), learnability (Aryana, & Clemmensen, 2013; Harrison *et al.,* 2013), errors (Harrison *et al.,* 2013), memorability (Harrison *et al.,* 2013) and cognitive load (Harrison *et al.,* 2013).

Gao & Andy (2010) suggested features such as visual aids, memory aids, features to minimise user error, and safety features will be very helpful to senior citizens. Díaz-Bossini & Moreno (2014) focused on features that developers should consider when developing mobile apps for the senior citizens users as shown in Table 1.

Table 1. Díaz-Bossini & Moreno (2014) Mobile Apps Features Checklist

Usability Attribute	**Mobile Apps Feature**
Learnability	• Content layout design such as: ○ simple and clear language ○ Avoid irrelevant information ○ highlight important information ○ simple, clear and consistent screen layout, navigation and terminology
Efficiency	• Non-text objects • Avoid long and complex words • Target design; large target, clear and single click

Memorability	• Use of colour to convey information
Errors	• Cognitive design; sufficient time to read, provide fewer choices
	• Avoid distractions
Satisfaction	• Graphics; provide relevant graphics, no animations, images with alt tags, simple and meaningful icon
	• Avoid blinking, moving, scrolling or auto-updating content

Despite the various age-friendly features that are available in the exiting specifically designed mobile apps, the acceptance of these apps among the senior citizens is still low (Wildenbos, Peute, & Jaspers, 2018). Moreover, not many studies had been conducted to gauge the perception of the senior citizens when using the specifically designed mobile apps. Therefore, our study investigates the acceptance of the senior citizens of mobile apps. By taking the recommendations from the existing work (Díaz-Bossini & Moreno 2014), that provides the solution of usability for older users of mobile app, we have developed a senior citizen friendly app.

III. METHODS

To fulfil the aim of this study, which is to investigate the needs, expectations and usability features of the current mobile apps of senior citizen users in Malaysia, this study will thus conduct a survey adopting the System Usability Scale's (SUS) questionnaire, distributed among the senior citizens from the Klang Valley.

A. Participants

This study involved 98 Malaysian senior citizen respondents who were aged 65 and above (age range is between 65 to 80 years old, with the mean age of 73 years old). The participants comprised 46 females and 52 males, and they were from the different races representing the Malaysian population. The number of respondents for senior citizens is usually very small as it is very difficult to get the senior citizen to involve in data collection process due to their physical limitation, getting the consent from the children, cultural restriction and so on. On top of that, the respondents need to be involved in a series of data collection process. However, the number of respondent in this research is much larger than the existing research involving senior citizen (Harte *et. al.,* 2017; Kaur & Cook, 2018; Li & Luximon, 2018; Yu & Chattopadhyay, 2020).

This study used purposive sampling where senior citizens who were also smartphone users were deliberately recruited. They would also be requested to try an existing app that was specifically designed for them. This explains why it is important for the participants to have some prior experience in using smartphones so as to facilitate the mobile apps acceptance.

B. Initial Data Collection and Analysis

In the first phase, the respondents were asked to use an existing mobile app that assist the Malaysian senior citizen in managing their health. After experiencing the apps, the respondents were requested to complete the SUS questionnaire. This was aimed at collecting more information on their experiences in using the existing mobile apps in term of usability function of the app. The questions used were adopted from Klug (2017), who briefly explained the System Usability Scale's (SUS) objectives and its usability score calculations. According to Klug (2017), the SUS is used to evaluate the ease of using the developed application by the end users. A total of 10 usability questions were employed (there are five positive and five negative statements) as shown in Table 2 (negative statements are italicised). These questions were rated on a scale of 1 to 5 where 1 indicates strongly disagree, 2 disagree, 3 neutral, 4 agree and 5 strongly agree.

The usability scores were calculated as follow:

i. (X – 1) x 2.5 for positive statement, and

ii. (5 – X) x 2.5 for negative statements

Where X refers to the score given by the respondent from the scale of 1 to 5.

Table 2. The 10 SUS usability questions

No	Statements
1	I think that I would like to use this mobile app frequently
2	*I found the mobile app is unnecessarily complex*
3	I thought the mobile app was easy to use
4	*I think that I would need the support of a technical person to be able to use this mobile app*
5	I found the various functions in this mobile app were well integrated
6	*I found there was too much inconsistencies in this mobile app*
7	I would imagine that most people would learn to

	use this mobile app very quickly
8	*I found the mobile app very cumbersome to use*
9	I felt very confident using this mobile app
10	*I needed to learn a lot of things before I could get doing with this mobile app.*

C. Development of the Specifically Designed Mobile App Prototype For Senior Citizen

The app prototype was developed by incorporating the usability features discussed in Díaz-Bossini & Moreno (2014). It was coded using AngularJS and JavaScript, wrapped with Apache Cordova, and ran in android platform. The AngularJS is a client-side JavaScript framework, which implements the MV* framework while the Apache Cordova is a mobile development framework that allows the use of a standard HTML5, CSSs and JS for cross-platform. The app prototype uses android 5.0.0, browser 4.0.0 Cordova platform, and embedded voice (with pre-recorded human speech in audio files). Table 3 shows the selected features that are incorporated into the app prototype.

Table 3. Selected features incorporated in the app prototype

Usability Attribute	**Mobile Apps Feature**
Learnability	Embedded assistive features in the mobile apps development: ○ Reads by voicing-over the touched items
Memorability	• Convey information using colour
Errors	• Minimising user error by implementing: ○ Extra confirmation dialogue box ○ Noticeable reminder
Satisfaction	• Implement target design with ○ Large icons ○ Clear and understandable icons by senior citizen people ○ Simple and meaningful icons

The app prototype was built by incorporating the identified usability features as shown in Figure 1. One of the functions in the app prototype is a calendar function that incorporates the selected mobile app features as stated in Table 3. Calendar function is considered as a basic function that helps the senior citizen with their daily plans. It is important for them to see what they have scheduled for the day ahead, as well as adding new events to their schedule. The developed app is very simple as the objective is to examine the acceptance of the app that meets the need and requirement of the senior citizens. On top of that, since the prototype app is a basic and simple calendar, we did not include the efficiency as it is not only difficult to measure but will be more relevant for complex apps.

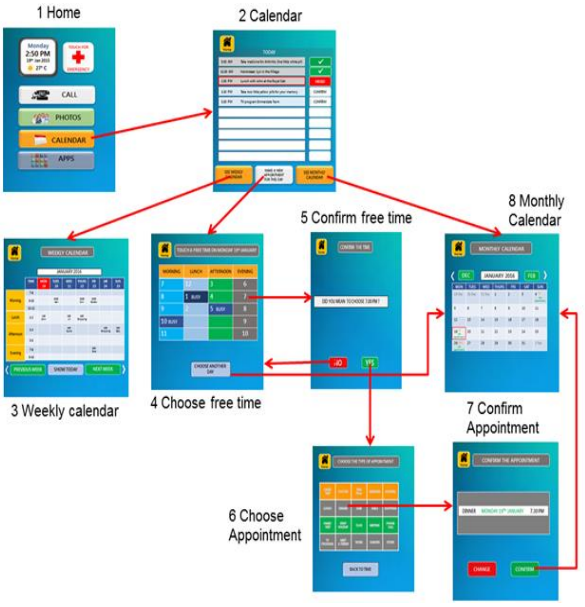

Figure 1. Calendar function of the app prototype

D. Evaluation of the App

The app prototype is evaluated using the same procedures with the existing mobile apps. The respondents were asked to use the app prototype. After experiencing the apps, the respondents were requested to complete the SUS questionnaire. The analysis of the data covers the mean and the standard deviation of the SUS score.

IV. RESULT AND DISCUSSION

Table 4 shows the results of the usability score for both the existing mobile app and the app prototype developed in this study.

For positive statement, the highest usability score for both of the apps is for the statement "I think that I would like to use this mobile app frequently", indicates that many of the senior citizens would like to use both of the offered mobile apps. On the other hand, the positive statement with the lowest usability score of 4.53 for the existing app and 7.67 for the prototype was, "I thought the mobile app was easy to use", which showed that the senior citizen do not find the apps easy to use though they like to use them. However, the

score for the prototype app was higher than the existing apps.

Table 4. The result of the usability score for the 10 usability questions

	Mean		Standard Deviation	
No	**Existing apps**	**Prototype**	**Existing apps**	**Prototype**
1	8.10	8.92	1.28	1.21
2	7.43	7.96	0.98	0.92
3	4.53	7.67	0.67	0.65
4	7.45	8.32	0.80	0.78
5	6.70	8.18	0.74	0.72
6	8.23	9.04	0.67	0.65
7	7.78	8.92	0.72	0.70
8	8.55	9.29	0.65	0.63
9	6.08	7.73	0.50	0.49
10	8.95	9.14	0.72	0.70

For the negative statement, the statement "*I needed to learn a lot of things before I could get doing with this mobile app*" has the highest score of 8.95 for the existing app and 9.29 for the app prototype. This means that many of the respondents disagreed that they need to learn a lot of things before they could get working on the mobile apps. The higher score for the app prototype shows that the respondents agree that prototype is much easier to be used by the respondents than the existing app.

Overall, the average SUS score for the 10 items were 7.38 for the existing app, and 8.52 for the app prototype, an improvement of about 15.5% on average.

In order to determine that the prototype has improvements in term of usability over the existing specifically designed mobile apps, we have compared the SUS of the existing specifically designed mobile apps with the developed app prototype. Table 5 shows the differences in the mean and standard deviation of the existing specifically designed mobile apps with the developed app prototype. For the positive statement, the highest mean improvement is for the statement "I thought the mobile app was easy to use". This suggests that the app prototype was much easier to use as compared to the existing specifically designed mobile apps. This suggested that the design that incorporate usability features such as learnability, memorability, errors, and satisfaction has improved the ease of using the apps as compared to the traditional apps that does not incorporate the usability features that are suitable for senior citizens.

On the other hand, for the negative statement, the highest mean improvement is for the statement "*I think that I would need the support of a technical person to be able to use this mobile app"*. This shows that the users found that the prototype requires less expert support as compared to the existing specifically designed mobile apps. From Table 5, it was also found that all of the standard deviation has reduced, which means that the responses are less varied than existing specifically designed mobile apps, indicating the consistency of the responses among the respondents.

Table 5. The differences in the usability score between the existing specifically designed mobile apps with the developed app prototype for the 10 usability questions

No	**Mean differences**	**SD differences**
1	0.82	-0.07
2	0.53	-0.06
3	3.14	-0.02
4	0.87	-0.02
5	1.48	-0.02
6	0.81	-0.02
7	1.14	-0.02
8	0.74	-0.02
9	1.65	-0.01
10	0.19	-0.02

V. CONCLUSION

This study has presented a list of the usability features of the current mobile apps that were accepted by Malaysia's senior citizen users (aged 65 years old and above). The identification of the suitable features is vital so as to ensure that the senior citizen community is not rejecting the benefits of technology advancement based on mobile apps. By understanding the needs and the abilities of these features which enhance usability of the mobile apps, developers and designers can offer more practical apps as well as be able to promote a change in the way the senior citizen users view the mobile apps so that they too are able to adopt these into their daily lifestyles. The developed app had also attempted to address the usability issues that were highlighted by the respondents during the data collection stage. Following the evaluation of the app prototype, the findings of this study showed that existing mobile apps and future designs should emphasise on the needs and capabilities of senior citizen (Harrison *et. al.,* 2013; Mohadis *et. al.,* 2014; Nielsen, 1994; Yusof *et al.,* 2014).

This study can be extended to future research which can incorporate more complex mobile apps with local languages such as Malay, Chinese and Tamil for better usability and accessibility for the Malaysian senior citizen. In addition, future designs may consider incorporating more usability attributes such as efficiency.

VI. ACKNOWLEDGEMENT

This research was supported by the Ministry of Higher Education, Impact-Oriented Interdisciplinary Research Grant Programme (IIRG) (Grant. No.: IIRG030B-2019).

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