Designing Mobile-based Chat

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Designing Mobile-based Chat Application for Elderly

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***Abstract*—Technology development has been very rapid, and the users are diverse, ranging from small children to the elderly. One thing most often used today in technology is a smartphone for entertainment or productivity. However, not all people can follow the existing trends due to physical or cognitive conditions, especially for elder people. It is known that with increasing age, motor and cognitive functions begin to decrease, which can affect the use of applications/smartphones. In this study, several universal design principles will be tested to determine whether these principles can be applied to mobile applications specifically for the elderly. Quantitative and qualitative methods, based on task time and input from respondents on each task, will be used to conclude whether the above principles can help. From this study, it can be concluded that there are principles that can help the elderly use applications such as large button sizes, but some are not due to the habits of the elderly or other external factors.**

***Index Terms*—user-centered design, mobile applications, elders**

I. Introduction

Smartphones users are spread from the young to the elderly [1]. However, not all people can enjoy/use smartphones easily, especially the elderly. Due to old age, cognitive, motor, and sensory functions do not work like when they were young [2]. These abilities will decrease, which causes the elderly to be unable to use smartphones easily [3], [4]. This also causes the digital divide to occured, which makes it difficult for the elderly to interact with the community through technological intermediaries [5], [6]. The use of warm colours, the use of large font sizes for easy reading, reducing the number of actions to achieve certain targets, and many other things are techniques for building a good display design for parents/elderly. However, these principles are not specific to the display of mobile applications but rather a good display for parents in general.

In the past, smartphones were not as much as now. People are starting to switch to using devices that are more practical to carry compared to computers which take up more space and are difficult to carry. Because a mobile computer (smartphone) differs from a personal computer, other application design principles specific to mobile have emerged. The two devices are different in the physical aspect and the constituent components. The interface on a smartphone must be structured using certain rules to support various variants of existing smartphones based on several parameters, such as screen size and ratio [7].

A mobile application is a program that runs on a mobile device/smartphone, composed of a software set of programs that can perform several user commands [8]. The difference in the characteristics of mobile applications with web/desktops can be seen from the screen size where applications can be run, with smartphone screen sizes which tend to be smaller than monitors where web/desktop applications usually run. The way to interact with smartphone applications tends to use a touch screen compared to web/desktop applications, which predominantly use input-output devices. Smartphones that tend to be handheld (designed to be held by hand) are easier/more practical to carry.

In this study, an application will be made based on several principles of a good display/layout for the elderly, with a case study of chat applications to find out whether some general display principles to accommodate the elderly can also be applied to mobile applications [9]–[11]. The chat application was chosen because currently, this type is the application that is most widely used by people in daily life in various aspects such as casual chatting, transactions, or ordering certain services and services [12]. This research was conducted with the hope that the elderly can use smartphones and applications more so that it is expected to reduce the level of loneliness caused by a lack of social activities, communication, and other activities that require other people. Apart from reducing loneliness, this research can be applied as a basis for making further applications aimed specifically at the elderly and universally.

II. Literature Review

There is previous research on building a particular chat application for the elderly using the Elderly-centered Design

method [13]. The study was quite successful because the resulting application can be used properly by the elderly. This research will try to use a more general approach, namely user-centered design, with the aim that the resulting application can be used by everyone but is still friendly for the elderly.

The main focus of this research is designing mobile chat application for elderly using the standard User Centered Design method combined with design principles for older adults [3]. In contrast, the UCD method is a method that focuses on who the product/application will be aimed at. The method has 4 phases/processes (1) Specify the context of use. (2) Specify requirements. (3) Create Design Solutions. (4) Evaluate designs.

In the first phase, specify the context of use or specify the target user. In this phase, the target user of the product/application is identified, the intended use of the product/application to be made, and under what circumstances the user will use the product. This phase will be the basis for data collection in the next phase.

The next phase, specify requirements or determine the needs of the product/application. In this phase, the tester collects data, a requirement that must be achieved so that the design can be said to be successful. This phase can be done in various ways, such as through Literature Review, interviews, observations, and others. Literature Review is a data collection method in which the examiner collects data from existing journals by the research to be carried out. Interviews are conducting direct questions and answers to the target users. At the same time, observations of the target users using products/applications are similar to those made by researchers. After that, the creating design solutions phase is carried out, or design solutions from the data collected through available methods (i.e. Literature Review). This phase can be repeated to refine the design until it becomes a design that fulfils the purpose of making the product/application. In the last phase, design evaluation, the researcher tested the results of the design based on the data to the target, in general, using the usability testing method. The testing results will be used as feedback from the designs made for conclusions.

Usability testing is the testing phase of a product/application that has been designed to determine whether the product is suitable for external use [14]–[16]. One of the testing techniques is usability testing. This technique aims to evaluate the results of products made/designed. In usability uesting, the examiner assigns several tasks to the respondent while recording the respondent's behaviour during the test, and also the feedback from the respondent is recorded. In its form, usability testing can be either qualitative or quantitative.

Quantitative usability testing focuses on collecting the performance of a given task, either from task completion time, success rate, or the number of errors [17]. In other words, quantitative research is numerical data. The data obtained from the quantitative research results can be used as a basis for whether the design can or cannot be used as the final design. However, this data makes researchers unable to determine what problems make respondents experience difficulties [18]. Qualitative usability testing focuses on the respondent's experience in carrying out the given tasks. With data that focuses on respondents' experiences, researchers can conclude what designs can be easily understood by respondents and what problems they experience. Furthermore, researchers can determine what designs can be applied, changed, or not used [19]. In this study, quantitative usability testing was carried out, and several qualitative usability tests were added to get responses from respondents on whether the principles applied were helpful.

In determining the number of respondents, the Slovin formula is used with the following equation:

$$n = N/(1 + Ne^2) \tag{1}$$

Where n is the number of samples, N is the total population, and e is the margin of error.

Respondents from this study were elderly, where the World Health Organization categorizes the elderly into two groups, namely the elderly group (ages over 65 years) [20] . Along with increasing age, the elderly experience degenerative conditions that impact reduced physical and cognitive abilities [3].

One of the characteristics of the elderly is that from a psychological/mental point of view, the elderly tend to feel lonely, which can lead to psychological disorders, which can indirectly make the body vulnerable to depression, decreased quality of life, to suicide (Haris et al., 2015). Therefore, social activities can help the elderly avoid things that can cause feelings of loneliness.

The other aspect is the physical aspect. With increasing age and motor performance, a person's physical will decline, which can trigger the elderly to get the disease. It is not uncommon for the elderly to be unable to maintain their immune system and body fitness level with exercise like when they were young.

III. Research Methods

This research aims to determine whether some of the principles from the "Design principles to accommodate older adults" [3] can also be applied to mobile applications. So, usability testing was carried out on the elderly as respondents, where these principles were applied/applied to mobile applications with social media case studies. The case study selection was based on research using the Slovin formula to determine the number of respondents. The study was conducted in a HASH sports community with a population of (N) 27 people, and the margin of error (e) was set at 0.05.

$$n = 27/(1 + 27 * 0.05^2) = 25.2927 \tag{2}$$

So that the calculation is obtained as shown above, which is a total of 26 up (rounded up).

In addition to collecting data on the elderly, random sampling of non-elderly persons aged 19-59 years was also conducted with the same number as the elderly group. Furthermore, the respondents obtained as follows: The implementation of the phases in the UCD method in the application is made as follows: 1) Specify the context of use: the research subjects

are the elderly aged 60 years and over, and the research object is some of the design principles contained in the journal "Design principles to accommodate older adults". 2) Specify requirements: application of literature review to the journal "Design principles to accommodate older adults" to obtain several principles that will be applied to the mobile application: a) Use of fonts/writing sizes above 12. b) Use of warm colours/warm(red, orange, yellow). c) Reducing the activity of sliding/sliding to achieve a goal due to weakened muscle strength and reduced coordination to do something. d) Use fonts such as Sans Serif, Arial, Helvetica, Serif, Century Gothic Times, Bookman, and Book Antigua; In this context, the Arial font is used. e) Writing in black on a white background or vice versa. f) The use of Capslock attracts attention, but not for long sentences. g) Use of large buttons. Then in phase 3) Create the design solutions: the selected principles are applied to create applications focusing on chatting/social media applications for the elderly. Then the last phase 4) evaluate designs: some things in the mock-up are removed to make it easier for the elderly to use the application, or in other words, shorten an activity to achieve goals such as removing the notification screen that something has been made (group created, friends added successfully).

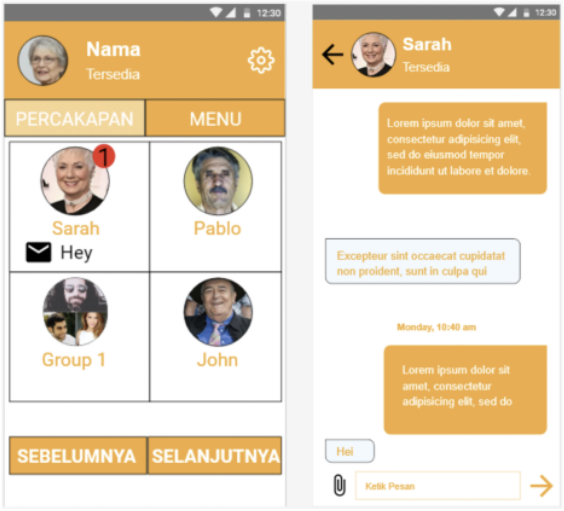

Fig. 1. Example of Chat Application UI

After creating an application with these principles as shown in Fig.1, several tasks are used as testing in Usability Testing, which is based on some of the main functions of a social media/messaging application. There are six tasks, namely: 1) registering, 2) creating a group/community, 3) joining a group/community, 4) sharing photos with a group/community, 5) changing the name/photo on the respondent's profile, 6) joining a group/community. In each task, the time will be recorded from the start. Some buttons should not be pressed, and when the button is pressed, the number of errors will be added and used for the next calculation.

Apart from quantitative data, qualitative data was also collected, using the interview method at the end of completing all tasks, with the following questions: 1) Is the button size enough/less/too big? 2) When given a choice to slide or press, which one do you prefer and why? 3) Is the size of the text enough/less/too big? 4) Does the colour suit you? 5) Is the icon size enough/less/too big? ; with the hope that the results of the answers will be grouped into positive answers (supporting/stating that the principle can help) and negative (considering that the principle is not suitable to be applied).

IV. Result and Discussion

A test was carried out on 52 respondents consisting of 26 older people and 26 younger people. by calculating completion time from six tasks:

1) T1: Register
2) T2: Creating a group/community,
3) T3: Joining a group/community,
4) T4: Sharing photos with a group/community,
5) T5: Changing the name/photo on the respondent's profile
6) T6: Joining a group/community (2nd)

The result was shown in Table I.

To prove that the ability of the elderly and non-elderly to operate smartphones is different, quantitative measurements (task time) from six tasks were carried out using the single factor ANOVA method with the following hypothesis: H0: there is no difference between the average time of the elderly and non-elderly groups, and H1: there is a difference between the average time of the elderly and non-elderly groups as present at Table II.

From these data, it can be concluded that the accepted hypothesis is H1. The ability to learn new things from the elderly and non-elderly is different due to age. So the time to complete tasks becomes longer, proven by the F value, which is much larger than the F-crit value.

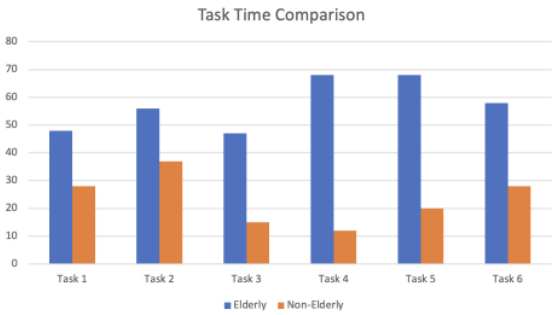

Fig. 2. Task Time Comparison Between Elderly and Non-Elderly

The task time ratio of elderly to non-elderly from Fig.2 was shown in Table III.

The total completion task time from elderly group (26 participants) can be divided into three based on their job:

TABLE I
TASK TIME RESULT

#	Occupation	Age	T1	T2	T3	T4	T5	T6
1	Housewife	61	52	37	124	96	51	22
2	Entrepreneur	73	16	55	57	61	76	44
3	Entrepreneur	66	19	80	87	91	58	57
4	Marketing	60	88	64	29	94	83	72
5	Entrepreneur	73	30	70	57	63	65	95
6	Teacher	67	32	43	54	120	113	74
7	Employee	62	52	56	56	151	125	108
8	Housewife	64	34	45	56	58	74	42
9	Teacher	74	67	58	63	105	95	52
10	Housewife	66	39	42	42	127	29	41
11	Housewife	60	25	45	69	34	138	40
12	Employee	62	41	48	53	102	49	48
13	Teacher	60	122	67	25	70	155	49
14	Housewife	60	32	53	17	49	31	69
15	Teacher	61	32	48	44	32	36	53
16	Entrepreneur	62	42	25	65	32	37	95
17	Teacher	62	54	49	31	58	65	36
18	Housewife	63	62	59	37	42	27	60
19	Entrepreneur	60	52	52	36	67	52	53
20	Housewife	68	49	63	42	53	56	42
21	Entrepreneur	60	44	45	21	35	51	59
22	Entrepreneur	60	56	104	19	27	109	54
23	Housewife	62	50	52	39	48	29	81
24	Nurse	60	37	72	24	62	56	30
25	Housewife	66	67	62	30	45	47	67
26	Housewife	70	47	61	37	35	49	36
27	Student	22	29	38	11	10	20	20
28	Student	21	34	33	11	10	20	20
29	Student	22	32	53	12	14	18	19
30	Student	22	14	17	17	6	7	17
31	Student	21	17	28	8	8	14	18
32	Student	21	37	30	9	9	18	15
33	Student	22	57	62	14	21	30	44
34	Student	21	19	35	16	10	15	33
35	Student	22	34	31	12	7	17	21
36	Student	22	25	44	14	15	10	25
37	Student	22	42	60	5	14	20	30
38	Student	21	33	41	15	14	26	39
39	Student	22	27	31	12	14	28	40
40	Student	21	25	34	11	13	16	48
41	Student	21	26	27	16	11	24	21
42	Student	19	20	34	15	19	13	33
43	Employee	24	25	45	21	17	26	25
44	Director	54	78	90	31	36	44	44
45	Employee	31	21	20	11	7	13	25
46	Employee	35	25	29	19	13	20	32
47	Employee	24	8	28	14	13	24	26
48	Employee	32	21	23	13	7	19	19
49	Employee	30	11	27	14	7	20	21
50	Employee	28	13	23	18	11	21	16
51	Employee	27	16	24	15	13	24	25
52	Entrepreneur	48	32	25	22	7	17	22

TABLE II
ANOVA CALCULATION

Source of variation	SS	df	MS	F	P-value	F crit
Between Groups	3479.7740	1	3479.7740	43.1323	6.33154E-05	4.9646
Within Groups	806.7675	10	80.6767			
Total	4286.5414	11				

TABLE III
ELDERLY TO NON-ELDERLY TASK TIME RATIO

	Task					
	1	2	3	4	5	6
Ratio	172.40%	156.21%	313.70%	543.96%	337.69%	208.90%

1) entrepreneurs/employees, 2) housewives, 3) teachers and others. Grouping is based on the need for a level of education to be able to become someone in the profession. From the graph, when explained in comparison, the average time needed to complete six tasks for entrepreneurs (366.56 seconds) is longer than the group of teachers and others (359.71 seconds). However, the group of housewives (308.7 seconds) can have less time because the elderly who work as housewives have more free time, so they use their smartphones more often in daily activities than lecturers who have to teach, entrepreneurs who have to keep shop. So they (housewives group) are more familiar with mobile applications than other groups.

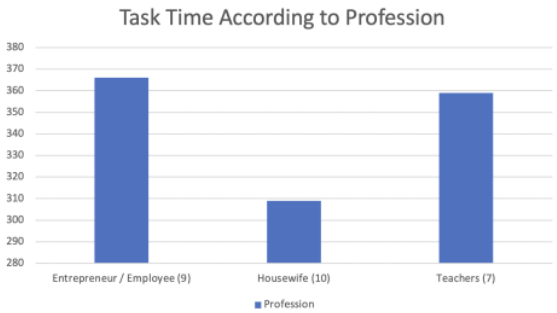

Fig. 3. Task Time Comparison According to Profession

Qualitative assessments were also conducted on both groups to ask whether the design principles could help the elderly use smartphones. There are five questions, each related to 1) Button size, 2) Slider replacement, 3) Text size, 4) Color use, and 5) Icon size. In addition to the elderly, these qualitative questions were also asked by non-elderly respondents. The answers to each question will be categorized into two categories (positive and negative) to make analysis easier. The answer criteria are considered positive if the answers lead or tend to support the design principles and negative if they are against the design principles. The result of assessments was shown in Table IV.

TABLE IV
QUALITATIVE ASSESSMENTS

Questions #	Positive	Negative
1 (Button Size)	**37**	15
2 (Slider Replacement)	19	**33**
3 (Text Size)	**40**	12
4 (Colour Use)	**33**	19
5 (Icon Size)	**49**	3

Based on the results of testing the design principles for the elderly, which are applied to mobile applications, it can be

concluded that not all principles can be well received by the elderly, such as slider shape and the usage of warm colours as shown in Table V.

TABLE V
QUALITATIVE ASSESSMENTS

Design Principles	Accepted / Not Accepted
Use of fonts/text with a size above 12	Accepted
Use of warm colours (red, orange, yellow)	Not accepted. They prefer cool colours (blue, purple, green) than warm colours.
Reducing sliding activity to achieve a goal due to weakened muscle strength and reduced coordination to do something	Not accepted. The statement was obtained from qualitative data of respondents who said they prefer to shift rather than press buttons.
Use fonts such as Sans Serif, Arial, Helvetica, Serif, Century Gothic Times, Bookman, and Book Antigua; In this context, the Arial font is used.	Accepted
Black content on a white background, or vice versa	Accepted
The use of Capslock attracts attention, but not for long sentences	Accepted
Use of large buttons	Accepted

The elderly group does not fully accept the principle of using buttons to replace the slider due to the level of procedural memory of the elderly, which makes it easier for them to do things that have been done for a long time. In this case, elderly respondents are already accustomed to doing activities slide, so that when the slide system is changed to pressing the button, the respondent becomes confused. On the principle of using warm colours, not a few of the elderly respondents said that they did because this is related to the preferences of each individual.

V. CONCLUSIONS

Based on the results of testing the design principles for the elderly, which are applied to mobile applications, it can be concluded that it is not entirely suitable for the elderly. For example, reducing the use of sliding on the screen due to the procedural memory factor, where almost all smartphone applications have implemented sliding activities to move or achieve something. So that the elderly who use smartphones are already familiar with the sliding movement activity and are not accustomed to changing sliding activities by pressing the button. However, in terms of health, it is advisable to use the press rather than slide. In addition, the use of colour also still depends on the tastes of the elderly. However, in terms of health for the elderly themselves, it still needs to be studied further in other fields of research, but overall, warm colours are not a problem for both the elderly and non-elderly. Also, based on these tests, it can be concluded that work background affects a person's ability to operate a smartphone.

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