Research on Two Dimensional Touched Position Distributions of the Touch Screen QWERTY Keyboard

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Abstract. This research explored the characteristics on two dimensional touched position distributions in each key of a touch screen QWERTY keyboard through the experiment. The results of the experiment revealed that the mistyping ratio was more than 5% and it suggested the necessity of an approach for key input performance improvement. The results also revealed that the center of distribution of the key touched position tended to be positioned in the low part of the key regardless of keys and the mistyping concentrated under the bottom of the key area. A new approach that the key input performance could be improved by using these characteristics of key touched position and mistyping was proposed.

Keywords: Software keyboard, Touch panel, Touch Screens.

1 Introduction

Recently iPad, android based tablet PC, and Windows based tablet PC have been developed and the touch screen input devices have been increasingly used. The user can input a long sentence by using the touch screen QWERTY keyboard (the virtual keyboard). However the software keyboard brings the disadvantages that the typing speed is slower and the typing accuracy is lower than the hardware keyboard (Andrew(1992)). This disadvantage is caused by the lack of the physical feedbacks. Many kinds of tools for inputting the text from the virtual keyboard were proposed in order to improve the performance of inputting the text from the virtual keyboard (Altinsoy (2009), Go(2007, 2010), Jeong(2012)). However few literatures discussed the characteristics on two dimensional touched position distributions of the virtual keyboard (Leah(2011)). The characteristics on two dimensional touched position distributions could be expected to be the significant information in order to propose the new tool for the virtual keyboard.

This research explored the characteristics on two dimensional touched position distributions in each key of a touch screen QWERTY keyboard through the experiment in order to propose a new approach that the key-input performance could be improved.

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2 Methods

2.1 Participants

12 right-handed university students ranging in age from 19 to 24 (M=21.9) participated in the experiment. All subjects regularly use the hardware QWERTY keyboard but they cannot use blind touch perfectly. They also have experience of the usage of the virtual keyboard but they don't regularly use it.

2.2 Experimental Task

In the experiment 12 participants were required respectively to input five sets of meaningless text strings via the virtual keyboard on the tablet PC without blind touching. The participants were also required to neglect the mistyping and input the next character when they recognized their own mistyping.

Each set of the strings consisted of 156 characters, 26 alphabetical characters times 6, and were displayed on the same tablet PC.

2.3 Apparatus

Participants sat at the desk and the tablet (Iconia Tab A500) was tilted five degrees to the desk as well as the normal hardware keyboard. The tablet had the capacitive sensing touch screen and the screen size was 10.1 inches wide (1280×800 resolution).

The strings of the task were displayed at the top of the screen. The virtual keyboard was displayed at the bottom of the screen, and every key size was set 1.35cm square. As the visual feedback, a character was painted out with white in each touch.

The original application, which was made in Java, displayed the keyboard and the strings, controlled the visual feedback to each touch, and acquired the two dimensional position of each touch.

2.4 Experimental Procedure

In order to understand the experiment task clearly and be acclimated to the experimental environment, the participants were required to input a set of meaningless text strings before the experiment. After that, the participants were required to input five sets of meaningless text strings. The participants were required to take one minute break between each set.

3 Results

In this experiment, if the touched key was more than 2 keys away from the target key, this touch was regarded as the irregular such as the touch by the other parts of the body because the participants input the characters without blind touching. So this kind of the touched key was excluded from the data. In Figure 1, 3σ limits of the two

dimensional touched position of each key were shown by the circles. As shown in Figure 1, the center of 3σ limits circle tended to be positioned in the low and slightly right part of the key regardless of keys. A one-way ANOVA within keys was conducted to compare the position between the center of keys and the center of circles and the results confirmed the tendencies statistically ($F(1,25)= 1673.53$, $p<0.01$, $F(1,25)=10.21$, $p<0.01$).

As shown Figure 1, the sizes of 3σ limits circle tended to be different between keys in both vertical and horizontal directions. A one-way ANOVA was conducted to compare the effect of keys on the square deviation of each touched position from the center of circle and the results confirmed the tendencies statistically ($F(25,8309)=1.74$, $p<0.05$, $F(25,8309)=1.65$, $p<0.05$)..

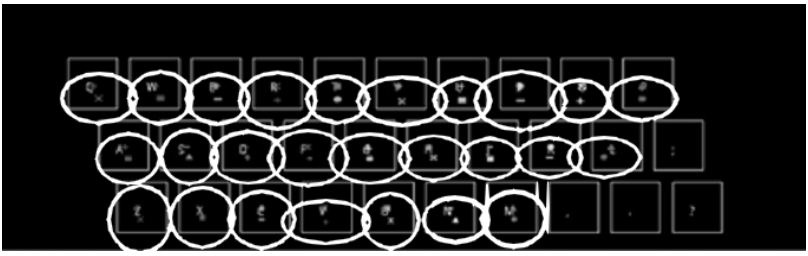

Fig. 1. The virtual keyboard and 3σ limits circles of the two dimensional touched position

4 Discussions

The experimental results showed that the center of distribution of the key touched position tended to be positioned in the low and slightly right part of the key regardless of keys, the same as tendency in the virtual QWERTY keyboard of the mobile phone for one-hand typing (Niels(2012)).

4.1 Mistyping Characteristics

The averaged mistyping ratio was 6% even though the participants input characters without blind touching and a part of a 3σ limits circle was not included within the key area regardless of keys as shown in Figure 1. In order to clarify the characteristics of the mistyping, a one-way ANOVA within keys and the Bonferroni's multiple comparison was conducted to compare the effect of the eight mistyping areas which were out of the key area, as Figure 2 shows, on the ratio of the whole mistypes. The results of the ANOVA revealed that the ratio of the whole mistypes was significantly different between the areas ($F(7,175)=51.05$, $p<0.01$), and the results of the multiple comparison revealed that the ratio in the area "B" was significantly higher than all the others and the ratio in the area "R" was significantly higher than "LT", "T", "RT", and "RB" as shown in Figure 2. These results revealed that the mistypes concentrated under the bottom of key area.

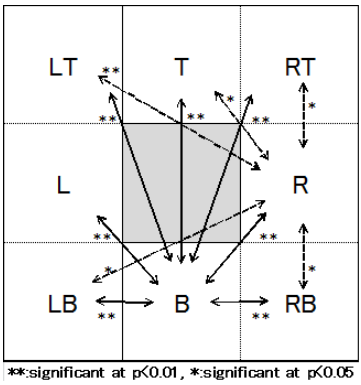

Fig. 2. The eight mistyping areas and the results of the multiple comparison

4.2 New Approach for Key Input Performance Improvement

The results of the experiment revealed that the mistyping ratio was more than 5% and it suggested the necessity of an approach for key input performance improvement. The results also revealed that the center of distribution of the key touched position tended to be positioned in the low part of the key regardless of keys and the mistyping concentrated under the bottom of the key area. We proposed a new approach that the key input performance could be improved by using these characteristics of key touched position and mistyping. The new approach was named the Pop-Up Key system that the users could chose the second possible key by the flick input if the users touched the area within a 3σ limits circle of a certain key but on the visual surface of another key or the overlapped area of 3σ limits circles of two keys. In this system if the users didn't use the flick input and release the finger from the screen, the first possible key was chosen automatically. The priority for the possible characters was according to the rules as follows.

1. In case that the users touch the area within a 3σ limits circle of a certain key but on the visual surface of another key, the first possible key is the corresponding key to the circle and the second possible key is the touched key.
2. In case that the users touch the overlapped area of 3σ limits circles of two keys, the first key is the key of which Mahalanobis distance from the center of the circle is shorter and the second key is the longer one.

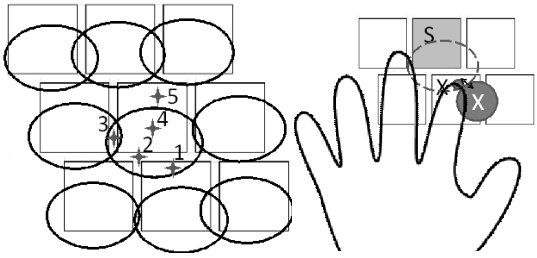

Fig. 3. The rule's number and the touched area and the example of the Pop-Up Key system

Figure 3 shows the relationship between the rule's number and the touched area and the example of the Pop-Up Key system.

This system had also the other rules as follows.

3. If the users touch the area within a 3σ limits circle of a certain key and on the visual surface of the key, only the touched key is chosen automatically.
4. If the users touch the area within a 3σ limits circle of a certain key but not on any key, only the corresponding key to the circle is chosen automatically.
5. If the users touch the area in a certain key which does not belong to any circle, only the touched key is chosen automatically.

5 Conclusion

This research explored the characteristics on two dimensional touched position distributions in each key of a touch screen QWERTY keyboard through the experiment. The results of the experiment revealed that the mistyping ratio was more than 5% and it suggested the necessity of an approach for key input performance improvement. The results also revealed that the center of distribution of the key touched position tended to be positioned in the low part of the key regardless of keys and the mistyping concentrated under the bottom of the key area. A new approach that the key input performance could be improved by using these characteristics of key touched position and mistyping was proposed. Further researches will be held in order to exam the effectiveness of the proposed Pop-Up Key system through experiments.

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