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Connecting Elderly and Digital Devices: a Literature Review of User Interface Studies for Indonesian Elders

Ketut Ajeng Sespiani[1*], Niken Febrina Ernungtyas[2]

[1,2]University of Indonesia, Jakarta, Indonesia
Email: ketut.ajeng@ui.ac.id
Email: nikenfebrina@ui.ac.id

Abstract
The impact of rapid change in technology infrastructure expedites our global economy. Today, most people in the big cities are inseparable from digital technology. Meanwhile, those who are unable to adapt are at real disadvantages. With the surging population growth of an aging society, these disadvantaged people are mainly elderly. Widespread dependency can become a catastrophic problem if not addressed immediately. Therefore, developing user interface (UI) designs specifically tailored to the needs and capabilities of elderly users are crucial. By using a descriptive qualitative approach by collecting various previous studies, the result of this paper suggesting that colourful interface, minimum icon usage, grid menu and bigger font size are the features that able to help the elders to operate digital devices. Moreover, the government's role is needed to enhance the willingness and confidence of older adults by setting up the pieces trainings of digital devices throughout regions especially in rural areas.

Keywords: *elderly, literature review, user interface, Indonesia*

Paper type: *Research paper*

***Corresponding author**: ketut.ajeng@ui.ac.id
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INTRODUCTION

In the last twenty years, all aspects of our lives have been made easier with the help of technology. Digitalization is also inevitable, both the service sector and existing resources utilize digital devices and continue to adapt to the existing technological trends. One of the many examples of modern application of technology in everyday life is the use of smartphones. The use of smartphones is not only limited to making calls, or sending messages but has penetrated into social media, shopping, playing games, and health aids. Not only are they needed for adults, smartphones are a huge necessity for elderly. But unfortunately, unlike in developed countries where elderly individuals can take advantage of technology well, most elders are digital immigrants in Indonesia. The elderly population in Indonesia is not tech-savvy and is already fluent in using computers, telephones, and other information technologies (Restyandito, Kurniawan, and Widagdo 2019).

According to the Ministry of Health (2019) the number of elderly people has increased, where in 2010 there were 18 million people or around 7.6% of the total population in Indonesia to 25.9 million people or around 9.7% in 2019. This number is predicted to continue to increase to 48.2 million people or 15.8% in 2035. Thus, with the increasing proportion of the elderly population, attention is needed in various aspects as well as special handling so as to ensure the success of their quality of life (Fan, Forlizzi, and Dey 2012).

In elderly's perspective towards the use of digital devices, smartphone utility is expected to elevate communication processes both with family and close relatives (Beer and Takayama 2011). Unfortunately, the existing technology, especially in regards to the effective utility of smartphones, is still a complex challenge for elderly. Though the elders have a healthier, more prosperous life, have better access to education, and have basic skills in using mobile devices, computers, and related technologies (de Barros, Leitão, and Ribeiro 2014). There are still many available user interfaces that focus on the needs of youngsters while the needs of the elderly are ignored, therefore it is difficult for the elderly to adapt to complex user interfaces to meet their needs (Krayz Allah, Ismail, and Almgerbi 2021). The older adults tend to think that even though many design recommendations have been provided to facilitate the user interface of elderly

users in their application in everyday life, there are still complaints from the elders who feel that the product is not tailored for them (Liu and Joines 2012). However, smartphones are required to improve their competence to adapt to new situations that they have never lived in before with increasing challenges as they age while digitalization can't be avoided. As for the pressure felt from society, family or even within oneself which ultimately forces elderly to adapt to what is being done by others, especially in respect to current technology issues (Ronning and Solvberg 2017).

Fairly complex appearances and features of digital application interface makes a barrier between elderly users with the devices they possess (Preeyanont 2017). The omnipresent obstacles require serious attention to design an interface experience that elevates physical and cognitive burden while precisely answering the needs of elderly users

The underlying problem in terms of smartphone utility among elderly users can be answered through a user interface design specifically accustomed to elderly characteristics by facilitating effective interactions that can accommodate users to run their daily activities with ease. The focus towards enhancing elderly users' experiences in using smartphones effectively should not be underestimated considering the sharp increase of ageing process around the world and the global working population growing much less from 1970 to 2005 and now established ageing society.

The long-run trend of global working population growth faces an end as the fertility rate has dropped significantly. At the same time, the world is witnessing extreme acceleration of ageing process particularly in high income countries. As the self-sustaining rate in halt and life expectancies continue to increase, elderly aged 60 years or over will account for 17% of Asia population in 2030 along with the surge of dependency ratio (Goodhart and Pradhan 2020). We can see from the report from the Indonesian Ministry of Health (2019), the number of elderly people has increased, where in 2010 there were 18 million people or around 7.6% of the total population in Indonesia to 25.9 million people or around 9.7% in 2019. This number is predicted to continue to increase to 48.2 million people or 15.8% in 2035.

It began in the early 1970s when the death and birth rates were very high in Indonesia. Women usually give birth to 5 to 6 children in their lifetime, while the life span is 46 years. Thus, the Indonesian government has begun to aggressively introduce family programs to reduce serious illnesses and increase access to quality health facilities. Over time, efforts have been made to minimize birth and death rates, and life expectancy has also increased from 45 years to more than 65 years. The average Indonesian enjoys a longer life span. As a result, in 2010, the age structure began to shift to a higher age group (Adioetomo Sri Moertiningsih and Mujahid Ghazy 2014),

The concern in regards to ageing society has been a critical concern in Japan. As a home to the world's most aged population, Japan takes a few steps ahead in defining their population decline problem with "hyper-ageing society." This naming marks the idea behind Japanese 5.0 Society which is expected to provide human welfare, launching sufficient solutions to facilitate elderly care by integrating artificial intelligence in many aspects of humanity including health (Elsy 2020).

Therefore, the provision of digital infrastructure has to be inherent to the diverse social needs. Both technological and non-technological post humanization are required to build a firm paradigm of society 5.0 whose population is mostly accounted for by older adults. The need for elderly to be connected with advanced technological post humanization comes from two technological dynamics in today's society. First, the growing use of mobile and augmented virtual reality devices for many daily purposes from social media interactions, business and commercial transactions, to online medical check-up. Second, the ardent pursuit enhancing artificial and emotional intelligence to be pervasively used in daily life (Gladden 2019). Therefore, ageing society faces the challenge of adopting sophisticated technology in order to sustain their daily life, as well as sustaining economies.

Greatly associated with the work of visual touch in digital devices, user interface is a communication concept with a goal of achieving effective communication between users and a digital product. In this sense, user interface design encompasses objective principles of communication skills that allow users to perform tasks successfully through various design decisions. Therefore, the user interface is not limited to subjectively accomplishing great visual aesthetics.

Ideas about visual details such as control selection, icon design, color and animation are manifested in a way that serves as a comprehensible and intuitive function to the users. By taking a user centered approach, user interface designers evaluate their product by how effective it communicates with users with a final outcome of natural conversation using the language of user interface guidelines (Johnson and Finn 2017; McKay 2013).

Distinguished from user experience which comprises the entire experience of using a digital product, user interface covers what users can immediately see and feel when using a product. Rather than stressing the abstract aspects of product experience such as ordering, customer and technical support process, user interface only addresses the actions that users must do, be it to click "approve" before proceeding to the next step of a transaction or to choose which font style a user wishes to use before writing a story caption. In many ways, these decisions are designed according to users' perception of quality as the best visual appearance is the one that fits users' purposes (Johnson and Finn 2017).

Describing goals and actions needed to be taken according to users' needs, (O'Sullivan 2011) explains that user interface guidelines must follow fundamental laws based on human psychology. Other than expertise of curating graphical and visual experience, understanding how human perception is formed and affected by the past, present and future as well as acknowledging how the human perceptual system has been primed are important to overcome design complications. With this strategy in mind, user interface is a design applicable towards careful interpretation to specific situation.

In a modern society constructed by a digital technology infrastructure, people who are not connected are at real disadvantages. With the expanding growth of an aging society, more than half of these disadvantaged people are elderly. Compared with younger users, elderly have been imposed with a knowledge gap as most digital devices are not designed for their decreasing capabilities. However, while not being savvy, the nature of their understanding about how the world and society works is far more comprehensive than their younger peers. Elderly's needs for suitable digital devices should not be neglected as they possess a greater task-domain knowledge. Therefore, empowering the

elderly with a user interface design which manifests into digital-friendly devices becomes a vital necessity that is not only ethical but certainly logical (Johnson and Finn 2017).

In advancing technologies to be leveraged with the idea of better life quality for elderly, user interface designers must understand the common challenge faced by elderly which is mainly divided into three categories. First, the physical challenge that addresses many forms of deterioration such as impaired eyesight such as a high level of sensitivity to light and difficulty distinguishing colors (Eichenbaum 2012) which results in ineffective task performances, reduced fine motor skills, and compromised hearing system. The other challenge includes problems faced with computer experience. They will quite often sit around squeezing all through layers to see content (Lin, Lin, and Yueh 2014) or on the other hand leisurely sort messages or make mistakes and wrong orders while utilizing the telephones (Nicolau and Jorge 2012; Rodrigues, Carreira, and Gonçalves 2014). Some don't even understand several functions that can causing errors when sending phone commands (Zainal, Razak, and Ahmad 2013). Elderly's unfamiliarity with the interface has been a major reason for reluctance towards using the technology. Outdated knowledge and limited understanding of basic principles makes simple tasks difficult to perform. Lastly, cognitive issues such as attention, working memory and long-term memory also render difficulties in optimizing utility of digital devices mostly designed for younger adults who have not yet experienced these problems (Dodd, Athauda, and Adam 2017).

User interface design has been perceived as one example of a sustainable approach to elevate the economic burden of caring for elderly. With the aim of maintaining older adults as self-sufficient as possible, interface design should reduce elderly's experience of unfamiliarity with modern technology. By following guidelines that carry natural conversation between elderly and digital systems, user interface design may contribute to four major needs of elderly. First, by implementing effective intuitive interaction and reducing cognitive burden, a user interface design can gain the ability of living independently as elderly continuously experience memory and physical deterioration. Second, to reduce loneliness by upgrading elderly's social skills through digital technology. Third, to assist elderly in monitoring personal medical information and sustaining their healthy living. And finally, to prolong learning skills through informational and

educational applications such as newspapers, dictionaries or brain test games with easy to follow instructions (Cheng and Sabran 2021).

With increasing dependency rates towards non-human assistance, innovating digital devices for older adults becomes crucial (Goodhart and Pradhan 2020), ant attention is needed in various aspects as well as special handling so as to ensure the success of their quality of life (Fan et al. 2012). Therefore, this article aims to study research literature on user interfaces specifically designed for the elderly in Indonesia and understand the variety of problems identified regarding their smartphone's utility as well as the implemented user interface decisions to achieve an organic interaction between elderly users and digital products. Moreover, by analyzing the types of user interfaces that have been conducted in the previous studies, this paper could examine and summarize the types of user interfaces that could mitigate the barriers for elders in order to adapt to digital devices.

METHOD

This study uses a qualitative approach that aims to explore and understand the meaning and problems that occur in the context of user interface design for elderly. Data analysis was conducted inductively, starting from specific things to general themes to allow researchers to make an interpretation of the meaning of the data. The results of the study put forward the element of flexibility with a focus on individual meaning and the importance of interpreting the complexity of the situation (Creswell 2013). In addition to using a qualitative approach, the researchers conduct a literature review to help determine research topics that are worthy of deepening and to limit the scope of the research. After the researchers identify the topics to be studied, a purposive search of Indonesian literature published in international journals related to the chosen topic can be implemented. In addition to sharing the results of relevant studies might provide a framework for establishing the importance of research and benchmarks for comparing results with other findings. Incorporating a literature review into research with a qualitative approach can help strengthen the research problem, but does not limit the views of participants (Creswell 2013).

To conduct a literature review according to Snyder (2019), several steps should be followed, including: 1) it determines topics and looks for journals with issues related to user interfaces and an aging society by considering articles and literature published from 2011 to 2021 that are still relevant to the current phenomena; 2) screening research by collect articles with specified keywords and analyze them with existing phenomena in Indonesia.; 3) perform analysis by elaborating cases and concepts from the selected theory; 4) write reviews and draw conclusions that can contain suggestions for further research.

RESULTS AND DISCUSSION

Loneliness is a major problem faced by old parents, especially for those who live far away from family members (Durick et al. 2013). The situation often occurs when adult children live independently, resulting in decreasing attention towards parents. Meanwhile, children's increased mobility causes a decrease in communication and interaction with old parents. Possible impacts of loneliness and lack of interaction experienced by the elderly are isolation and depression. Therefore, the role of communication is a solution.

By utilizing social media, interactions between parents and families as well as relatives can be facilitated. Technology allows them to share contacts and information via text, images, sound, and video. Restyandito et al. (2020) mention that social media features such as Facebook are unfortunately only intended for people who are technology savvy, while old parents find it difficult to operate them.

It has been common knowledge that for decades parents in Indonesia experience a wide technology gap, meaning that not everyone has the same opportunity to access technology. Parents often find it difficult to adapt to technology because of their lack of skills and knowledge are making them reluctant to learn new skills in using technology. As elderly users face difficulties in using technology, the complex appearance of digital applications becomes an important reason. Thus, to encourage parents to embrace technology in their daily lives, a non-sophisticated application design is a better option. Furthermore, Restyandito et al. (2020) argues that it is important to consider a more friendly human-computer interaction and participatory design approach to track elderly habits, behavior and physical and mental health.

With a supportive research environment, Restyandito et al. (2020) created a WhatsApp prototype that has been modified to be more user-friendly for elderly. WhatsApp was chosen as parents are more familiar with its features and their experience helps researchers to better understand their knowledge in utilizing WhatsApp. This prototype application was designed with various features selected based on the habits and social activities of parents offline and online, including telephone features, video calls, text messages, communities, and entertainment (connected to YouTube content tailored to user preferences) as well as notes. The shortcut feature was designed to make calls available in each part of the application, reducing the burden of memorizing each step of making a phone call. The features developed in this prototype are limited to the main necessity features to minimize the physical and cognitive load prior to various menu choices and symbols. Seven tasks are assigned in this study, ranging from making phone calls or video calls to finding information in communities.

Based on the result, 80% of users can input mobile phone numbers into contacts during the first task. On the second task, 100% of users can find the call history successfully. The result of task three shows 100% success of making video calls. Users on task four were asked to look for announcements in the community and as many as 90% of users succeeded. Next, 90% of users succeeded in searching video content. 100% of users succeeded in making phone calls during task 6. And finally, task seven asked users to make voice notes. During this session, failure in memorizing and understanding steps of making voice notes and distinguishing icons made users fail the first and last task. Lack of familiarity with the design interface also contributes to their failure, as these elderly are used to using conventional phones, therefore there is no memory in operating a smartphone that can lead them to successful task performance.

Addressing different elderly issue from Restyandito et al. (2020), the study conducted by Putri, Junaedi, and Suwawi (2020) created a scheduling application to remind elderly of taking meals, exercising, and making phone calls, setting an appointment for therapy and medical check-up. In Indonesia, scheduling applications are not novel, they are already available but mainly targeted for younger users. With elderly who depend more on reminder assistance are not

finding a scheduling application that is specifically tailored according to their comprehension. Overcoming this issue begins with collecting users' experience of perceived deficiencies and unmet need in the existing applications.

The next step comprises designing the UID patterns, to better exhibit elderly needs and habits in utilizing smartphone applications executing the principles of User-Centered Design (UCD), which is a method for dealing with repetitive design problems. UCD was chosen as it involves the elderly users throughout the design process to create a product suitable for them in the form of mock-up.

The effectiveness of the mock-up was measured using the USE questionnaire evaluation with three parameter measurements of usability, ease of use, and satisfaction. The result shows that the UID Pattern model for activity scheduling applications provides. Adequately provides solutions to recurring design problems, the result of the UID Pattern model emphasizes the importance of easy-to-read text size and easily identifiable buttons. However, complex and sophisticated steps needed to be taken to perform task and ineffective communication from product to users cause elderly get bewildered resulting to an insufficient scheduling application.

Creating an application system that address the deteriorating spatial perception, compromised visual processing, and faded problem solving skills, Restyandito, Kurniawan, and Widagdo (2019) identify common visual elements in user interface design which are icon design comprising representation, size and type, menu layout of horizontal, list and grid style, and menu representation of text based, icon based, picture based, and icon and picture based.

Moreover, two experiments were carried out to measure the cognitive abilities of respondents. The first experiment uses a “Wechsler Adult Intelligence Scale” (WAIS) block design which comprises a human intelligence assessment to test spatial visualization abilities and motor skills. Meanwhile, the second test is the “Mini-Mental State Exam” (MMSE) Which distinguishes different menu layouts of horizontal, grid and list. The results of this study found that the grid menu can increase effectiveness in user interactivity as all menu and product categories are presented at the same time on one screen with the downside of small images causing another problem for elderly with poor eyesight. Furthermore, the horizontal menu displays images in large size with a trade-off that demands

elderly to memorize position of each product categories from different vertical displays. Lastly, the list menu layout is the worst performing user interaction design.

Pepita and Juhana (2018), introduced Ambient Assisted Living (AAL), which automatically records and retrieves health information of elderly. Integrated with Google Firebase, users are provided with the user's heart rate, remote condition, and data which detects heart abnormality symptoms. To create sufficient medical care for elderly, this study used two Samsung Android Mobile in the form of a smartphone used by elderly users, and a smartwatch used by family members for health information monitoring. Having successfully recorded and transferred heart rate information through the Firebase system in real time, as well as automatically sending emergency SMS to family members with an average delay of 5.4 seconds, this result emphasizes the process of transforming numerical and alphabetical data into a graphical form. This design approach relies on simplicity of data presentation, allowing family members to easily comprehend elderly's health conditions.

Through Octavia and Anindita (2017), researchers tested three well-known Android launchers (Big, Necta, and Wiser) using the System Usability Scale (SUS) test based on five criteria, namely effectiveness, efficiency, satisfaction, usability, and capability. These three applications are the top three special applications for elderly users that are most downloaded on the Playstore. The results of the SUS test show that the effectiveness and efficacy of the Android 3 Launchers are below acceptable standards. Meanwhile, the standard for each launcher is rated: Big 49.72, Necta 66.38 and Wiser 51.11.

Based on the results obtained, the researchers decided to create a new launcher as features needed by elderly users have not been met by existing ones. Moreover, the new launcher has eight features such as My Contacts, Dialer, My Number, SOS, Camera, My Apps, All menu and All Apps. Researchers use a colorful interface to help elderly users identify icons and features more easily. One of the main advantages lies in the SOS feature that can be used when an emergency situation occurs where users can easily call an emergency phone number. Based on interviews with users, the abundance of icons, images and

logos on smartphones makes it difficult to find specific applications. To solve the problem, My Apps feature is created to list the most frequently used applications. Therefore, the new Android Launcher created based on information on the suggestion of twenty-four elderly users was proven to be more sufficient, with the percentage of effectiveness increasing by 42.5% and the percentage of efficacy increasing by 65%. The overall usability level achieved by the new launcher is 69.17, above the standard values of Big, Necta and Wiser.

Based on the literature review of studies about user interface design for elderly, a number of issues regarding the life quality of elderly have been addressed. The first problem is loneliness experienced by elderly as they are distanced apart from family members. With outdated knowledge of modern technology and complex devices designed for tech savvy users, elderly users are discouraged from using smartphones, resulting in prolonged isolation from families and society (Restyandito et al. 2020). Health and medical care is also another prevalent issue of elderly who have high dependency towards the external environment along with deteriorating physical and cognitive ability. Addressed by Putri, Junaedi, and Suwawi (2020), an Ambient Assisted Living gives a general yet daring form of unprecedented elderly's dependency in ageing society towards an assistant to better evaluate health conditions. The application developed by Pepita and Juhana (2018) does not only speak about the need for health assistance but also the lack of effective reminders that work for elderly. Hence, short-term memory is an occurring problem among elderly and sophistication in digital devices only worsens this condition. In fact, elevating cognitive load has been attempted in all literature studies by eliminating redundant features and minimizing applications.

In the case of developing a WhatsApp prototype conducted by Restyandito et al. (2020), the researchers realized that minimizing the amount of icon design is important to achieve simplicity. Types of features and functions provided in the prototype are based on elderly's needs and most frequent activities. The provision of functions other than making phone calls, video calls and sending text messages such as digital community platform, entertainment and notes applications will burden the user's memory unless the users are used to the activities provided by those applications. The wide range of selection and abundant logo icons results in the insufficiency of this prototype.

Furthermore, having elaborate steps of processes in performing a task is also a downside of digital products. The result from an experiment by Putri, Junaedi, and Suwawi (2020) explain a user interface that fails to communicate in a straightforward manner became the reason for elderly users uninstalling scheduled applications that was supposed to be a helpful reminder.

The other approach to reduce cognitive burden and achieve simplicity focuses on the visual touch point of a product which is still a common strategy in maximizing the experience of using digital devices. Attention towards visual details such as layout menu, icon design, choice of text size and color scheme occur in each article despite the different types of digital application being created or improved, and the diverse problem wanted to be solved. Octavia and Anindita (2017), conducted a new launcher design with a limited range of applications called My Contacts, Dialer, My Number, SOS, Camera, My Apps, All Menu and All Apps. Asserting the sense of possession or belonging with the use of "my" helps elderly users better identify with the different purposes of each necessary feature. Colourful interface in icons and features is reported to reduce cognitive load. Similarly, another interface design study by Restyandito, Kurniawan, and Widagdo (2019) use this strategy to improve layout menus in smartphones by taking elderly's cognitive characteristics into account. Instead of applying a visual touch from the designer's personal preference, objective decisions regarding visual design are proven to be critical in helping users to complete tasks and achieve their goals successfully.

Based on the elaborations above, there are several user interfaces that can assist the elders in adapting to new technologies especially smartphones, including the application of a colorful interface, minimum icon usage, grid menu and bigger font sizes. To adapt into the technology and bringing the friendly user interface requiring a lot of efforts especially for the elders. In Puspitasari and Ishii (2016), mentioned that younger and educated people can take advantage of the features on mobile phones to a certain extent. Meanwhile, individuals with low levels of education and older will be more fluent in using feature phones. The main reason is partly due to differences in individuals' ability to access and use information communication technology.

CONCLUSION

Possessing a greater task-domain knowledge compared to their younger peers, elderly are often overlooked in terms of sufficient digital devices that suit their needs. The provision of technological post humanization for digital assistance can no longer be neglected as the surging global elderly population and sharp decline of fertility rates result in high dependency. With this trend continuing to expand, the prediction of our future is terrorized with pervasive dependency. Reliance towards digital assistance will grow with elderly's skill and comprehension are challenged to quickly adapt with sophisticated technology. However, the expectation towards elderly to adjust with digital devices must shift to the creation of user interface design that can elevate their problems, functioning as their personal assistance. The synthesis of user interface studies conducted in Indonesia suggest that designers should start with a careful understanding regarding both physical and cognitive challenges experienced by elderly, before stepping into the design process. By prioritizing objective decisions, designers must understand the trade-off in implementing certain guidelines, choosing visual simplicity, customizable fonts and colorful interface then effectivity over personal aesthetic preferences to conduct an organic communication with users. But to enhance the willingness and the confidence of older adults to interact with digital products, the government should take part in setting up training programs throughout regions regarding how to operate digital devices, especially in rural areas-considering that the elderly often doubt their ability.

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