Usability Evaluation for Software Keyboard on High-Performance Mobile Devices

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Abstract. Most of high-performance mobile devices called smartphone or slate computer which recently emerged uses general-purpose mobile operating system (Mobile OS) such as Android, iOS, Symbian OS, etc. These devices have two characteristics compared with previous mobile devices: 1) many of the devices have touchscreen as main user interface, hence users operate graphical user interfaces (GUIs) displayed on the screen directly by fingers or a pen and 2) different devices made by different companies have similar GUIs because the devices use the same mobile OS. Furthermore, usability evaluation and improvement for one of the mobile OS affects many devices which use same mobile OS, hence importance of the usability evaluation for mobile OS is more valuable than for previous mobile devices. In this paper, we evaluate how position of software keyboard on touchscreen affects usability of a mobile OS, Android. Software tool to record user operation history on software keyboard was developed for evaluation experience. In an experiment, three positions of software keyboard were tested. As a result, keyboard placed on top or middle of the display takes better error rate and subjective evaluation than the previous position, bottom of the display.

Keywords: Usability Evaluation, Mobile OS, Software Keyboard, Android.

1 Introduction

Most of the high-performance mobile devices called smartphone or slate computer which recently emerged uses general-purpose mobile operating system (Mobile OS) such as Android, iOS, Symbian OS, etc. These devices have two characteristics compared with previous mobile devices:

1. Many of the devices have touchscreen as main user interface, hence users operate graphical user interfaces (GUIs) displayed on the screen directly by fingers or a pen.
2. Different devices made by different companies have similar GUIs because the devices use the same mobile OS.

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Previous mobile devices (i.e. feature phone or PDA) had user interfaces which consist of hardware buttons and GUIs that developed for each hardware model. Hence, developer evaluates device's usability one by one without any distinction between hardware and software.

On the other hands, user interface of mobile devices consist from the mobile OS and the touchscreen have only a few hardware buttons than the previous devices, that is, the difference of user interface between devices is shrinking. Therefore, the impact of individual hardware is decreasing from a view point of usability evaluation. In contrast, the impact of software for user interface is increasing. Evaluation and improvement for one Mobile OS lead to improving many products which using same Mobile OS. Moreover, even if the devices have different Mobile OS, their user interface have very similar structure; i.e. touchscreen and GUIs. Hence, evaluation and improvement of Mobile OS is useful.

In this paper, we evaluate one of the mobile OS, Android. We focus on software keyboard, common character input method of the mobile devices. Most of the mobile OS place the software keyboard at the bottom of screen. This design assumes what users operate by one hand and hold the device other hand. However, 74% of mobile device users holds the device and inputs by same hand [1]. In this case, users hold the device by palm and touch the keyboard by thumb; here, software keyboard position in the display is a critical factor in usability of mobile OS. In this paper, we quantitatively evaluate the effect of software keyboard position to the usability from subject's input history.

2 Related Work

Software keyboard is one of a graphical user interface component to input character strings. In contrast to hardware keyboard, software keyboard can modify size, position and layout of each key freely. Because users of software keyboard cannot recognize a borderline between keys and/or shape of keys, developers need to consider a form of software keyboard.

A lot of study propose novel type of software keyboards or input methods [2][3][4][5]. MacKenzie and Read evaluated an effect of software keyboard layout [6]. Sears and Zha focused on size of software keyboard [7]. However, neither study considers about position of software keyboard in a mobile device display. In this paper, we focus an effect of software keyboard position.

Several studies evaluate performances of mobile phone operation by thumb tapping [8][9]. These studies measure the effect of key size and position for operation accuracy and/or input speed. Also both of the study selects single software key (NOT a set of keys like software keyboard) as a target. In software keyboard operation, users tap a set of keys which compose a word or phrase sequentially, hence nature of the operation is different from single software key operation. This paper focuses to single-handed operation for software keyboard of mobile device.

3 Experiment

3.1 Settings

To record operation history of software keyboard, author developed software tool as Android OS application. This tool record key codes of subject's operation for keys on software keyboard and its timing during phrase input tasks. Figure x shows a screenshot of the tool. Subjects can select a display position of keyboard from following three patterns: 1) Under the input window, 2) Top of the display, and 3) Bottom of the display (Fig. 1).

Six subjects are participated in the experiment. Every subject has no experience of smartphone and age is between 18 and 20. In the experiment, subjects stand without any support and hold the device with right hand. Subjects are informed to do not use a left hand to operate the device. We select NEXUS ONE made by htc for the experiment.

3.2 Task

We adapt single keyword input task that assume users want to search information from the Web. Subjects input ten Japanese words indicated on the display one by one with three different keyboard positions described in Section 3.1. Words in the task are selected from Yahoo! Japan’s ranking of most searched words. Every word is indicated by Hiragana (primitive character of the Japanese input method) and person name or words from other language were removed.

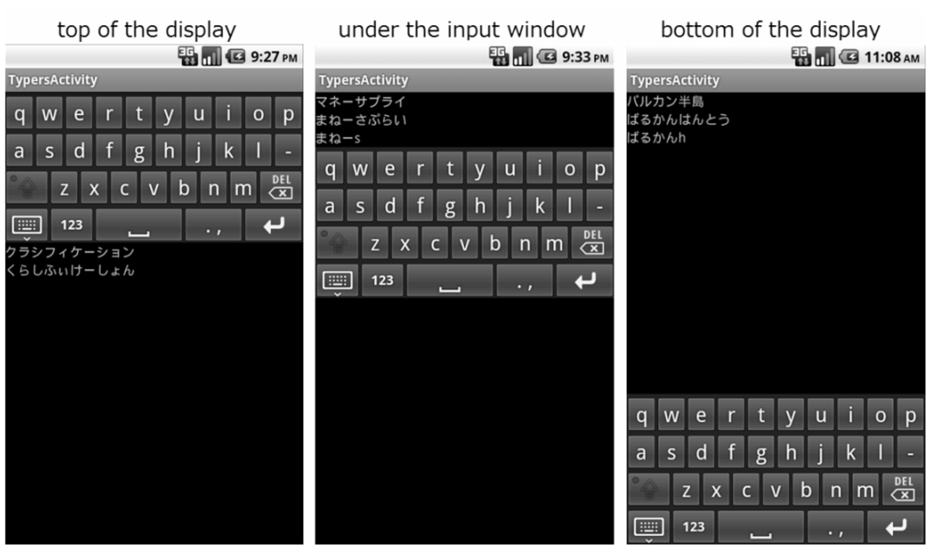

Fig. 1. Position of Software Keyboard

For an evaluation, we count the number of DEL key in the operation history to calculate EPM (Error per Minutes) of each task. Here, meaningless DEL key input such as for blank string is ignored. We also measure an input speed by Stroke/min, not by WPM (Word per Minutes.) We consider WPM is unsuitable in this experiment because of Japanese input method allows several input for one keyword (i.e. "ringo" or "rinngo" for "りんご" means apple.) Subjective estimation of usability was collected with the five-grade questionnaire.

4 Result

As a result, 180 cases data was obtained and six are excluded as noise. Table 1 shows average value of each metrics. At Bottom of the display (de-fact standard position of smart phone,) Stroke/min shows highest speed in the three keyboard positions. However, EPM shows at double count with others. This is considered as subjects take more mistakes during the tasks, hence they push DEL key many times than other keyboard positions. Under the input window shows lowest EPM and highest subjective value. This result suggests lower EPM is more important than higher input speed for subjective evaluation. In Top of display, Stroke/min and EPM is similar to "Under the input window," but in contrast, Subjective takes the lowest value. This might be caused by the subject's hand hide a wide area of display, therefore, they feel inconvenience.

Table 1. Summary of the Experiment

	Stroke/min	EPM	Subjective
Bottom of the display	90.24	13.77	3.17
Under the input window	82.17	7.35	3.67
Top of the display	79.82	7.55	1.83

5 Conclusion

In this paper, we evaluated how position of software keyboard on mobile device affects usability. As a result of the experiment, when keyboard is displayed on bottom of the display, input speed is highest but EPM is worst in compare to other position. In contrast, when keyboard is displayed on under the input window leads lowest EPM and highest Subjective evaluation. Top of the display's input speed and EPM are similar to "under the input window" but Subjective indicates worst value. These results suggest while Subjective and EPM is important, change the position of software keyboard from current position is worth to consider.

As future work, we record acceleration of device to evaluate stability and ease of hold the device during the single-hand operation. Also an evaluation of learning efficiency on each keyboard position is planned.

In future, we try to logging acceleration of device to measure device stability and ease of holding. And deference of learning efficiency on each keyboard position are also considering.

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