JESK
J Ergon Soc Korea 2016; 35(6): 569-580
http://dx.doi.org/10.5143/JESK.2016.35.6.569
http://jesk.or.kr eISSN:2093-8462

Usability Evaluation of Touch Keyboard in Smart Watch Environment

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Received : September 04, 2016
Revised : September 17, 2016
Accepted : November 01, 2016

Objective: This study aims to identify the most effective keyboard layout in the area of performance for securing usability in a smart watch-using environment and to verify the usability of touch keyboard calibrated by hand.

Background: It is necessary to understand the environmental characteristics in using the smart watch and to secure the usability of touch keyboard based on this understanding in order to take account of the users who use the touch screen in the extreme input conditions caused by the small screen of a smart watch.

Method: 30 participants in this study were required to input characters using the QWERTY keyboard and 3x4 keypad (Naratgul, Chunjiin), which were familiar with them, in order to grasp the keyboard layout suitable in the smart watch- using environment; the performance (error rate, performance time) of this case was measured. In addition, 30 participants in this study were required to input the characters setting the QWERTY keyboard with calibrated touch area and the one with uncalibrated touch area, based on the characteristics of touch behavior, by finger typing the keyboard, with the performance (error rate and performance time) of this case measured.

Results: QWERTY keyboard (93.3sec) is found to be 31.2% faster than Naratgul keyboard, a kind of 3x4 keypad, and 43.6% faster than Chunjiin keyboard, in the area of efficiency, in the results of the usability evaluation regarding the keyboard layout. QWERTY keyboard with calibrated touch area (7.5%) is found to be 23.5% improved compared to the QWERTY keyboard with uncalibrated touch area (9.8%) in the area of accuracy (error rate). The results of the usability evaluation regarding the QWERTY keyboard with touch area calibrated by finger typing the keyboard and QWERTY keyboard with calibrated touch area (80.7sec) is found to be 5.7% improved compared to QWERTY keyboard with uncalibrated touch area (85.6sec) in the area of efficiency (performance time).

Conclusion: QWERTY keyboard is found to have an effective layout in the area of efficiency in the smart watch-using environment, and its improved usability is verified in the areas of accuracy and efficiency in the QWERTY keyboard with a touch area calibrated by finger typing the keyboard.

Application: The results of this study may be used to set up the basic touch keyboard of the smart watch. The input usability is expected to secure the smart watch-using environment, which is an extreme input condition by applying QWERTY keyboard with touch area calibrated by finger typing the keyboard.

Keywords: Smart watch, Touch keyboard, Touch area correction, Keyboard layout, Usability evaluation

1. Introduction

Interest in wearable devices has been rising in the recent years. According to IDC, a market research organization, the number of wearable devices shipped around the world is expected to be 45.7 million units and to be 126.1 million units in 2019. In particular, smart watch is considered to be the center of the market for wearable devices as a variety of smart watches have been produced by leading smart phone makers in 2015.

Smart watch may be called a smart device which allows closer interactions, including the functions of telephone, text message, and mail upon wearing it on your wrist and by connecting it with the Internet or a smart phone wirelessly and by checking the physical conditions of the uses through sensor. However, there is a limit to the size of a smart watch in consideration of its wearability as a device worn at the wrist. A smart watch with a screen of such small size poses a difficulty in entering information, which still makes smart watch auxiliary to smart phone. With the gradual evolution of the wearable devices, it is necessary for the independent Stand Alone on the small screen to be conducted in order that the complex performances in the smart phone can be conducted in the future. Such requires the careful consideration for the input methods of the user in the small screen.

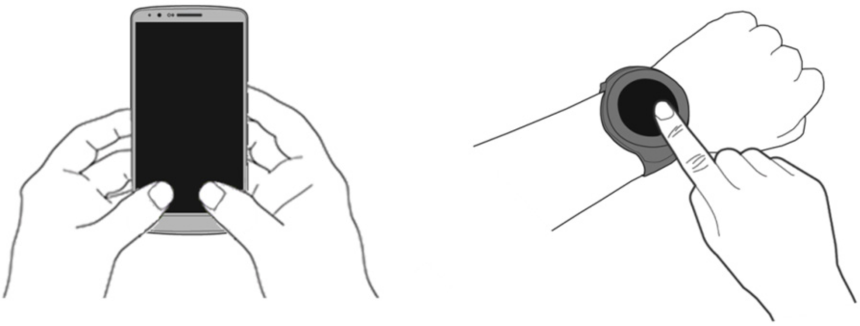
The input methods of the recent smart devices may be divided into speech recognition and touch keyboard. Speech recognition is now being considered as an effective input method. However, it shall be considered as being used together with the touch keyboard as there is a limit to the input in a noisy environment, possibility of leaking the security information, and difficulty in accepting the usage of speech in public places in terms of traditional culture. Therefore, it is absolutely necessary to prepare the plant to secure the usability of touch keyboard in the constrained environment of the small screen of a smart watch.

A variety of researches on the optimum design value of the size of key and the space between the keys (Martin, 1988; Scott and Conzola, 1997; Colle and Hiszem, 2004; Balakrishnan and Paul, 2008; Pereira et al., 2012) have been conducted in terms of the existing relevant researches on the plan to secure the usability of touch keyboard in the smart watch-using environment. However, there is a limit to understanding and applying the optimum size of key and space between the keys due to the constraints on design in which a number of keys shall be provided within a limited small screen on the touch keyboard of a smart watch. Therefore, it may be necessary to consider a plan to effectively arrange the keys within a limited small screen first.

The researches on the new keyboard layout other than the one used as a standard on a variety of smart devices (Ha et al., 2004; Gong and Tarasewich, 2005; Kim and Yoo, 2008; Kim, 2009; Kim, 2014; Dunlop et al., 2014) have been conducted in terms of the existing researches on the keyboard layout. However, the fact that even though Dvorak keyboard (Dvorak, 1943) has a more effective keyboard layout compared to QWERTY keyboard, QWERTY keyboard has been fixed as the standard, implying that the keyboard layout habituated by the experience of the users is an essential influential factor in the area of usability. Such is because the users get accustomed to the keyboard layout through experience and practice by long-period usage, which helps form the exercise schema of the users (Schmidt, 1975) and requires the considerable amount of additional practice and learning, making it difficult for the users to accept the new keyboard layout. Therefore, the attempt to secure usability by changing the keyboard layout habituated by the experience of the users shall be carefully taken into account. In this light, it is necessary to consider the keyboard layout habituated by the experience of the users in terms of the touch keyboard layout in the smart watch environment by priority.

The keyboard layouts of QWERTY keyboard and 3x4 keypad (Naratgul, Chunjiin) may be the typical standard keyboard layout of the smart phone, a typical smart device. QWERTY keyboard has a layout familiar with the PC users and it may be considered to be effective in that just one key is to be pressed to input the character in the comparison of QWERTY keyboard and 3x4 keypad but many keys are to be provided, which increases the likelihood of error in the extremely small screen in the smart watch-using environment by providing a number of small keys. On the other hand, 3x4 keypad has a layout familiar with the feature phone users and it may be considered not to be effective in that many touch keys are to be pressed to input a certain character but a small number of keys compared to those of QWERTY keyboard are to be provided, which relatively decreases the likelihood of error caused by the inappropriate size of touch area by securing the relatively large area for touch keys. Two types of the keyboard layout show the contradictory characteristics in terms of accuracy and efficiency, which requires investigation into what influence they have on the performance in the smart watch-using environment with the extremely small screen sizes.

The understanding of the postures in using smart watch as well as the small screen of smart watch is considered necessary in order to secure the usability of touch keyboard in the smart watch-using environment. Unlike the input postures of both hands in using the smart phone keyboard as shown in Figure 1, the characters are input by the index finger of one hand with the other hand wearing smart watch in using the smart watch keyboard. In light of the posture characteristics in using smart watch, it is considered necessary to prepare a plan to secure the usability of touch keyboard.



(a) Smart phone (b) Smart watch

Figure 1. Input postures for smart devices

In addition, hand wearing a smart watch may depend on the dominant hand, which leads to the difference in usability depending on the hand inputting the characters. As seen in the case of the Apple watch, there have been complaints that it had no consideration for left-handed people judging from its appearance, including the position of buttons, seemingly only for right-handed people. In the light that 15% of the world's population are left-handed people, it is necessary to take into account that the consideration for left-handed people may be the product of competitiveness in the smart watch market.

A closer look at the input posture characteristics of keyboard in the smart watch-using environment reveals that when smart watch on the wrist in a certain direction is approached by the other hand in order to input, the wrist and the index finger make a lateral rotation outward the body in order to touch the screen with ease as the bottom of the hand inputting is being adducted toward the body as shown in Figure 2. This input posture characteristic makes the index finger come into contact with the screen at an angle out of the vertical. The user may then touch the touching point tilted to the hand inputting other than the expected touching spot depending on the user's sightline. As a result, the distribution of the touching spots varies according to the hand inputting. In other words, the touching points of the right-handed people tend to be tilted to the right and those of the left-handed people to the left. It is considered necessary to secure the accuracy of inputting by calibrating the touch area depending on the inputting hand in consideration of these input posture characteristics.

This study compares the performances of QWERTY keyboard and 3x4 keypad (Naratgul, Chunjiin) used as the standard in the smart phone in order to identify the appropriate keyboard layout of the touch keyboard in the environment using the extremely small screen of a smart watch. In addition, this study aims to identify the input posture characteristics by touch in the relevant

Figure 2. Smart watch usage posture and point of touch for right-hander

posture in consideration of the environment in which smart watch is put on one wrist and the keyboard is input by the other and to verify the usability of the touch keyboard with touch area calibrated by the finger typing the keyboard.

2. Method

2.1 Subjects

In this experiment, a comparative experiment on the usability of keyboard layout has been conducted and an experiment has been conducted to verify the usability of the keyboard with touch area calibrated by the finger typing the keyboard. To begin with, 30 participants (14 males and 16 females) in the verification experiment on the usability of keyboard layout were among those who did not have any difficulty inputting as they were looking at the touch keyboard of a smart watch with normal vision or corrected vision in their 20s to 40s and were recruited using the random sampling method. They mainly used a smart phone with QWERTY keyboard at a high rate, with 21 participants using QWERTY keyboard, 9 participants using 3x4 keypad (5 participants used Naratgul keyboard, 3 participants used Chunjiin keyboard, and 1 participant used Vega keyboard).

Next, 30 participants (9 males and 21 females) in the verification experiment on the keyboard with touch area calibrated by finger typing the keyboard were also ones who did not have any difficulty inputting as they were looking at the touch keyboard of a smart watch with normal vision or corrected vision in their 20s to 30s. The hands of the participants were identified using Edinburgh Handedness Inventory and 20 persons were right-handed while 10 persons were left-handed.

2.2 Experimental apparatus

Watch Urbane of Company L was selected as the test equipment. The screen of the smart watch was made up of the round capacitive touch screen of 1.3 inch (33mm of diameter) as shown in Figure 3. Considering that a number of smart watches have been produced in a round shape to be faithful to the original design of watch in the recent years, smart watches with the round shape were selected as test equipment. QWERTY keyboard (27 keys provided, single-tap type), a typical Hangeul keyboard, Naratgul keyboard, Chunjiin keyboard, and typical 3x4 keypads (12 keys provided, multi-tap type) were used in the verification experiment on the usability of the keyboard layout in order to check the size (number) of keys and the input method (single tap, multi tap).

QWERTY keyboard was used in the verification experiment on the keyboard with touch area calibrated by finger typing the keyboard. QWERTY keyboard with relatively small space in the touch area was used in the experiment as the degree of tiltedness

(a) QWERTY keyboard (b-1) 3x4 keypad (Naratgul) (b-2) 3x4 keypad (Chunjiin)

Figure 3. Smart watch touch keyboard

of the touching point is expected to be minute and the effectiveness in terms of accuracy is expected to become greater in case the touch area is calibrated by a key of small size. The keyboard with touch area calibrated by finger typing the keyboard and the keyboard with uncalibrated touch area were set up by applying the QWERTY keyboard touch map derived from the analysis on the touching point of the user in order to verify the improvement effect of the keyboard with touch area calibrated by finger typing the keyboard to the relevant test equipment.

2.3 Experimental design

To begin with, the participants were required to input the first verse of the national anthem to type in the input sentences without looking at them as the experimental work in the verification experiment on the keyboard layout using the QWERTY keyboard and 3x4 keypad. The relevant sentences were composed of 126 phonemes and the participants were required to input the following characters without correcting them even if there were errors in the performance of the work in order to count the errors. Three levels of QWERTY keyboard (126 types required to complete the sentence), 3x4 keypad, including Naratgul keyboard (165 types required to complete the sentence), and Chunjiin keyboard (206 types required to complete the sentence), were set up as touch keyboard types which is a factor of within-subject as an independent variable for the comparison of the usability of keyboard layout. The error rate (the number of errors / the number of input types) and the performance time were measured as the dependent variable.

The participants were then required to use the Korean pangram sentences which allowed all the spellings to be evenly input across in the screen (Do you hear the sound of the wind? / "Do you fall in reminiscence of an old village?" / "Lastly, is there anybody going to get off?" / "Does Baritone have a beautiful tone?") which were composed of a total of 95 phonemes in the verification experiment on the usability of the keyboard with touch area calibrated by finger typing the keyboard with the participants required to input the following characters without correcting them even if there were errors in the performance of the work in order to measure the errors. Two levels of the keyboard with uncalibrated touch area and the keyboard with touch area calibrated by finger typing the keyboard were set up as touch keyboard types which is a factor of within-subject as an independent variable. The error rate and the performance time were also measured in the same way as the dependent variable.

2.4 Experimental procedure

To begin with, the purpose and precautions of this study were explained to the participants before the verification experiment on the usability of keyboard layout and enough time for the practice was given to the participants in order to get used to the input environment on the smart watch and how to use the presented keyboard. In order to prevent the typographical errors (typos) caused by the shaking of the keyboard in typing the keyboard, the participants were required to conduct the experimental work by mainly using a hand with the hand wearing smart watch being placed on the desk. The error rate and performance time of this case were measured. The presentation order of the keyboard type was provided at random to minimize the order effect, whereas the interviews on the experiences on each keyboard type were conducted after the completion of work. It took 30 minutes or so for the experiment.

Afterwards, the touch area in the screen was derived from the analysis on the touching point in order to identify the touching pattern depending on the inputting finger in the preliminary experiment before the verification experiment on the usability of keyboard layout, through which the degree of tiltedness of the touch area depending on the inputting finger was identified. In this case, a total of 20 persons (10 right-handed participants and 10 left-handed participants) wearing smart watch on the opposite wrist of the mainly used hand participated in the experiment and their characteristics in touch behavior by using the index finger of the mainly used hand typing the touch keyboard in the relevant use postures were identified. As a result, the average distance from the center of key was found for the touch area of the right-handers to be 9% tilted to the right and for that of the left-handers to be 6% tilted to the left. Based on this, the touch area of the keyboard used in this experiment was calibrated.

In this experiment, the purpose and precautions of this study were explained to the participants and the right-handed participants were required to wear smart watch on their left hand and to use the keyboard with uncalibrated touch area and the keyboard with touch area calibrated by the right hand typing the keyboard. The left-handed were required, in the same way, to wear smart watch on their right hand and to use the keyboard with uncalibrated touch area and the keyboard with touch area calibrated by the left hand typing the keyboard. In order to prevent the typos caused by the shaking of the keyboard in typing the keyboard, the participants were required to conduct the experimental work by the finger of the other hand with the hand wearing smart watch being placed on the desk and the error rate and performance time of this case being measured. The presentation order of the keyboard type was provided at random to minimize the order effect. The interviews on the experiences on each keyboard type were conducted after the completion of work. It took 20 minutes or so for the experiment to be conducted.

3. Results

3.1 Results of usability test for keyboard layout

3.1.1 Accuracy

Variance analysis was conducted using Minitab 17 in order to examine the difference in accuracy of QWERTY keyboard and 3x4 keypad. As a result, there was no statistically significant difference in the error rate depending on the keyboard layout (Table 1). However, QWERTY keyboard (8.1% of error rate, 10.3 cases in the number of errors) tended to be lower in the error rate compared to the 3x4 keypads, including Naratgul keyboard (9.8% of error rate, 16.2 cases in the number of errors) and Chunjiin keyboard (10.9% of error rate, 16.2 cases in the number of errors, Figure 4).

Table 1. ANOVA Table of error rate for keyboard layout

Source	DF	SS	MS	F	Pr>F
Keyboard layout	2	0.001183	0.005915	0.67	0.512

(* $p<.05$, ** $p<.01$, *** $p<.001$)

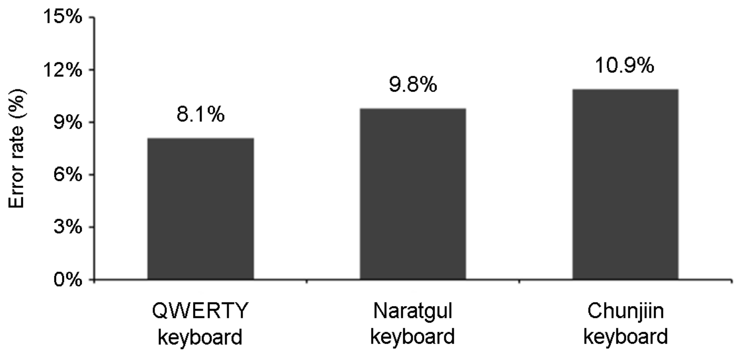


Figure 4. Error rate for keyboard layout

3.1.2 Efficiency

Variance analysis was conducted using Minitab 17 in order to examine the difference in efficiency of QWERTY keyboard and 3x4 keypad. As a result, there was a significant difference in the performance time depending on the keyboard layout (Table 2). With regard to this, QWERTY keyboard (97.3sec) was found to be faster in the performance time compared to 3x4 keypad (Naratgul 141.4sec, Chunjiin 172.6sec) by the ex-post analysis results obtained from the Tukey test (Figure 5), which meant that QWERTY keyboard was statistically significantly, being 31.2% faster than Naratgul keyboard and 43.6% faster than Chunjiin keyboard.

Table 2. ANOVA Table of performance time for keyboard layout

Source	DF	SS	MS	F	Pr>F
Keyboard layout	2	85724	42862	15.42	0.000***

(*$p<.05$, **$p<.01$, ***$p<.001$)

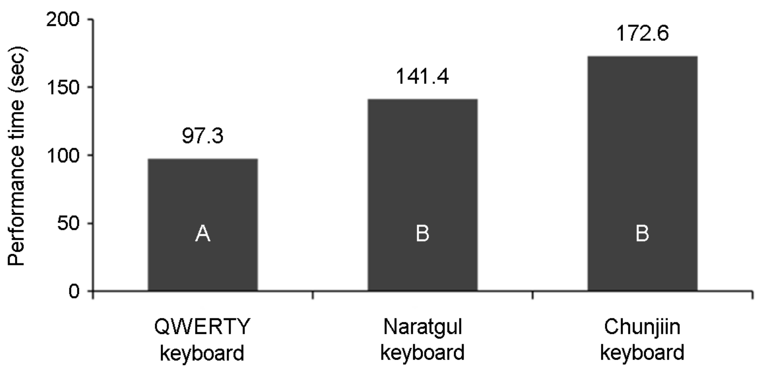


Figure 5. Performance time for keyboard layout

3.2 Results of usability test for keyboard corrected touch area by input hand

3.2.1 Accuracy

T-test was conducted using Minitab 17 in order to examine the difference in accuracy depending on the calibration of touch area. As a result, the keyboard with touch area calibrated by finger typing the keyboard (7.5% of error rate, 9.5 cases in the number of errors) was found to be statistically significant (p=0.004) or 23.5% lower in error rate compared to the keyboard with uncalibrated touch area (9.8% of the average error rate, 12.3 cases in the number of errors) with higher accuracy in typing the characters (Figure 6, Table 3).

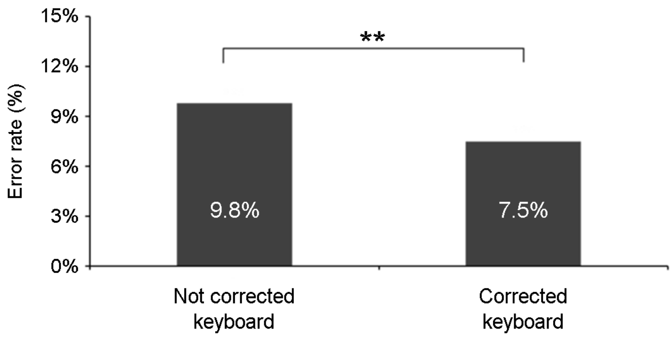


Figure 6. Errors for keyboard type (*p<.05, **p<.01, ***p<.001)

Table 3. T-test result of errors for keyboard type

Source A (Mean)	Source B (Mean)	df	t-score	p-value
Not corrected keyboard (9.8%)	Corrected keyboard (7.5%)	29	3.14	0.004

3.2.2 Efficiency

T-test was conducted using Minitab 17 in order to examine the difference in efficiency depending on the calibration of touch area.

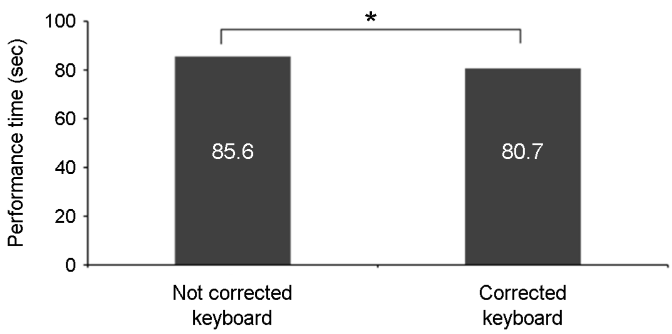


Figure 7. Performance time for keyboard type (*p<.05, **p<.01, ***p<.001)

Table 4. T-test result of performance time for keyboard type

Source A (Mean)	Source B (Mean)	df	*t*-score	*p*-value
Not corrected keyboard (85.6)	Corrected keyboard (80.7)	29	2.75	0.010

As a result, the keyboard with touch area calibrated by finger typing the keyboard (80.7sec) was found to be statistically significant (p=0.010) and 5.7% lower in the performance time compared to the keyboard with uncalibrated touch area (85.6sec) with the speed increasing in typing the characters (Figure 7, Table 4).

4. Conclusion

This study verified the suitability of QWERTY keyboard and 3x4 keypad (Naratgul, Chunjiin) familiar with the users by their comparative evaluation on their usability in order to identify the keyboard layout appropriate in the environment in which it is difficult to type in the small screen of smart watch. In addition, the characteristics of behavior touching the keyboard of smart watch was to be identified based on the understanding of the use postures of smart watch, on which the verification experiment on the usability of keyboard with touch area calibrated by the finger typing the keyboard was conducted.

To sum up the results of researches on the usability of keyboard layout, QWERTY keyboard was found to be 31.2% faster (97.3sec of QWERTY keyboard performance time, 141.4sec of Naratgul keyboard performance time) than Naratgul keyboard and 43.6% faster (97.3sec of QWERTY keyboard performance time, 172.6sec of Naratgul keyboard performance time) than Chunjiin keyboard in terms of efficiency, which could be interpreted that QWERTY keyboard with the single tap type was more efficient than 3x4 keypad with multi tap type; that is, as the character which the user wanted to input was typed in by pressing one key at a time in the environment in which the keys were input by pressing finger in the QWERTY keyboard on the other hand, the character which the user wanted to input was input by pressing the same key repeatedly in the 3x4 keypad, QWERTY keyboard took the less time to conduct the performance than the 3x4 keypad.

QWERTY keyboard (8.1% of error rate, 10.3 cases in the number of errors), though there was no statistical difference, tended to be higher in terms of accuracy compared to the 3x4 keypads, including Naratgul keyboard (9.8% of error rate, 16.2 cases in the number of errors) and Chunjiin keyboard (10.9% of error rate, 16.2 cases in the number of errors). QWERTY keyboard with the small touch space per key was found to have a smaller number of typos compared to the 3x4 keypad with the relatively large touch space, and even though the error rate of pressing a key just one time in the 3x4 keypad (a total of 165 types input for the sentence in the Naratgul keyboard and a total of 206 types input for the sentence in the Chunjiin keyboard) tended to be lower compared to that in the QWERTY keyboard, the error rate of 3x4 keypad of multi tap type tended to be higher by pressing many keys to input a character compared to the QWERTY keyboard of single tap type (a total of 126 types input), which resulted in more typos in order to complete the sentence in the smart watch-using environment with the extremely small screen which was susceptible to the typos.

In addition, QWERTY keyboard tended to be lower compared to the 3x4 keypad in terms of error rate, which could be interpreted that the key area as well as the input methods had some effect. The index finger was expected to be in contact with the screen out of the vertical into the shape of diagonal line in order to input the character in the environment in which the characters were input by the keyboard of the smart watch, forming a tilted ellipse of touch area, which could play an important effective factor in the width and height of keys by the formal characteristics of contacted touch area. Overall, even though QWERTY keyboard had a narrower touch area compared to that of 3x4 keypad, which resulted mainly from the width of key touch area (a maximum of 10 keys arranged in a row in the QWERTY keyboard, 3 keys arranged in a row in the 3x4 keypad) the QWERTY keyboard, in terms of the height of key touch area (3 rows provided at the QWERTY keyboard, 4 rows provided at the 3x4 keypad) might have an advantage over 3x4 keypad.

Then, to sum up the results of researches on the QWERTY keyboard with touch area calibrated by finger typing the keyboard, the keyboard with touch area calibrated by finger typing the keyboard showed an improvement of 5.7% (85.6sec of the performance time before the calibration of touch area, 80.7sec of the performance time after the calibration of touch area) in terms of efficiency compared to the keyboard with uncalibrated touch area, the improvement of 23.5% in terms of the input accuracy (9.8% of error rate before the calibration of touch area, 7.5% of error rate after the calibration of touch area).

This could be interpreted that the typos were reduced and its performance time also was reduced because the touch area was calibrated based on the understanding of the touch input posture characteristics in the smart watch-using environment in which smart watch is put on one wrist and the keyboard is input by the other. It is because the faster input was possible when the accurate and smooth input was made, which could hesitate to input the next character even though the typos were not corrected at the sight of typos on the input screen.

5. Discussion

This study examined the keyboard layout appropriate in the smart watch-using environment and the QWERTY keyboard was found to have an advantage over 3x4 keypad in terms of efficiency by the results of the study. In addition, it was also found that the appropriate width and height of touch key based on the shape of the contact surface when touched as well as the comprehensive area of touch key could be important and the touch input methods (single tap, multi tap) were an important factor in determining accuracy in terms of usability in the light of accuracy in the environment in which the keyboard is input by one hand on the extremely small screen of the smart watch.

The usability in light of accuracy and efficiency was found to be improved in case the understanding of the input posture characteristics depending on the postures in using smart watch was reflected on the keyboard. In addition, a close look at the cases that the typos occurred due to the tiltedness to the right and to the left depending the calibration of touch area revealed that the numbers of typos tilted to the right and to the left in the QWERTY keyboard with touch area calibrated by the finger typing the keyboard for the right-handers and for the left-handers generally showed 33.3% (18 cases before the calibration of touch area, 12 cases after the calibration of touch area) and 5.6% (34 cases before the calibration of touch area, 28 cases after the calibration of touch area) of reductions respectively (Figure 8). In particular, 14 cases of typos tilted to the right in the keyboard for the right-handers were reduced compare to the cases before the calibration of touch area and 21 cases of typos tilted to the left in the keyboard for the left-handers were reduced compare to the cases before the calibration of touch area. However, 8 cases

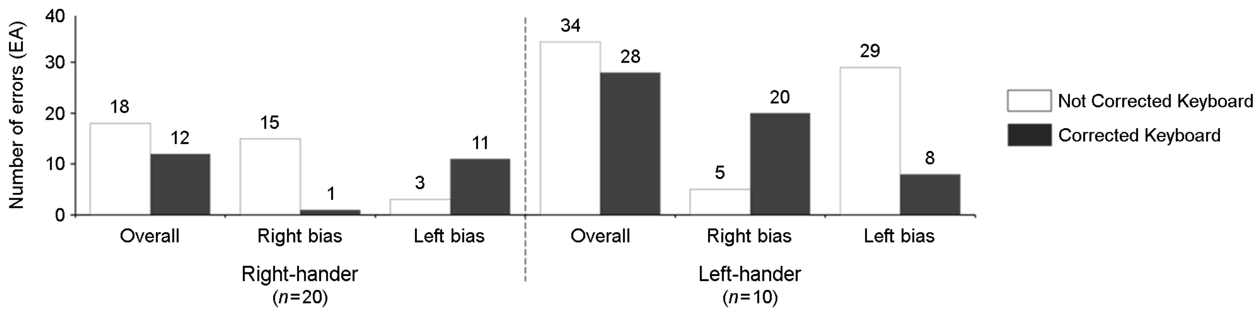


Figure 8. Result for error tendency analysis

of typos tilted to the left increased in the keyboard for the right-handers and 15 cases of typos tilted to the right increased in the keyboard for the left-handers.

These analytical results means that the usability could be improved due to reduced typos at the calibration of touch area but there might be the difference in its effect depending on the individual, which means that the physical characteristics and usage habits of the individuals might be varied and this difference could lead to the difference in the distribution of the touching points of their touches. According to the previous researches related to the automatic calibration of the touch area (Findlater and Wobbrock, 2012), the effect of usability is expected to be improved in case the function of calibrating the touch area appropriate for each person by real-time analysis on the input habit of the users regarding the touch input behavior characteristics of the individuals with the consideration of the research results that every automatic calibration of the touch area based on the analysis of the touch behavior of the users have an effect on its efficiency.

Smart phone users in their 20s to 40s were recruited using the random sampling method in this experiment which was conducted based on the assumption that the exercise schema formed by the existing experience of the keyboard layout would be minute as the posture in using the smart phone and the one in using the smart watch would be different from each other. The verification on whether the experience of the existing keyboard in the smart phone-using environment had an effect upon the usability of keyboard in the smart watch-using environment may be needed in future researches. However, considering that the percentage of the users of QWERTY keyboard as the main keyboard is higher in the real market environment, the results of this study are expected to be used as a reference in setting up the existing keyboard.

The results of this study also are expected to be used as a reference to the appropriate keyboard layout in terms of usability in the smart watch environment. If the smart watch is provided with the keyboard with touch area properly calibrated by finger typing the keyboard, the improved usability will be experienced due to the touch area calibrated and suited for the behavior of touch pressing and maintaining the continuity of the existing experiences by maintaining the keyboard layout visually familiar with the users. In addition, if the touch area can be calibrated by hand typing the keyboard, it will offer an improved satisfaction to the left-handers as well as the right-handers.

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