Mobile Menu Representation for Elderly

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Abstract. There are many aspects of interface design such as typography, information flow, visual hierarchy, navigation, interaction style et cetera. Each of these aspects must be used in consideration with whom the user of the system or application. This research focuses on menu icon for elderly using pictorial representation, photograph representation and combination of both pictorial and photograph representation. A total of four hundred and sixty-eight responses (52 participants × 3 menu representations × 3 tasks) were collected followed by a second experiment involving six hundred responses (50 participants × 4 menu representations × 3 tasks). Tasks were assigned randomly from a set of tasks to minimize the learning effect biases. One-way analysis of variance was conducted to examine the effect of menu representation on the time needed to complete a task and number of steps needed to complete a task. Despite the decreasing condition of visual ability, most elderlies tend to read the menu label. Due to the limited space on mobile device, most texts used small fonts, therefore it is difficult for an elderly to read the label. Alternatively, mobile application design for elderly can use icons to represents menu items. A simple icon with minimal feature is recommended instead of a photograph or a picture menu representation.

Keywords: Interface design · Menu representation · Mobile application

1 Introduction

Technology has impacted every aspect of human live in this modern era. For those born as digital native generation mostly have no problem adapting to the fast development of technology. Elderly especially those in developing countries such as Indonesia undergoes a technology leap, therefore they are more prone to experience difficulties adapting to the new technology. Such digital gap may not be a big problem in developed countries because an elderly may be exposed to some form of technology when they are younger. This may cause elderly in Indonesia (and other developing countries) missing out on many technology advantages that otherwise can improve their quality of life. There are many assistive technologies developed to help old people became more independent and productive (Akbar et al. 2018; Hsieh et al. 2019; Mostaghel 2016; Saracchini et al. 2015; Yusif et al. 2016).

Restyandito and Kurinawan (2017) conducted research on technology acceptance among elderlies in Yogyakarta Indonesia. They found that even though elderlies are

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aware of the usefulness of technology, not many of them are using it. Data from Statistics Indonesia shows that only 8.83% of the population age 50 years old and over ever accessed the Internet (Statistics Indonesia 2020). Two major factors hindering them from using technology are their perception that technology is expensive and they do not have adequate skill and knowledge to use it. However, technology has become more affordable (Chen et al. 2011; Xu 2006), thus it should not hinder elderly from using them.

Raising awareness on how technology can improve the quality of life may encourage elderly to use technology. Nevertheless, as revealed by Restyandito and Kurniawan (2017) many older people are already interested in technology, but lack of self-efficacy may be holding them back from using it. Design approach can be used to minimize an elderly from being intimidated by technology (Restyandito et al. 2019a, b). A user-friendly interface designed to fit user's experience and knowledge will make it possible for elderly to use technology easily. A positive experience in interacting with technology can boost one's beliefs in self-efficacy, hence motivate them to use technology.

Statistics Indonesia (2020) pointed out the use of Information and Communication Technology by households in Indonesia showed a rapid development. By 2020 mobile phone subscriber in Indonesia has exceeded 355,620,388 subscribers which exceeded the total population that was 270 million people. Furthermore, percentage of population who accessed the Internet in Indonesia who are using mobile phone were 98.31%. Therefore, this research focuses on designing interface for mobile application. In addition to the widespread use of mobile phones, they are affordable, ubiquitous and portable (Hsieh et al. 2019).

Previously the author has conducted research on icon design (Restyandito et al. 2019b) and menu layout (Restyandito et al. 2019a) suitable for elderly in Indonesia. They found that concrete icon represented using exemplar approach is best to help convey the meaning symbolized by the icon. Furthermore, they also found that menu presented as a grid is a better choice compared to list layout or horizontal scroll due to the minimum cognitive load required to memorize the menu option. In this research the author is investigating another aspect of interface design which is the menu representation. Schröder and Ziefle (2008) discover that pictorial representation produces higher learnability compared to textual representation if it represents prototypical semantic knowledge. Moreover, anthropomorphic icons (such as picture or photographs) resulted in higher degrees of accuracy than more abstract icons (Zikmund-Fisher et al. 2014). In the case of elderly in Indonesia who have lack exposure to technology, they may not be familiar with icons commonly used in technology such as computer and mobile phone. For this reason, the author conducted an experiment to examine which pictorial representation is best for elderly i.e. photographic icon, picture icon or both photographic and picture icon. There are four ways to represent the real world using a picture: resemblance, exemplar, symbolic and arbitrary (Wang et al. 2007). As Restyandito et al. (2019b) pointed out, the best way to represent real world to elderly is by using the exemplar approach. Consequently, in this experiment this approach is used. Some objects that can be used to represent real world are chosen. For example, calendar and pill bottle were used to represent medication intake schedule (as seen in Fig. 1).

Fig. 1. Pictorial representation for medication intake schedule using photograph icon, picture icon, and both.

2 Method

2.1 Participants

Fifty-two older adults (Male = 16, Female = 36) with average age of 68.27 years old (STD = 6.45), participated in the study. Participants have various education backgrounds (15.38% elementary school, 15.38% junior high school, 42.31% high school, 26.92% university). All participants took a Mini Mental State Examination (MMSE) with average result of 27.433 (Min = 24, Max = 30, STD = 1.71). A score of 25 or higher is classed as normal. If the score is below 24, the result is usually considered to be abnormal, indicating possible cognitive impairment (Gowan and Roller 2019). According to Hager et al. (2014), a person with MMSE score 27–30 are considered without cognitive impairment while MMSE score of 20–26 indicates a slightly cognitive impairment. Therefore, it can be said that participants in this study did not have any serious cognitive issues.

2.2 Apparatus and Instrument

Research was conducted using ASUS Zenfone MaxPro mobile phone, Qualcomm Snapdragon 636, 3 GB RAM, 32 GB ROM with 5.99 screen 1080 × 2160 resolution. Test application was made using: Java SDK 1.8; Android SDK; IDE Visual Studio 2017; Xamarin Cross Platform Mobile Development Framework; Grial UI Kit and Syncfusion for Xamarin.

2.3 Procedures

A dummy mobile application was developed to conduct this experiment. The application was made to measure user's performance when interacting with the interface particularly how the menu is represented. The application has eight menus, namely: personal data, hospital, doctor consultation schedule, medicine intake schedule, therapy schedule, self-diagnose, health articles, medicine information, illness information, and eating diet information. These menus are presented in three different ways as shown in Fig. 2.

Each participant was given three different tasks to complete for each menu representation. Some of these tasks are:

1. Changing the data of their home address
2. Inputting date reminder for upcoming doctor visit
3. Finding out the composition of the medicine prescribed
4. Finding out the best diet suitable for him/her condition
5. Diagnosing possible sickness based on the symptoms occurred

Fig. 2. Usability test application using three different menu representations (photograph icon, picture icon, both).

There are a total of twenty-seven tasks, where nine of them were randomly assigned to participants (three tasks for each menu representation). The tasks were presented in a dialog box as seen in Fig. 3.

Fig. 3. A different task was assigned to a participant.

After participants understand the task given, they can proceed by pressing the “yes” button. They will then be presented with the menu and must choose the appropriate menu to complete the task. The application would keep track of the time and the number of steps taken by participant. To minimize the possibility of learning effect, the order of the menu representation was randomized. After participants understand the task given, they can proceed by pressing the “yes” button. They will then be presented with the menu and must choose the appropriate menu to complete the task.

The application would keep track of the time and the number of steps taken by participant. Time and number of steps is used to measure efficiency of the interface and has been used widely in many usability evaluation model Kurniawan et al. (2021). To

minimize the possibility of learning effect, the order of the menu representation was randomized. While participants were completing the tasks, the author observed their behavior to gain any insights on any issues that may occur during the experiment.

3 Results and Discussion

A total of four hundred and sixty-eight (52 participants × 3 menu representations × 3 tasks) responses were collected. One-way analysis of variance was conducted to examine the effects of menu representation on the time needed to complete a task. The picture representation has the least time needed, followed by photograph representation and both representation (34.550 ms, 37.801 ms, and 38.986 ms respectively). However there was not a significant effect of menu representation on the time needed to complete a task at the $p < .05$ level for the three representations [$F(2,465) = 0.552$, $p = 0.576$]. One-way analysis of variance was also conducted to study the effect of menu representation on the number of steps needed to complete a task. There was not a significant effect of menu representation on the number of steps needed to complete a task at the $p < .05$ level for the three representations [$F(2,465) = 0.866$, $p = 0.421$].

One way ANOVA analysis revealed that there was no significant difference between menu representation. During the test, many respondents took some time not to look at the photograph or picture but reading the menu. Since all respondents are literate and almost 70% of them have minimum education of High School, they tend to focus on the text rather than the photograph or icon. It might be due to the fact that a literate person tends to experience reading automaticity and processing without awareness (Tzelgov 1999). The result also supports previous study by Salman et al. (2010), where they proposed GUI layout for mobile phone interface. Senior users were expected to choose layout of icon with labels compared to icon only.

However, older people may suffer from degenerative condition of their physical as well as cognitive ability. For that reason, they may have difficulties in reading the small text and thus needed more time. During the experiment, the author observed that a respondent would move the mobile phone closer as they tried to read the text. To eliminate this effect, the usability test application was revised by removing the text under the menu. Instead, the author added one more representation using text only as control group (see Fig. 4).

Fifty older adults (Male = 31, Female = 19) with average age of 63.42 years old (STD = 4.42), participated in the second study. A total of six-hundreds (50 participants × 4 menu representations × 3 tasks) responses were collected. The participants in this second study differed from the first study to eliminate the bias of learning effect. The research procedure and problem is the same with the first study.

The result showed that there was a significant statistic difference on the time needed to complete the task at the $p < .05$ level for the four representations [$F(3,596) = 19.353$, $p = 0.0000$]. The average time needed to complete the tasks for photograph, picture, combination of photograph and picture and text are 16,353 ms; 11,181 ms; 14,284 ms and 8,839 respectively. Result also showed that there was a significant effect of menu representation on the number of steps needed to complete task at the $p < .05$ level for the four menus [$F(3,596) = 12.821$, $p = 0.0000$]. The average number of steps needed

Fig. 4. Top: Revised menu representation for eating diet information using photograph, picture, both photograph and picture, and text. Bottom: Usability test application using four different menu representations.

to complete the tasks for photograph, picture, combination of photograph and picture and text are 1.84; 1.28; 1.52 and 1.32 respectively. It was found that respondents need less time completing tasks when menu is represented using text followed by icon. It supports previous finding where most respondents tried to read the menu even though there was a photograph and/or picture. However, in regards to the number of steps, menu represented using picture followed by text yielded less steps (hence least error).

These findings suggested that an elderly prefers textual presentation or icon with labels for menu representation. However, because of their decreased visual ability due to degenerative condition, makes it hard for them to read the text or label. Hence it is a challenge for mobile interface designer where there is limited space on a mobile phone screen. This study also suggests that pictorial icon representation is easier to comprehend by older people compared to photographic icon representation. Pictorial icons have less details compared to photograph icons. Consequently, it takes less time to be recognized. This finding is in line with Zikmund-Fisher et al. (2014) who found that icon type matters on the perception and recall of pictographs, because it affected the mental processing of the viewer. They also suggest that pictorial icons are a more practical choice for many purposes (compared to other type of icon such as photograph icons). Study by Guo (2016) indicated that the extremely simplified icons had similar correct icon recognition rates as those of the relatively more detailed icons. For that reason, it is recommended to use simple pictorial icon to represent menu for elderly. In any respect, it must be noted that icon should not be too simple as it may become an abstract (Zikmund-Fisher et al. 2014; Restyandito et al. 2019b). Combination of pictorial and photographs representation only add to the complexity of the menu, resulted in more time to comprehend. Icons should be designed and chosen cautiously to make it easily identifiable and do not create ambiguity (Cheng and Patterson 2011).

4 Conclusion

This research has shown that most elderlies tend to read the menu label, yet the small space on mobile device prove to be a challenge for designer as many elderly suffer from decreased visual ability. For this reason, whenever possible it is better to represent menu using text, but designer must consider the size of the font so that it is still readable. When using text is not possible, it is advisable to use a simple icon. It is noteworthy that icons should be designed as simple as possible but still identifiable by elderly.

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