Smartphone Menu Design for Elders

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INTRODUCTION

With the changing of age-related decline related to both physical and cognitive ability for elders, it is critical to develop a user-friendly system menu for a mobile phone to provide a high-quality user experience (Petrovčič et al., 2018). Numerous researches have been conducted focusing on the mobile interaction in terms of visual design, graphic design, motor control, and menu organization (Bailly et al., 2017)(Díaz-Bossini & Moreno, 2014)(Pfeuffer & Li, 2018)(Calak, 2013). However, setting the menu is hard for elders to interact with (Czaja et al., 2019).

This research will focus on the menu design of system settings in terms of structure and contents. A design prototype will be developed based on a review of related literature on mobile design guidelines and interaction design for elders, followed by usability testing on the proposed prototype.

LITERATURE REVIEW

Some general design checklists for mobile phone menu design are proposed. The aim to characterize the design space was proposed (Bailly et al., 2017). It discussed the design possibilities and compared the similarity and differences among menus by refining menu performances and reviewing existing analytical and empirical methods for quality evaluation. The type of users was classified and the evaluation methods of performance were proposed. A taxonomy of menu properties was concluded. A heuristic checklist for accessible smartphone interface design was provided by reviewing existing design standards and guidelines and validating these guidelines with user involvement (Mi et al., 2013). A set of preliminary user requirements with 59 items was extracted and re-organized into 44 statements in six general categories.

The literature review that is specific for elders was proposed. It was explored that the usability dimensions of mobile phone design, and related changes (Petrovčič et al., 2018) based on the literature view. Eight mobile phone design guidelines and checklists were demonstrated. It focuses more on dealing with visual and haptic issues and hardly addresses various elements of the textual interface.

The detailed checklist for designing the mobile phone for elders was illustrated. The usability of mobile devices for an older audience was assessed by analyzing literature on age-related physical and cognitive changes impacting smartphone usability, and gathering information on how older adults use cell phones through interviews and an online survey (Calak, 2013). It proposed a heuristic evaluation framework on vision, hearing, attention, memory, and motor control. It demonstrated that the strength of support for some

heuristics increases with age. The accessibility of mobile phone app for elders was also considered (Silva et al., 2014). It concluded with a heuristic list of 35 items.

There are some disadvantages to the smartphone interface, especially the unfriendly usability for elders (Petrovčič et al., 2018). In this paper, there are 2 disadvantages of the interface: screen display and UI design. In screen display, the screen-dimming time needs to be extended to ensure that elders have enough time for cognitive processing and executing the required operations (Hassan & Md Nasir, 2008). The research also emphasizes the necessity of applying conservative colors and using a high screen contrast between the foreground and background.

In UI design, elders always press the wrong buttons because the buttons are too sensitive to avoid accidental pressing (Kim et al., 2007). Moreover, the study points out scroll buttons should be avoided or at least minimized. Furthermore, it emphasizes that the size of the phone should be big enough to enable a comfortable grip, but also light enough for convenient carrying. Moreover, there are some elements of menu and navigation interaction for the older adult. First, they feel stress when the structure of the menu becomes deeper. Therefore, menus should be simplified and flattened. Also, the nesting of features and available options should be avoided (Gao & Koronios, n.d.). Due to the elder's thinking model is not hierarchical, a one-layer structure menu is convenient for them to operate. Second, the use of the icon is unfriendly for them. When elders see an image button, they don't have clue about the function of it. Third, function naming should be semantic understandable and minimal ambiguity.

The source of the survey and descriptive research methods were provided (Mi et al., 2013). The 2 types of mobile phone interface layouts for elders were proposed (Díaz-Bossini & Moreno, 2014).

RESEARCH QUESTIONS AND HYPOTHESES

The purpose of this research is to find ways to improve the smartphone menu usability for elders. Based on the literature review, this research raises the question of how different menu structures influence usability.

The independent variables are 2 kinds of structure: big icon grid layout and Android style home screen layout (Díaz-Bossini & Moreno, 2014). The dependent is the usability measured by questionnaire.

The hypotheses of the menu structure is proposed: the usability of the Android style layout is better than the big grid layout.

METHODS

The operational definition of menu structure:
The big icon grid layout comes from the mobile app called Big Launcher. The icons are understandable and the size is comfortable for users to interact with. The layout is shown in Figure 1.
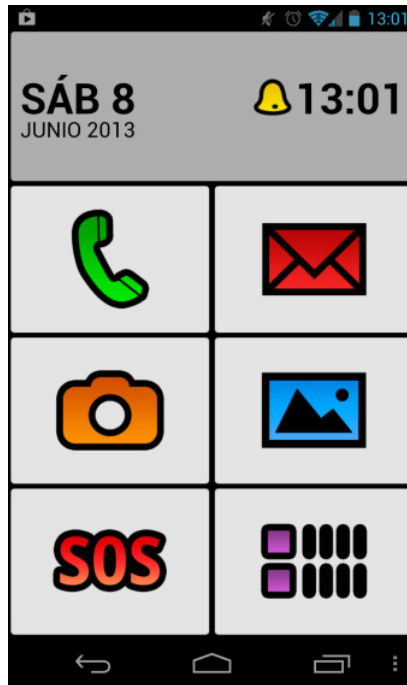
Figure 1: Big Icon Grid Layout (Díaz-Bossini & Moreno, 2014)

The Android style layout is shown in Figure 2. Compare to the previous one, the Android style layout has small icons but having text illustrations of icons.

Figure 2: The Android Style Layout (Díaz-Bossini & Moreno, 2014)

The operational definition of usability:

There are 5 criteria in usability: speed, accuracy, learnability, memorization, and satisfaction (Bailly et al., 2017). Speed and accuracy are combined together due to their strong relatedness. The learnability and memorization are combined together because they both rely on user frequency. The details of usability are summarized in Table 1.

Table 1: describe of usability (Bailly et al., 2017)

Factor	Criteria
Usability. Adequacy of menu systems for the cognitive, motor, and sensory abilities of the user	**Speed and accuracy.** Menu efficiency for selecting commands
	Learning and memorization. The capacity of the menu to allow the user to use it in an optimal way quickly and in the long term
	Satisfaction. The capacity of the menu to provide a pleasant feeling that results from the fulfillment of what the user wants

Participants:

To obtain a general result, 2 groups of healthy people age from 20 to 80 are recruited to participate in this study. Each group includes at least 5 participants (Mi et al., 2013). They will be recruited by using Facebook groups, flyers in communities, and visiting. They will be considered unpaid. A between-subjective design with each of two groups being assigned to one layout type: big icon grid style vs Android style.

Instruments/Survey Design:

According to (Mi et al., 2013), some participants will be randomly selected to test the 7 functions of the prototype. The 7 functions are:

(1) place and end a call (from the start menu, from a shortcut, and by speed dial)

(2) add a contact

(3) send a text message

(4) delete a text message

(5) turn on/off the software

(6) add an appointment to the calendar

(7) play media

There are 3 minutes limit for completing each task. A success rate will be calculated across all participants for each task. The participants are required to fill out a questionnaire about accessibility, ease of use, and effectiveness.

The questionnaire questions will be adapted from related literature (Mi et al., 2013). A five-point Likert scale (1=Very Unsatisfied, 5=Very Satisfied) will be used to evaluate the satisfaction with the following aspects of the interactions (see Table 2).

Table 2: Satisfaction Questions for Each Task

Tasks	Questionnaire
1) place and end a call	Voice-activated status/ Assignable ringtones/ Speed dialing/ Ring or vibrate Indicator/ Turnoff sound
2) add a contact	Common buttons easy to find/
3) send a text message	Message reader
4) delete a text message	Unique button shape/ Error notification/ Error correction
5) turn on/off the software	Function confirmation
6) add an appointment to the calendar	Easy access to voicemail
7) play media	Screen reader/ Battery and signal indicators/ Consistent layout

Study design:

This study will use a between-subject design. The independent variables are the type of menu structure. The dependent variable is usability.

Procedure:

First, the evolution of the mobile phone interface and the evaluation of interfaces are reviewed. Second, the design guidelines and checklists for smartphone menu design will be viewed, especially for elders. Third, finding frameworks of menu layout for elders. Then, 2 kinds of prototypes of the layouts will be developed according to the layouts, design guidelines, and checklists. Finally, the prototype will be given to 2 groups of participants separately and they will fill a questionnaire to evaluate the performance.

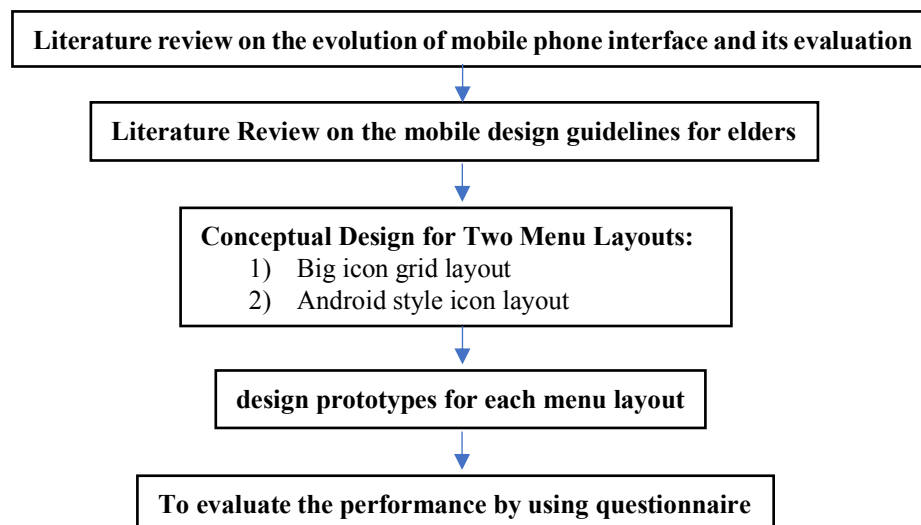The process of this research is illustrated in Figure 3.

Literature review on the evolution of mobile phone interface and its evaluation

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Literature Review on the mobile design guidelines for elders

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Conceptual Design for Two Menu Layouts:
1) Big icon grid layout
2) Android style icon layout

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design prototypes for each menu layout

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To evaluate the performance by using questionnaire

Figure 3

Data Analysis Plan:

To test the usability of each type of layouts, the descriptive analysis will be used to analyze each item from the questionnaire, including the degree of satisfaction and the rate of success. The item with the lowest mean value means it is the primary tactile marker.

To test the hypotheses, the final score for a layout is the average of the value of items. The independent T-test will be used to evaluate if there are significant differences in layout preferences between the 2 groups.

References

Bailly, G., Lecolinet, E., & Nigay, L. (2017). Visual Menu Techniques. *ACM Computing Surveys*, *49*(4), 1–41. https://doi.org/10.1145/3002171

Calak, P. (2013). *Smartphone Evaluation Heuristics for Older Adults* [Master's thesis]. The University of Guelph.

Czaja, S. J., Boot, W. R., Charness, N., & Rogers, W. A. (2019). *Designing for Older Adults: Principles and Creative Human Factors Approaches, Third Edition*. CRC Press.

Díaz-Bossini, J.-M., & Moreno, L. (2014). Accessibility to Mobile Interfaces for Older People. *Procedia Computer Science*, *27*, 57–66. https://doi.org/10.1016/j.procs.2014.02.008

Gao, J., & Koronios, A. (n.d.). *Mobile Application Development for Senior Citizens*. 11.

Hassan, H., & Md Nasir, M. (2008). The use of mobile phones by older adults: A Malaysian study. *ACM SIGACCESS Accessibility and Computing*, *92*, 11–16. https://doi.org/10.1145/1452562.1452564

Kim, H., Heo, J., Shim, J., Kim, M., Park, S., & Park, S. (2007). Contextual research on elderly users' needs for developing universal design mobile phone. *Proceedings of the 4th International Conference on Universal Access in Human Computer Interaction: Coping with Diversity*, 950–959.

Mi, N., Cavuoto, L., Benson, K., Smith-Jackson, T., & Nussbaum, M. (2013). A heuristic checklist for an accessible smartphone interface design. *Universal Access in the Information Society*, *13*. https://doi.org/10.1007/s10209-013-0321-4

Petrovčič, A., Taipale, S., Rogelj, A., & Dolničar, V. (2018). 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, *34*(3), 251–264.

https://doi.org/10.1080/10447318.2017.1345142

Pfeuffer, K., & Li, Y. (2018). Analysis and Modeling of Grid Performance on Touchscreen Mobile

Devices. *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems -
CHI '18*, 1–12. https://doi.org/10.1145/3173574.3173862

Silva, P. A., Holden, K., & Nii, A. (2014). *Smartphones, Smart Seniors, But Not-So-Smart Apps: A
Heuristic Evaluation of Fitness Apps*. Springer International Publishing.

https://doi.org/10.1007/978-3-319-07527-3_33