Developing New Gesture Design Mode in Smartphone Use for Elders

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Abstract. This article is aimed to design new hand gesture mode of smartphone for better used by the elderly. The method first use focus grouping to find out the most difficult use hand gestures for the elderly. Secondly, we develop new gesture mode with one-finger gesture. Finally, we compare the traditional gesture with new design gesture mode. Results show that (1) use two fingers as gesture are the most difficult for the elderly; (2) new design mode are better than traditional mode statistically significant in usability evaluation. Accordingly, we suggest the new design gesture mode may be as one solution to substitute the traditional gesture mode for the elderly.

Keywords: Hand gesture mode · Smartphone design · Focus grouping · Usability evaluation · The elderly people

1 Introduction

With the rising in smartphone use in recent years, there have been many academic studies on mobile phone use.

Nowadays, smartphone use is one of the study areas that should be explored and invested. Many studies have shown that it is a big challenge for elderly people to use smartphones, especially touch-screens. Because of factors related to aging in visual acuity, aging of tactile perception, aging of cognitive ability and aging in motor ability.

Many studies mentioned that touch-screen user interface. Such as Guenther et al. (2010) [1] compared with gesture inputting and traditional inputting, gesture inputting interface is more efficiency; Kine et al. (2009) indicated that in selection task "one finger direct-touch is faster than using a mouse and bimanual interactions are faster than using one finger"; Park and Han (2010) [2] indicated that in regard to reaction time, icon size design 10 mm is better than 7 mm and 7 mm is better than 4 mm [2]; And Piper et al. (2010) [3] compared with multi-touch inputting device and traditional inputting device by interview survey, they indicated "multi-touch inputting device is less intimidating, less frustrating, and less oppressive than a traditional computer".

Gestures for human to human interaction are a natural and powerful tool of communication. And it has instead speech communication in many situations (Seow et al. 2010) [4]. Charness et al. (2004) [5] and Rogers et al. (2005) [6] compared with direct

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input devices and indirect input devices (e.g. mouse or trackball), with respect to older users have shown a general benefit of direct input devices over indirect ones. The direct nature of gesture input thus might facilitate interaction for elderly. Therefore, it's necessary to avoid excessive wrist joint flexion and extension, continuous and rapid movements, high coordination movements and to attention tactile perception feedback.

Gestural input interfaces are applying on many technical systems and it can be classified roughly into 2D gestures, using finger or hand movement on touch-screens to operate. And 3D gestures, using free-form movements in space to operate (Saffer, 2008) [7]. This study is focus on 2D gestures to explore better Smartphone operating gesture for elderly.

However, the literature on elderly motor ability aging has documented a couple of observations which might put the suitability of finger gesture input for elderly into question, shown as Chaparro et al. (2000) [5] indicated that compared with two age groups: the younger (aged 25 to 30) and the elderly (aged 60 to 69), the elderly wrist joint flexion is decreased 12–14 %. Therefore, if included gesture input wrist activity should be considered elderly wrist flexibility, judgment whether the gesture of the elderly is a gracious gesture input. Walker et al. (1997) [8] indicated that the elderly have less efficiency tactile perceptual feedback systems and lack the force to produce very rapid movements. And Microsoft (2009) [9] indicated that the elderly are difficult to conduct continuous moving task or the coordination of moving task.

The smartphone use is not conductive for the elderly. As of now, there still have few studies on smartphone operating gesture designs for the elderly. Thus this study takes an attempt to develop a new gesture mode of operating smartphone for elders.

To reach the aim of this research, three stages are adopted. In the first stage we use focus grouping to find out the most difficult use hand gestures for the elderly. In second stage, we develop new gesture mode with one finger gesture. In Final stage, we compare the traditional gesture with new design gesture mode.

2 Method

2.1 Focus Grouping

- *Sample products*. The most sail products are used as samples in Taiwan market. These include five brands smartphone, which are brand SS, A, H SN, and A. Please see Fig. 1.
- *Subjects*. Five individuals older than 60 (Mean = 63.2; female = 2, male = 3) with at least one year previous smartphone use experience were found to explore and discuss smartphone operating gestures of five brand sample products that might be suitable for the elderly.
- *Process*. Initially, a host provides subjects with five brand sample products and shows them how to do gestures of different sample (with 30 min.). Then let each subject to operate them (with 30 min.) in order to determine which smartphone operating gesture is the most difficult for the elderly, and the top three most difficult gestures become the main research core (with 60 min.).

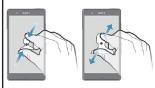
Brand	Brand SS	Brand A	Brand H	Brand SN	Brand AU
Gesture					

Fig. 1. Five brands are used as sample products

2.2 Developing New Gesture Mode

First, a team consisted of five designers with at least 6-year product design experience are organized to find feasible solutions (with 2D sketch drawing) to solve operational difficulty of two-finger gesture for the elderly using smartphone. Then 10 elders are invited to evaluate feasible solutions and choose best new solution for the designer team to develop computer simulation.

2.3 Usability Evaluation of New Design Gesture Mode

This research uses usability evaluation to compare traditional gesture with new designs. Usability evaluation include five sector indexes as the following:

1. Learnability-ease to learn and learning quickly.
2. Efficiency-efficient to use and after learning, then quickly to reach high efficiency.
3. Memorability-easy to memorize and casual user can operate immediately, no need to learn again.
4. Errors-lower error rate.
5. Satisfaction-total feeling of usability to satisfy the operation.

Experimental procedure follows three steps. First, three experimenters teach subjects how to operate traditional smartphone and new gesture design mode. Second, all subjects practice till they familiarly to use traditional smartphone and new design mode. Finally, all subjects answer the questions of usability evaluation.

3 Result

3.1 Result of Focus Grouping

The final summary of focus grouping is the top three most difficult gestures for elders are rotate gesture, zoom in gesture and zoom out gesture (refer to Figs. 2, 3 and 4). The reason is two-handed gesture is too messy and that multi-finger gestures are sometimes not so easy for elders.

Fig. 2. Zoom in gesture (shrink)

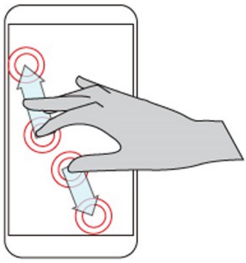


Fig. 3. Zoom out gesture (enlarge)

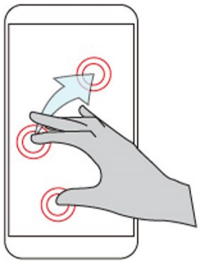


Fig. 4. Rotate gesture

3.2 Result of Developing New Design Gesture Mode

Two new design gesture mode are built (please see Figs. 5 and 6). The character of new designs is singer-finger gesture that is easier to operate than multi-finger gesture for elders, according to the result of focus grouping (Figs. 7, 8 and 9).

3.3 Result of Usability Evaluation to New Design Gesture Mode

Tables 1 and 2 show that ND 1(New Design Gesture 1) is the best gesture mode and reach to statistical significant ($P < 0.05$) in usability evaluation which includes 5 items

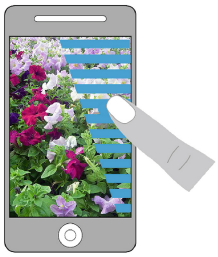


Fig. 5. Zoom in (slide down gesture new design 1)

Fig. 6. Zoom out (slide up gesture new design 1)

Fig. 7. Zoom in (reverse clock circle gesture new design 2)

Fig. 8. Zoom out (clock circle gesture new design 2)

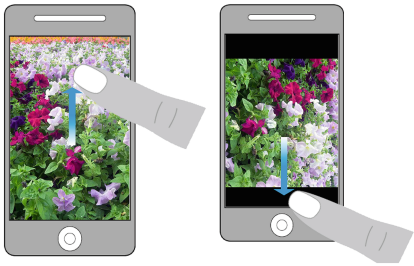


Fig. 9. Rotation (slide up and rotation gesture new design 3)

Table 1. Mean and S.D. in different gesture mode

			Evaluation items				
			Learnability	Efficiency	Memorability	Errors	Satisfaction
Gesture mode	TR	number	30	30	30	30	30
		Mean	3.80	3.43	3.40	3.37	3.13
		S.D.	0.407	0.626	0.498	0.669	0.730
	ND1	number	30	30	30	30	30
		Mean	4.40	4.30	4.00	4.30	4.70
		S.D.	0.675	0.651	0.643	0.466	0.466
	ND2	number	30	30	30	30	30
		Mean	3.30	3.50	3.80	3.20	3.80
		S.D.	0.651	0.509	0.761	0.407	0.761

(learnability, efficiency, memorability, errors and satisfaction). However, ND 2 (New Design Gesture 2) is only better than traditional gesture mode in regard to usability evaluation in 3 items (efficiency, memorability and satisfaction).

Table 2. Comparisons in usability evaluation Font sizes

Variable	(I) gesture	(J) gesture	Standard error	Significance	Comparison result
Learnability	ND 1	ND2	0.152	0.000	ND1>TR>ND2
		TR	0.152	0.001	
	ND2	ND1	0.152	0.000	
		TR	0.152	0.006	
	TR	ND1	0.152	0.001	
		ND2	0.152	0.006	
Efficiency	ND1	ND2	0.155	0.000	ND1>ND2> TR
		TR	0.155	0.000	
	ND2	ND1	0.155	0.000	
		TR	0.155	0.911	
	TR	ND1	0.155	0.000	
		ND2	0.155	0.911	
Memorability	ND1	ND2	0.166	0.487	ND1>ND2> TR
		TR	0.166	0.002	
	ND2	ND1	0.166	0.487	
		TR	0.166	0.060	
	TR	ND1	0.166	0.002	
		ND2	0.166	0.060	
Errors	ND1	ND2	0.136	0.000	ND1>TR> ND2
		TR	0.136	0.000	
	ND2	ND1	0.136	0.000	
		TR	0.136	0.474	
	TR	ND1	0.136	0.000	
		ND2	0.136	0.474	

3.4 Result of Rotation New Design in Usability Evaluation

Table 3 shows that rotation design gesture (RN1) is better than traditional gesture (TR) in all aspects of usability evaluation and all reach statistical significance.

Table 3. statistical result of rotation new design gesture in usability evaluation

			Effecttive evaluation items				
			Leanabity	Efficiency	Memor ability	Errors	Satisfaction
Rotation gesture mode	TR	Number	30	30	30	30	30
		Mean	2.6	2.3	3.0	3.2	2.7
		S.D.	0.81	0.65	0.45	0.61	0.91
	RN 1	Number	30	30	30	30	30
		Mean	4.4	4.6	4.0	4.6	4.6
		S.D.	0.93	0.93	0.78	0.67	0.93
F value			63.5	122.7	36.3	71.1	63.4
P value (significance)			0.00	0.00	0.00	0.00	0.00
Compare result			RN1>TR	RN1>TR	RN1>TR	RN1>TR	RN1>TR

4 Conclusion and Further Study

Given the analysis results, this study suggests that the elderly aged 55 up may use new design mode (ND 1) with single-finger operating gesture as a smartphone operating gesture mode. These results also contribute to further study intended to develop an elderly touch-screen user interface. Finally, this study expects to be an entry point by which to explore more suitable way to make smartphone use more accessible for the elderly.

Further study will focus on motion analysis on muscle fatigue and joint anger vary of finger gesture and tracking eye movement of finger gesture to new design mode. These study will scientifically prove that the new design gesture mode is really better than traditional one.

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