A Two-Step Click Interaction for Mobile Internet on Smartphone*

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Abstract. Mobile Internet gains popularity due to the increasing use of smartphones having wireless network capabilities. However, the current click interaction method (hereafter, *CC*) hinders user experience when the size of the target hyperlink to be selected is small. The present study developed a two-step click interaction method (called *Press and Flick;* hereafter *PF*) for smartphone and evaluated its effectiveness by GOMS model. GOMS results indicate that the PF has a substantial benefit compared to the CC when a click error is occurred. The PF can enhance usability and user experience (UX) by reducing click error and providing a joyful interaction.

Keywords: Press and Flick, Two-step Click Interaction, Mobile Internet, Smartphone.

1 Introduction

With the increasing use of smartphones having wireless network capabilities (e.g., 4G and Wi-Fi), mobile Internet access becomes daily life. The percentages of smartphone users in South Korea and North America have reached about 63% (Korea Communications Commission, 2013) and 50% (Wikipedia, 2013), respectively. In South Korea, the 88% of smartphone users are regularly accessing to mobile Internet, and the 87% of them connects to it at least once a day (KISA, 2011). Especially, the 51% of mobile Internet users are willing to access Internet through smartphone even if there is a personal computer nearby. This survey results indicate that Internet access through smartphone becomes daily life among smartphone users.

User interaction methods commonly used in a smartphone for website navigation can be divided into 3 types: 1) press, 2) flick, and 3) tap. The press interaction is to click a hyperlink on the touch screen of a smartphone. The flick interaction is to scroll up or down the touch screen. Lastly, the tap interaction is to zoom in or out by touching the touch screen twice. The aforementioned interactions can strongly enhance both usability and user experience (UX) of a smartphone.

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The press interaction for click hinders user experience when the size of target hyperlink is small. Not only the current press interaction provides no feedback for the recognition of click error before touch, but also allows no mean to recover a click error. The only way to correct a click error is to press the Back button on the lower part of a smartphone. Therefore, the current press interaction can cause unhappy experience to users; otherwise, to avoid a click error, it requires elaborative effort in precise press.

The present study developed a two-step click interaction for website navigation on a smartphone. Based on the analysis of mobile users' behavior, a two-step (Press and Flick) interaction was developed. The initial interaction of press is for click a target hyperlink; the post interaction of flick is for recovery of a click error if necessary. The present study evaluated the effectiveness of the new click interaction by GOMS model.

2 Development of a Two-Step Interaction Method

The present study developed a two-step click interaction by 3 steps: 1) users' behavior observation, 2) interaction characteristic analysis, and 3) new interaction development. In the first step, a visual observation was conducted while users surfed mobile websites for about 10 min. Ten mobile users (female: 5, male: 5) were asked to surf mobile websites with their own smartphone without any restriction. Mean age of the users was 23 (SD: 2) and their dominant hand was all right-side.

In the second step, three characteristics for click interaction were identified by the visual observation conducted in the first step. First, click errors tended to increase as the size of a target hyperlink displayed on a touch screen decreased. Second, time required for a click interaction tended to delay as the size of a target hyperlink decreased because a small hyperlink requires precise interaction. Lastly, click errors were commonly occurred by pressing a neighbor hyperlink of the target hyperlink.

In the last step, the press and flick interaction (hereafter, PF) was developed which reduces both click errors and psychological burden caused by precise touch of a small target hyperlink. The PF consists of two-step interactions of press and flick. The initial interaction is to press a target hyperlink with the index finger. If the target hyperlink is not successfully selected by the initial interaction, the post interaction of flick with the index finger while pressing down is followed. The post interaction allows a user to reselect the target hyperlink by flicking the index finger upward, downward, leftward, or rightward. Therefore, the post interaction can be an effective remedy when a user mistakenly pressed a neighbor hyperlink of the target hyperlink.

3 Performance Evaluation

3.1 GOMS Model

The GOMS operators used in the present study (Table 1) can be divided into 3 types: 1) physical operator, 2) mental operator, and 3) system operator. The physical operator includes Position (P), Keystroke (K), and Movement (M) which are related to finger interactions. The mental operator includes Attention Shift (S) and Mental Act (A). Lastly, the system operator includes Smartphone Response (R) which is an idle status of a user while waiting for system's response.

Time for the operators was determined by referring to existing studies (Card et al., 1983; Chi and Chung, 1996; Kieras, 1999; Holleis et al, 2007; Oyewole and Haight, 2011) except for smartphone response and mental act. The existing studies did not provide time for smartphone response because it relies on system's performance (Kieras, 1999). Therefore, the present study measured transition time between webpages in a smartphone using a stopwatch and determined smartphone's response time (1 sec) as their average value. In addition, the existing studies used different time for mental act (Holleis et al, 2007). For example, Oyewole and Haight (2011) and Dunlop and Crossan (2000) applied the original value of 1.35 sec for mental act; however, Mori et al. (2003) and Myung (2004) used 0.38 sec and 0.57 sec, respectively. This difference seems to rise due to difference in context (Holleis et al, 2007). The present study determined time for mental act as 0.22 sec by summation of two median values of perceptual process time (median = 0.125 sec, range = 0.05 sec ~ 0.2 sec) and cognitive process time (median = 0.098 sec, range = 0.025 ~ 0.17 sec) reported in Card et al. (1983). This study used a smaller value for mental act because the mental act in this study is simple to detect whether a click error exists or not after press interaction.

The GOMS model of the current click interaction method (hereafter, CC) consisted of two goals (click and undo) as shown in Table 2.a. The first goal of click is achieved through three operators (P-K-K) in relation to click interaction. The second goal of undo is conditionally conducted when the target hyperlink is not successfully clicked by the first goal. The second goal is achieved by six operators (R-A-M-K-K-A) associated with going back to the original webpage to recover a click error.

The GOMS model of the PF consisted of two goals (press and flick) as shown in Table 2.b. The first goal of press is achieved by four operators (P-K-A-K). The last operator, K, is conditionally included in the first goal when the target hyperlink is successfully selected by the first goal. The second goal of flick is conditionally conducted when the target hyperlink is not selected by the first goal. The second goal is achieved by two operators (A-K) associated with flicking the index finger toward the target hyperlink.

3.2 Analysis Results

Completion time (hereafter, Time) of the CC without a click error was estimated as 0.43 sec (Table 3); however, Time of the CC with a click error significantly increased

Table 1. GOMS operators for mobile interactions

Type	Code	Name	Description	Time(sec)	Reference
Physical operator	P	Position	Position the index finger above a target hyperlink	1.10	Card et al. (1983), Chi and Chung (1996), Oyewole and Haight (2011), Kieras (1999)
	K	Keystroke	Press or release a hyperlink with the index finger	0.10	Card et al. (1983), Oyewole and Haight (2011), Kieras (1999)
	M	Movement	Move the index finger	0.23	Holleis et al. (2007)
Mental operator	S	Attention shift	Shift display-to-hotkey	0.14	Holleis et al. (2007)
	A	Mental act	Detect an error	0.22	Card et al. (1983)
System operator	R	Smartphone response	Wait for smartphone's response	1.00	Measured in this study

Table 2. GOMS models for click interaction

(a) Current click method

Goal	Method	Operator	Time (sec)	Total (sec)
Click	Point to the target link	P	0.23	0.43
	Press the target link	K	0.10	
	Release the target link	K	0.10	
Undo	Wait smartphone's response	R	1.00	1.71
	Shift attention from display to hotkey	A	0.14	
	Move to the hotkey back	M	0.23	
	Press the hotkey back	K	0.10	
	Release the hotkey back	K	0.10	
	Shift attention from hotkey to display	A	0.14	

(b) Press and flick method

Goal	Method	Operator	Time (sec)	Total (sec)
Press	Point to the target link	P	0.23	0.65
	Press the target link	K	0.10	
	Judge whether the target link clicked	A	0.22	
	(conditional*) Release the target link	K	0.10	
Flick	Decide flick direction	A	0.22	0.32
	Conduct flick	K	0.10	

* This operator is conditionally included when the hyperlink is selected by the goal of press.

Table 3. Completion time estimated by GOMS models

Method	Condition	Time (sec)
Current	No error	0.430
	One error	2.570
Press and flick	No error	0.650
	One error	0.870

to 2.57 sec (click time 0.43 sec + undo time 1.71 sec + re-click time 0.43 sec). Therefore, the CC can deteriorate usability and user experience because Time and number of the interactions required drastically increase when a click error occurs.

Times of the PF with or without an error were not significantly different. Time of the PF without an error was 0.65 sec, and Time with an error was 0.87 sec (click time 0.65 sec – release time 0.1 sec + flick time 0.32 sec). Mean difference between with and without an error was only 0.22 sec.

Time of the PF without an error (0.65 sec) delayed 0.22 sec compared to Time of the CC without an error (0.43). The main cause of the delay is that the PF requires a mental judgment to determine whether the post interaction of flick is needed or not. However, Time of the PF with an error (0.87 sec) was 1.7 sec shorter than Time of the CC with an error (2.57 sec). The main reason is that the PF can rapidly correct a click error through the post interaction of flick.

4 Conclusion

The PF developed in this study can be help of enhancing usability and user experience of website navigation in a smartphone when the size of target hyperlink is small.

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