Open Access Journal of Information Systems (OAJIS)

Available at http://is.its.ac.id/pubs/oajis/index.php

The Third Information Systems International Conference

User Interface Design for Elderly Mobile Assistive Systems

Wahidah Husain,[a*] Asmawati Ibrahim[b], Amirah Mohamed Shahiri[c], a*

[a, b, c] *School of Computer Sciences, 11800 Universiti Sains Malaysia, Penang, Malaysia*

Abstract

The increasing number of the elderly population and process of modernization and migration for work has increase the issue of giving support for older people. This had contributed to a worrisome feeling among the caretakers. Therefore, Mobile Assistive Apps is designed to support and improve the quality of life among elderly. In order to develop the application, an empirical study had been conducted to discover the requirements for designing suitable Human Mobile Interaction (HMI) for elderly. Older people will experience cognitive, perceptual and psychomotor impairment that restricted them to use the smart phone or touch screen technology. This study had proposed a set of recommendations for designing HMI that will enhance their navigation and access to touch screen of the smart phone. The evaluation result with the average score 92% satisfaction on the interface design of the system indicated that the proposed recommendations had enhanced elderly navigation of the system.

Keywords: user interface; elderly; human-mobile interaction; mobile assistive; mobile apps

1.0 Introduction

Mobile communication becomes as popular solutions for older adult and had been proven as the useful device that may benefit, improve their life and sustaining independent lifestyle [1]. Mobile assistive system is a service which supports elderly people, foster their independent living, help them to connect with their peer groups, cultivate a closer relationship with their family, check and monitor health status, remind daily routines and showing directions or ways. However, acceptance and adoption of smart phone among elderly is still low compared to others age group [2]. In fact, most elderly people feel difficult to use smart phone [3]. They reported to have problems with the devices included display, buttons and character are too small, difficult to see and to push the buttons [2]. They also complaining about complex functions, menu arrangement are not user-friendly and unclear instruction on how to find and use [4].

The study had revealed that product for the elderly should be designed by considering their capabilities and needs. For this study, a questionnaire is used to obtain factual information from

* Corresponding author. Tel.:+604-653-3645; fax:+604-653-4759
E-mail address: wahidah@usm.my

participants in relationship to their experienced of using mobile technology. A total of 50 older people, age 60 and above from different education background had been chosen as the sample size. Based on the questionnaire, elderly people faced several difficulties or impairment that limited them from using the smart phone or touch screen technology included cognitive, perceptual and psychomotor changes. Therefore, a set of recommendations to enhance the problems of cognitive, perceptual and psychomotor among the elderly had been developed and had been adopted in the design of mobile interface. At the end of this study, evaluation has been conducted using cognitive walk-through to check whether usability and functions of the apps meet the needs of older people. The result provides evidence that by implementing the guidelines discovered in the study, elderly people have better access to smart phone or touch screen technology and they might be able to operate the system easily and efficiently.

2.0 Design Guidelines

Mobile devices has become as the useful and popular devices that support daily activities of different categories of user including young and older generations. However, according to Chan et all, (2002), the existing applications still not provide ease of use interfaces for certain users [5]. Most of the mobile applications fail to fulfil users' expectation and contribute to refusal to use the applications and slow down the adoption of smart phone technology [6]. The common error done by designers is assuming that all their system users are similar [7]. This statement supported by Newell (2008) who stated that "design for all" concept in designing a system is unrealistic [8]. Caprani et al., (2012) listed four characteristics of elderly need to consider when designing for them [9]. These characteristics are cognitive, perceptual, psychomotor, and physical changes. Quihui, (2008) also affirmed that factors that make elderly people feel difficult when using technology are contributed by perceptual, psychomotor, cognitive and physical decline [10].

1.1. Design Guidelines Focused on Perceptual Changes

In order to design for the elderly who has problems with decline of vision, the designer must ensure the interface are easy to use and should help the elderly maintain their attention on the system [11]. ISO/IEC (2001) stated that designer must avoid using capital letters and make use meaningful graphical symbols avoid using capital letters [12]. For colours, designers need to consider colour blindness problem. To this problem, Hawthorn (2000) suggested to avoid blue-green tones combination and ISO/IEC (2001) advised to avoid combination of red and green [11, 12]. ISO/IEC (2001) suggested black on yellow or light grey combination as the colour that provides strong definition without too much glare for the older people but avoid difficult to see colour such as light grey for text or symbols, pastel shades on pastel backgrounds or red lettering or symbols on light grey [12]. Furthermore, Hawthorn (2000) had suggested to use speech based interfaces that compensate for problems with sight [11]. The use of speech based interface also very helpful for other complications of aging. Regarding the decline of hearing, designer should provide adjustable audio output at low frequencies [9, 11].

1.2. Design Guidelines Focused on Psychomotor and Physical Changes

In order to accommodate with psychomotor and physical changes, Hawthorn (2000) found that older people need large targets and fewer of choice of menu on the interface [11]. He recommended that the timing of actions is adjusted to a slower rate. This recommendation supported by Boustani (2010) [13], who discovered that the designer should provide ample time for the elderly user to read the information on screen. Moreover, designer should use big button so that older users would have no trouble pressing them and would not try to use their fingernails [9, 14, 15]. The recommended size of button is between 10mm to 11.43 mm. Moreover, designer should reduce scrolling and make sure older people see the

entire menu options by displayed it in one page keep [9, 15]. In order to decrease error rate and increase elderly satisfaction, Phiriyapokanon (2011) suggested to separate the button or menu by adding space between 3.17 mm to 12.7 mm [16].

1.3. Design Guidelines Focused on Cognitive Changes

Farage and Miller (2012) recommended to present information in simple and intuitive logic way [17]. The visual information should be auxiliary, organized and in sequence. The information should be formatted consistently and specific types of information placed in expected location. As stated by Farage and Miller (2012), Holzinger, Searle, and Nischelwitzer (2007) also suggested that the designer should placing information in the task of environment and display information consistency [1, 11, 16]. This will help to reduce cognitive demands of older people while using the mobile applications. Caprani et al. (2012) recommended that designer should reduce confusion and enhance ease of use of the system by using simple text, colour and icons [9]. For the icons, Hawthorn (2000) and Phiriyapokanon (2011) suggested that designer should use relevant graphics rather than decoration [11, 16]. The interface design must simple, avoid distractions and undue manipulation. This recommendation helps users to process concrete representations of items rather than relying solely on working memory [11].

3.0 Develop Prototype

The prototype for the system is developed based on the design guidelines which focused on perceptual, psychomotor and physical and cognitive changes for the elderly. The objective of this phase is to identify the core functions of the proposed system and to obtain the feedback from the users. The home screen design and some of the important functions of the system is discussed in this section. Figure 1 (a) shows the screenshot for Home Screen Menu. This screen provides easiness for the elderly for making calls, sending SMS or MMS and taking pictures. The interface design support perceptual changes such as simple layout of menu, and no overlapping windows. Besides that, high contrast colour, black on yellow background and black on light grey background.

Fig. 1. **(a)** Home Screen; (b) Auto Calling; (c) Exercise Reminder; (d) Fall Detection

Figure 1 (b) shows the elements to support psychomotor and physical changes by providing fewer of choice of menu, button size display menu in one page and use button for easy navigation for auto calling function. The system also provides adjustable audio output at low frequencies, speech recognition, and voice asking for confirmation with audio output at low frequencies. Figure 1 (c) demonstrates screenshot for health care function and daily exercise reminder. The purpose of health care function is to monitor health of the end user. The system may detect sickness if the elderly do not respond to the system. Report on this function will be sent to the caregiver upon request. Figure 1 (d) illustrates fall alert notification in the fall detector function. The function that help to detect fall of elderly and once fall is detected, the

system will alert the user and if the user does not press a cancellation button within 1 minute, it will send an alert to pre-set phone number such as to the caregiver and nearest neighbour. For sickness detection, function is same with fall detector, but it will detect sick if the user does not respond or giving feedback for the daily alert for pre-set number of times. For location detector, the caregiver may know the location of users via location detector function.

4.0 Evaluate Prototype

After the prototype is developed based on the proposed interface design, evaluation had been conducted. The evaluation is to test the user interface design for the mobile assistive system that had been developed. The goal user interface testing to check whether the proposed guidelines match with the requirement of the target users and identify problem for future improvement. The method use in this evaluation is cognitive walkthrough, based on cognitive learning and use [18].

4.1 Participants and Sampling

This assessment involved 50 respondents, who are older people, aged 60. Respondent selected for this evaluation is elderly people who owned and used cellular phone. Among all participants, only 13 of them are living alone. Other respondents are living with their spouse or their adult children. But most of them will stay alone when their spouse or children going out for working. The data show that about 40% of respondents are smart phone user. The characteristics of respondents included gender, age, living arrangement, employment status, source of income and type of phone used.

4.2 Interface Design Evaluation

Evaluation of the interface is conducted to test whether the interface that had been designed based on guidelines recommended in this study meet the needs and requirements of elderly people. Questionnaire had been structured based on Heuristic Evaluation Checklist. Heuristic Evaluation is technique proposed by Nielsen and Molich (1990) to inspect whether the interface design is suitable for its target user [15].

4.3 Procedure

15 questions were used to measure nine criteria of the interface. At the initial, a short training in how to navigate the mobile application prototype had been given to the respondents. Then, each participant alone navigates the prototype. They were given task as follows: (1) go to Contact List and make calls to the contact (2) increase sound output when making calls (3) make calls using voice and speech recognition (4) navigate to all menus by scrolling or pressing the button (5) respond to the fall and sick alert. After completing the task, respondents had answered the questions in the questionnaires.

5.0 Data Analysis and Finding

As explained above, 15 questions which had been developed based on the Heuristics Evaluation Checklist and patterned according to Likert Scale point with this order: 1-Strongly disagree, 2-Disagree, 3-Neutral, 4-Agree and 5-Strongly agree. Figure 2 describes the responses of elderly relevant to the questionnaire's criterion. Percentage of elderly response against nine selected criteria indicated that the interface of the prototype is up to their level of expectations. 10% of respondents have strongly agreed that the interface has fulfilled their needs. More than 90% of respondents agreed that the design had fulfilled their needs and expectations regarding the layout, symbols/drawings and ease of handling. The

most interesting result discovered through the finding are 100% of respondents agreed that alternative format, loudness/pitch and fail safe criteria help them to use the interface more easily. The alternative format is referred to the speech recognition interface that allows them to give instructions to the phone using their voice. This interface had increased their ability to use smart phone although they do not have experience in using it

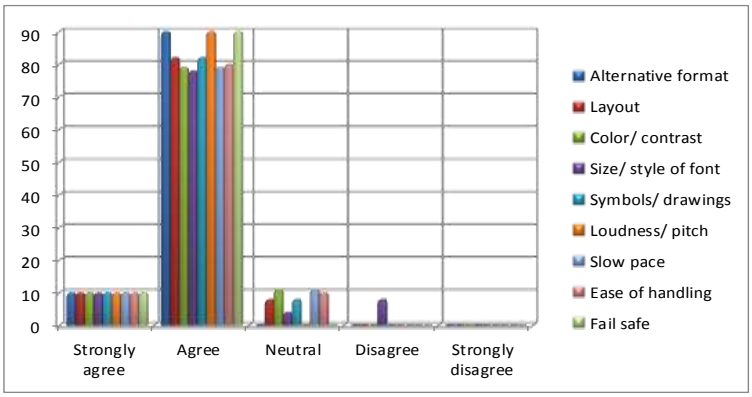

Fig. 2. Response of elderly relevant to the questionnaire's criterion

Loudness/pitch criteria referring to adjustable audio output provided in the calling interface. The respondents agreed that this adjustable audio output improve their hearing to the phone sound. For fail safe, all respondents agreed that the space provided between the icons make them free from errors when pressing the button or icons. This result indicated that guidelines for these three criteria fulfilled the older people needs. Average 10% of respondents have neutral response against to six criteria as followed: layout, colour/contrast, size/style of font, symbols/drawings, slow pace and ease of handling. Interestingly, this response is provided by the elderly people who owning and used the smart phone, aged 60 – 65. For the symbols/drawings, 92% agreed that they easily recognized and understand the icons used. The icons have increased their ability to use the system and help them understand the function without too much efforts of memorizing. 8% from them has neutral decision about the icons and symbols used. Regarding the colour/contrast, 89% of them are completely satisfied. The colour chosen improve visibility of the screen. The rest 11% of respondents do not decide or having neutral response towards this criteria. Respondents also have given positive feedback regarding layout and ease of handling criteria. 90% agreed the system achieved ease of use and 92% satisfied with the layout. Respondents feel glad with navigation button that had been provided at every page which provides them better option of navigation than scroll over the screen. The simple menu that arranged in one page without any overlapping windows also enhanced their navigation to the system and touch screen phone.

Regarding the slow pace criteria, 89% agreed that response time given in the reminder, sick and fall detector alert is appropriate and give ample time for them to give feedback. Only 11% among them has neutral opinions. This result shows that the one minute timing given in the reminder, sick and fall alert is sufficient enough. Moreover, for size or style of font criteria, 8% of the respondents disagreed that the font provided is match with their need. For them, the fonts beside the icons are small and quite hard for them to read the text. Bigger font size is needed in order to help them read it more easily. However, 88% of them agreed that the style and size of font provide easiness to read text on the screen.

6.0 Conclusion and Future Work

A set of guideline for designing interface for the elderly mobile assistive system had been proposed and then a prototype according to the guideline had been developed. At the end of this study, the interface design testing had been conducted in order to check whether the recommended guidelines and usability of the system meet the requirements and needs of older adult. This evaluation was done using cognitive walkthrough and data collected through questionnaire. A total of 50 older people, age 60 and above from three different districts of states had been chosen as the sample size. The evaluation on the interface is measured based on nine criteria or factor to be considered when designing interface proposed. The finding proved that implementation of proposed guidelines in elderly mobile assistive system had enhanced access to the interface and increase usability of the system.

In conclusion, data and finding shows that the proposed guidelines can be apply for the mobile assistive apps. The guidelines help to encounter problems or difficulties faced by elderly when using smart phone. It will improve hearing and seeing on the system, provide easiness to use the smart phone functions, minimize the possibility of misinterpretation, quickly and accurately identify and understand icons and its function and the most important thing is it will enhance quality of life of the elderly.

References

[1] Holzinger, A., Searle, G., & Nischelwitzer, A. (2007). On some aspects of improving mobile applications for the elderly. In C. Stephanidis (Ed.), *Universal Acess in Human Computer Interaction* (pp. 923–932). Berlin: Springer-Verlag.

[2] Naim Che Pee, Zulisman Maksom, & Azir Rezha Norizan. (2014). Factor influencing the use of smart phone by Malaysian's elderly. *Journal of Theoretical and Apllied Information Technology*, *59*(2), 421–425.

[3] Pattison, M., & Stedmon, A. (2006). Inclusive design and human factors: Designing mobile phones for older users. *PsychNology Journal*, *4*(3), 267–284van Leeuwen, J. (ed.): Computer Science Today. Recent Trends and Developments. Lecture Notes in Computer Science, Vol. 1000. Springer-Verlag, Berlin Heidelberg New York (1995)

[4] Mohd Hairul Nizam Md. Nasir, Hazrina Hassan, & Nazean Jomhari. (2008). The use of mobile phones by elderly: A study in Malaysia perspectives. *Journal of Social Sciences*, *4*(2), 123–127.

[5] Chan, S. S., Fang, X., Brzezinski, J., Zhou, Y., Xu, S., & Lam, J. (2002). Usability for Mobile Commerce across multiple form factors. *Journal of Electronic Commerce Research*, *3*(3), 187–199.

[6] Lee, Y. E., & Benbasat, I. (2003). Interface design for Mobile Commerce. *Communications of the ACM*, *46*(December), 49 – 52.

[7] Galitz, W. (2007). *The essential guide to user interface design: An introduction to GUI design principles and techniques*. New York: John Wiley & Sons, Inc.

[8] Newell, A. (2008). User sensitive design for older and disabled people. In A. Helal, M. Mokhtari, & B. Abdulrazak (Eds.), *Technology for Aging, Disability and Independence: Computer and Engineering Design and Applications* (pp. 787–802). New Jersey: John Wiley & Sons, Inc.

[9] Caprani, N., O'Connor, N., & Gurrin, C. (2012). Touch screens for the older user. In F. A. A. Cheein (Ed.), *Assistive Technologies* (pp. 95–118). United Kingdom: InTech. doi:10.5772/1089.

[10] Qian, W., & Dao, W. (2012). Interface design of handheld mobile devices for the older users. In *Proceedings of 3rd International Conference on e-Education, e-Business, e-Management and e-Learning* (Vol. 27, pp. 185–188). Singapore: IACSIT Press.

[11] Hawthorn, D. (2000). Possible implications of aging for interface designers. *Interacting with Computers*, *12*(5), 507–528. doi:10.1016/S0953-5438(99)00021-1.

[12] ISO/IEC. (2001). *Guidelines for standards developers to address the needs of older persons and persons with disabilities*. Geneva: ISO Copyright Office..

[13] Boustani, S. (2010). *Designing touch-based interfaces for the elderly*. University of Sidney, Australia.

[14] Strengers, J. (2012). *Smartphone interface design requirements for seniors (Unpublished master's thesis)*. University of Amsterdam, Netherlands. Retrieved from http://dare.uva.nl/document/460020.

[15] Nielsen, J., & Molich, R. (1990). Heuristic evaluation of user interfaces. In *Proceedings of the ACM CHI 90 Human Factors in Computing Systems Conference* (pp. 249–256). Seattle, Washington, USA: ACM Press.

[16] Phiriyapokanon, T. (2011). *Is a big button interface enough for elderly users: Towards user interface guidelines for elderly users (Unpublished master's thesis)*. Malardalen University, Sweden

[17] Farage, M., & Miller., K. (2012).Design principles to accommodate older adullts. Global Journal of Health Science, 4(2), 2-25.

[18] Te'eni, D., Carey, J., & Zhang, P. (2007). *Human computer interaction: Development effective organizational information systems*. United States: John Wiley & Sons, Inc.