FONT, COLOR, BRIGHTNESS OF SMARTPHONE USER INTERFACE FOR ELDERLY USERS

[1]R.SAKDULYATHAM, [2]S.PREEYANONT, [3]R.LIPIKORN, [4]R.WATAKAKOSOL

[1]Technopreneurship and Innovation Management Program, Graduate School, Chulalongkorn University, Bangkok, Thailand
[2]Department of Statistics, Faculty of Commerce and Accountancy, Chulalongkorn University, Bangkok, Thailand
[3]Department of Mathematics and Computer Science, Faculty of Science, Chulalongkorn University, Bangkok, Thailand
[4]Faculty of Psychology, Chulalongkorn University, Bangkok, Thailand
E-mail: [1]rasakd@rpu.ac.th, [2]somjaree@cbs.chula.ac.th, [3]rajalida.l@chula.ac.th, [4]wrewadee@yahoo.com

Abstract— Since most of elderly have visual impairment such as amblyopia, photophobia and grey vision, problems in using smart phone through user interface have occurred nowadays. As a result, a new user interface prototype, such as character, color and brightness, was created. This is to solve the problems of elderly in using the user interface and collect the data from samples, which are 20 elders at the age of 60-69 years, through the field survey. It was found that the most selected font is Arial Unicode MS size ***12***pt. This generated an additional concept to increase the font size when the required reading message is touched, from 12pt. to 16pt. The most selected color tone and brightness of the user interface are green and 75%, respectively. After that, the best prototype of each element were combined and designed, and used to collect data again. This is to find whether the combined prototype of each element is still the most appropriate prototype for elderly. The results showed that certain issues are not suitable to elderly because each elder has different visual impairment. After this research, researcher will use this user interface to conduct survey to test the hypothesis that the created user interface can assist elderly in using smart phone better than before.

Index Terms— User Interface, Elderly Users, Smartphone.

I. INTRODUCTION

Apparently, the number of elderly in Thailand has steadily increased due to the drop of the birth and the death rates[1].The society with a single family keeps increasing and the size of each family is smaller[2].Thus, most of the elderly have to live alone while they want to keep in touch with their friends and family members[3].With physical restrictions, it is difficult for them to travel to visit them or to help themselves.Many of the elderly subsequently turn to use smartphonesto communicateas they are small, portable and have easy-to-use touch screen[4].They often keep in touch through online social media[5].They also use it to acquire up-to-date knowledge, to make their daily lives moreconvenientand with lots of pleasures[6].However, smartphones are not used much among the elderly, compared to younger people[7]as the User Interface (UI) is not yet suitable to the elderly because the elderly have been physically degenerated, particularly the eyesight with blurred vision, hard to stand the brightness and seeing color in faded shades[5;8].Those defects have direct impact towards the use of smartphones. Such issues have been widely studied in many countries but in Thailand, our problems are more complicate than other countries because different regions have different dialects and cultures. In addition, each of the elderly has different defects. As a consequence, it isbetter to develop smartphone's UIthat is suitable to each elderly in order for them to enjoy using smartphones as an alternative channel of communication that is more effective and efficient as part of the attempts to cope with the elderly society.

II. RELATED TOPICS

Elderly users in this research refer to both men and women whose ages arebetween 60 and 69 years with Thai nationality and physical conditions that they can live alone, can help themselves in accordance with the Elderly Act BE 2546 (2013)of retirement age in Thailand or else those who do not work anymore.
User Interface designis significant to application development [9] as users have to work on UI. That is why the UI should be easy to use and understand in order to encourage users to use computers or electronic equipment as well as smartphones. In other words, UI is the link between the users and computers or electronic equipment [10]. Therefore, if UI is properly designed, users will enjoy using the applications on those electronic devices. UI may be graded as "good" or "not good" depending on the physical conditions of the users, such as eyesight and visibility. This research has focused on the study of suitable UI to the elderly with poor eyesight.

III. METHODOLOGY

The study of smartphone users among elderly in Thailand starts with a survey of 10 elderly smartphone users whose ages are between 60 and 69 years, through one of the most popular online social mediaapplication among Thai elderly. The study shows that most elderly often make mistakes because the user interface is not suitable to their eyesight, for example, small fonts, bright color and obscure screen. The study is conducted to designvarious user interface prototypes from different combinations of the individual top-selected components and testthem with

20 elderly smartphone users with age 60-69 years to find the most suitable prototype for elderly. The survey questionnaire and identify sample using random convenience sampling of 20 elders at the age of 60-69 years. However, because the survey required the prototype, the selected survey method was the field survey at the elderly nursing care where there are a lot of elders with visual impairment problem.First, the prototype of each component is created and the smartphone users are asked to select their favorite for each component then various user interface prototypes are created from different combinations of the top-selected components. Next, the smartphone users are asked to select the most favorite user interface prototype. The top-selected user interface prototype will be used to design the smartphone user interface that is suitable for elderly. The complete process of our study is illustrated in Fig. 1

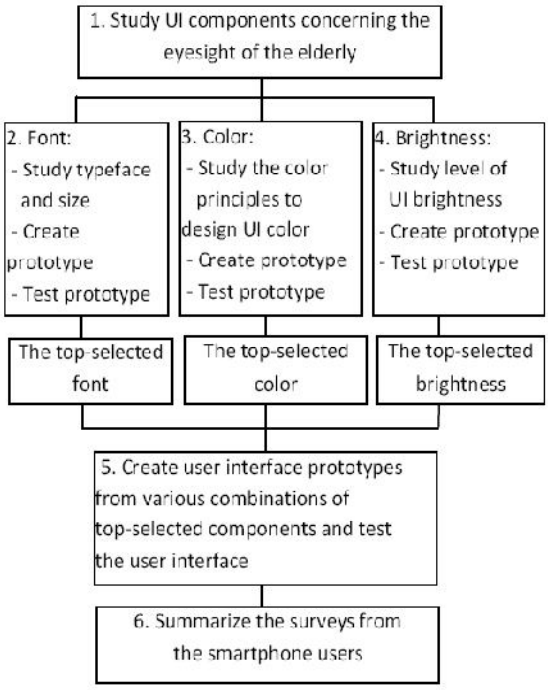


Fig.1 Process of this study

Figure 1 illustrates the following procedures:

1. Study user interface components that are commonly used by the elderly smartphone users. Seven primary components for the design of user interface include pictures, buttons, icons, logos, animation, typography (font and font size) and color [11].However, this study focuses on smartphone user interface for online social media, mainly through wordings, the main component of the user interface is therefore typography. Besides,pictures,buttons, icons and logos are rather global and subsequently are not the main issues here. From the experiments on the elderly users, components that have the most impact among the elderly with eyesight problems are font, color, and brightness in addition to the primary components of the smartphone user interface. (See Table I)

TABLE I: Compare the User Interface elements with eyesight problems

Component	Elderly Eyesight Problems	Problems when using the Application
Font	Blurred vision	To read text conservation
Color	Color vision in faded shades	To press a button/icon (they find it is hard to identify buttons, characters or icons from the background)
Brightness	Hard to stand the brightness	To read and identify components on the user interface

2. Find Thai fonts and font sizes that are suitable to the elderly. All 29 Thai fonts that are available in common Software with font size at 20 pt. are used to create prototypes [12;13]. These font prototypes are tested with the samples (elderly users) to find the top-selected fonts. Then use the top-selected fonts to create font size prototypes by setting each font with five different sizes (9, 12, 16, 19, 21 pt.) where three of which are available on most social media applications and the other two are additional. Interview the samples to find out which are their favorite ones.

3. Find proper colors for smartphone user interface (UI) that is suitable to elderly by studying the defects of color vision. The study shows that most of the elderly find it is hard to distinguish colors and they also see colors in faded shades [14;15].It is proper to design user interface with high contrast; i.e., the foreground and background colors can be easily distinguished [16]. If the colors are similar on the user interface, the elderly can hardly distinguish fonts or icons from the background. Therefore, the user interface should use easily-seen color themes, such as white, blue, yellow, pink, and green. For examples, the color prototypes use white or light color for background and black or dark color for foreground (fonts and icons) as shown in Fig.2. These color prototypes are tested with the samples to find the top-selected color themes.



Fig.2 Color prototypes

4. Find the screen brightness that is suitable to the elderly by creating several user interface prototypes using different levels of brightness which can be adjusted from the setting of the application. These user interface prototypes are tested with the samples to find the brightness levels that are pleasant to the elderly's eyes.

5. Create various user interface prototypes from different combinations of the top-selected components. Test these user interface prototypes with the samples to find the top-selected prototypes. The top-selected prototypes are assumed to be the most suitable prototypes for elderly. It is possible that there might be more than one prototype due to the fact that different persons have different preferences or different defects. In addition, we would like to test whether the combination of the top-selected components can be used to create the most suitable user interface prototype for elderly.

6. Summarize the surveys to find out which user interface prototype is the most suitable one for the elderly. Moreover, we can find out what are the main influences over their selections.

IV. RESEARCH FINDINGS

From our interviews with 20 elderly users who volunteer to test our prototypes of each component, the top-selected prototypes of each component are as shown in Table VI. The survey results for each component are as follows:

1. The top-selected Thai font prototype that majority of the samples (35% of the samples) can best see on the smartphone screen is Arial Unicode MS, followed by Tahoma which is selected by 30% of the samples. From the survey results, we can notice that only eight out of 29 fonts (shown in TABLE II) are selected. This is because these fonts arethick and wide, which can be seen very clearly. But Tahoma font has a problem of tone marks lying on top of the alphabets. Arial Unicode MS is therefore the best-seen font among elderly.

TABLE II: Survey result of font prototype

Prototype No.	Font name	Example	Survey result
1	Arial Unicode MS	สวัสดี	35%
2	Tahoma	สวัสดี	30%
3	EucrosiaUPC	สวัสดี	10%
4	Leelawadee	สวัสดี	5%
5	Microsoft Sans Serif	สวัสดี	5%
6	TH Kodchasal	สวัสดี	5%
7	TH KoHo	สวัสดี	5%
8	TH SarabunIT	สวัสดี	5%

The best size which is the top-selected size prototype is 12 pt., chosen by 34% of the samples, followed by 16 pt., chosen by 29.17%of the samples. If the font is too large, the screen will be crowded and the users have to scroll up and down very often which is not suitable to the elderly[14;17].It is better to set the font size to 12 pt. and userscan enlarge to 16 pt. by a touch on a screenif they prefer (as shown in Fig.3). Most samples or 90% of the samples like the idea as shown in TABLE III.

TABLE III: Survey result of font size prototype

Prototype No.	Font size	enlarge by a touch on a screen	Survey result
1	12 pt.	12pt. ->16pt.	35%
2	16pt.	16pt. ->19pt.	30%
3	9pt.	9pt. ->12pt.	20%
4	19pt.	19pt. ->21pt.	5%
5	19pt.	Do not like the idea	5%
6	12pt.		5%

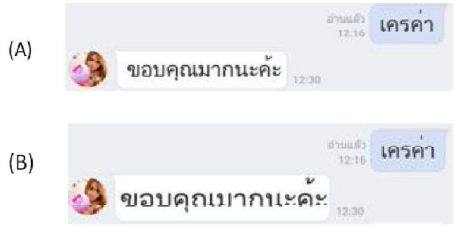


Fig.3 Example of idea to enlarge the font
(A) Normal font size
(B) After touch to enlarge the font

2.The most selected color for user interface background is green, i.e., 40% of the samples select green as it is best seen and pleasant to the eyes and the eyes can relax.[18]Among the samples who select green, 62.5% are male and 37.5% are female. Pink which is chosen by 30% of the samples is the second choice. Females prefer pink to males as shown in TABLE IV. Thus, in addition to age and eyesight problems, gender has impact on the color choice of the User Interface (UI).

TABLE IV: Survey result of UI color prototype

Prototype No.	Color	Survey result	Gender
1	Green	40%	Male = 62.5% Female = 37.5%
2	Pink	30%	Male = 33.33% Female = 66.67%
3	Blue	20%	Male = 100.00% Female = 0.00%
4	Yellow	10%	Male = 0.00% Female = 100.00%
5	White	0%	0%

3. The screen brightness that most of the samples (60% of the samples) select is 75%. It is the most suitable brightness level that the components on the user interface can be easily distinguished. More brightness can cause trouble to the eyes. The second top-selected level of brightness is 50% which is selected by 20% of the samples as shown in TABLE V.

TABLE V:Survey result of UI brightness prototype

Prototype No.	Level of brightness	Survey result
1	75%	60%
2	50%	20%
3	60%	10%
4	80%	10%

4. The combinations of the top two prototypes of each component are used to create eightdifferent user interface prototypesas shown in TABLE VI.

TABLE VI: Prototype of the combination of UI elements

Prototype No.	Font name	Font size and to enlarge the font	Color	Level of brightness
1	Arial Unicode MS	12 pt.-> 16 pt.	Green	75%
2	Arial Unicode MS	16pt.-> 19 pt.	Green	75%
3	Arial Unicode MS	12 pt.-> 16 pt.	Green	50%
4	Arial Unicode MS	16pt.-> 19 pt.	Green	50%
5	Arial Unicode MS	12 pt.-> 16 pt.	Pink	75%
6	Arial Unicode MS	16pt.-> 19 pt.	Pink	75%
7	Arial Unicode MS	12 pt.-> 16 pt.	Pink	50%
8	Arial Unicode MS	16pt.-> 19 pt.	Pink	50%

However, only two of the user interface prototypes are used in the survey due to the time constraint. Prototype 1 and Prototype 5 which are the combinations of the top-selected components are used. The study shows that Prototype 1, featuring Arial Unicode MS at 12 pt. and enlarging to 16 pt. with one touch, no need to scroll very often, with green color theme at 75% brightness, is the top selected. But some samples do not prefer these two user interface prototypes because of different eyesight problems.

TABLE VII: Results of UI components with users

Componcnt	Prototypc	Findings
Font	29 Thai fonts (20 pt.)	- Arial UnicodeMS
	Font size: 9 pt., 12 pt., 16 pt., 19 pt., 21 pt.	- 12 pt. - 16 pt.
	Possibility ofenlarging character size	Agreed with the idea

TABLE VII: (Continued)

Component	Prototype	Findings
Color	Green, pink, blue, yellow, white	- Green - Pink
Brightness	Screen brightness: 0%, 25%, 50%, 75%, 100%	- 75% - 50%
Combination	Combine each best prototype element in an interface design	- Arial UnicodeMS - 12 pt. -> 16 pt. - Green - brightness 75%

CONCLUSION

In order to study and create the most suitable smartphone user interface prototype to the elderly, we need to consider physical degeneration of the elderly. The degeneration that has the most impact on the use of a smartphone is the eyesight. The main components of the user interface for those who use online social media that impact the elderly eyesight are font, color and, brightness. The font prototype, Arial Unicode MS at 12 pt. and enlarging to 16 pt. with one touch, with green color theme at 75% brightness level is the most selected prototype by the elderly. The combinations of these most selected prototypes are used to create the user interface prototypes and to find which is the most suitable one to the elderly. But since eyesight defect of each elderly differs, it is possible to conclude that the user interface should be adjusted to suit each person, by getting some information from a user and then automatically adjusting the user interface especially for that particular user. It is expected to further this research, researcher will use this user interface to conduct survey to test the hypothesis that the created user interface can assist elderly in using smart phone better than before.

REFERENCES

[1] P.apattanawong and P.Prasartkul, "The future Thailand's population," Institute for Population and Social Research, Mahidol University, 2009.

[2] *S.Pitikultung, "Family situation and prospects of Thailand," proceeding in 6th national conference in family health*,2013, pp.1-8.

[3] J.Durick and T.Robertson. "Dispelling Ageing Myths in Technology Design," Adelaide, Australia: ACM, 2013.

[4] R.Harper, T.Rodden, Y.Rogers and A.Sellen. *Being Human: Human Computer Interaction in the year 2020*, England: Microsoft Research Ltd., 2008.

[5] Marek van de Watering. *The impact of Computer Technology on the Elderly*, Amsterdam Netherlands:Vrije University, 2005.

[6] C.Fan, J.Forlizzi and A.Dey. *Considerations for Technology that Support Physical Activity by Older Adults*, Colorado USA: ACM, 2012.

[7] J.Arfaa and Y. (Kathy) Wang. "An Accessibility Evaluation of Social Media Websites for Elder Adults," Switzerland: Springer International Publishing, pp. 13-24, 2014.

[8] K.Moffatt. *Older-Adult HCI: Why Should We Care?*,Universal Interactions Forum (July – August 2013).

[9] S.W.Ambler. *The Object Primer 2nd Edition: The Application Developer's Guide to Object Orientation and the UML*, SIGS Books and Cambridge University Press, 2001.

[10] D.Stone, C.Jarrett, M.Woodroffe, and S.Minocha. *User Interface Design and Evaluation*, ELSEVIER, 2005.

[11] AMX using TPDesign 4, "User Interface Design Style Guide," AMX Corporation, 2003.

[12] T.Phiriyapokanon, "Is a big button interface enough for elderly user? Towards user interface guidelines for elderly users," A thesis of Computer Engineer,Mälardalen University, 2011.

[13] V.Viet Linh, "Enhancing smartphone's usability for elderly in Finland" A thesis of Business Information Technology, University of Applied Sciences, 2013.

[14] C.A.SanchezandJ.Z.Goolsbee, "Character size and reading to remember from small displays," *Computers & Education*, vol.55, no.3, pp.1056-1062, 2010.

[15] M.S.Roy, M.J.Podgor, B.Collier, and R.D.Gunkel, "Color vision and age in a normal North American population," *Graefe's archive for clinical and experimental ophthalmology*, vol.229, no.2, pp.139-144, 1991.

[16] Y.B.Salman, Y.H.Kim, and H.I.Cheng, "Senior—friendly icon design for the mobile phone," *In Digital Content, Multimedia Technology and its Applications (IDC), 6th International Conference*, IEEE, pp.103-108, 2010.

[17] J.Harms, M.Kratky, C.Wimmer, K.Kappel, andT.Grechenig, "Navigation in Long Forms on Smartphones: Scrolling Worse than Tabs, Menus, and Collapsible Fieldsets,"*InHuman – Computer Interaction–INTERACT*, Springer International Publishing, pp. 333-340, 2015.

[18] QSX Software Group, "Color Theory Basics," Macromedia, Inc., 2003.