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English Input Keypad Method Using Picker-Based Interface

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ABSTRACT

By according to the development of the mobile devices, a touch screen provides the variety of inputting character and the flexibility of user interface. Currently, the physically simple touch method is widely used for English input but this simple touch is not increasing the variety of inputs and flexibility of the user interfaces. In this paper, we propose a new method to input English characters continuously by recognizing gestures instead of the simple touches. The proposed method places the rotational pickers on the screen for changing the alphabetical sequence instead of the keys and inputs English characters through the flick gestures and the touches. Simulation results show that the proposed keypad method has better performance than the keypad of the conventional methods.

Key words: Picker, Flick, English Keypad, Vocabulary

1. INTRODUCTION

The culture for communicating a text message to the mobile terminal has been generalized and the keypad is used extensively for inputting characters instead of the keyboard [1,2,3]. Recently, the character input method has become various by the adoption of the touch screen and a flexible user interface is possible to be provided [4].

However, the researches on the English input method can not largely depart from a simple touch of a physical keypad. The simple touch keypad is largely composed of multi-tab and QWERTY methods. The multi-tap method used in most non-English speaking country assigns 26 alphabets to eight or nine keys and allocates 2~4 alphabets on each key. This method inputs the next alphabet through the continuos enter of the key. QWERTY approach binds 26 alphabets to each key, so that input speed is fast but it has disadvantage of high mistype ratio because the gap between the keys is narrow.

The researches have been conducted to improve the problems of the simple touch keypads. The frequency and bigram of the alphabet for the efficient placement [5], genetic algorithm [6] were presented. However, these methods do not overcome the limitations of the touch method as to adjust only the arrangement of the keys in the conventional simple touch methods.

In this paper, we propose a new English input method by utilizing the various input methods and the flexibility of user interface on the touch-screen environment. The proposed method places the rotational pickers on the screen and rotates a picker from user's flick in order to change the alphabet

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sequentially and then input certain alphabet through the gesture and the touch. Picker is one of the input interface, often used when the user selects a date and time in a GUI environment. The arrangement of the alphabet is intuitive by placing the picker instead of keys, so that the proposed method can achieve the effect of increasing the degree of freedom in the English input from the user.

This paper is comprised of the next chapters. In chapter 2, it explains a conventional English input methods. In chapter 3, we presents a proposed method and in chapter 4, it compares with the conventional and proposed methods. Chapter 5 makes a conclusion.

2. CONVENTIONAL ENGLISH KEYPAD METHOD

In this chapter, we describe the current keypad methods. Fig. 1 shows the traditional 3×3 keypad. The method has been bound in three to four characters to a single key, so that this method incorporates the multi-tap method that a user should press the number of times in order to change the characters. The characters on each key are arranged in alphabetical order, so that the user is easy to learn the keypad for the first time. However, this method does not consider the frequency of characters in English sentences and a user has to press a space button in order to input continuously a character on the same button [5, 7].

Fig. 2 shows the design of a keypad using the frequency and bigram of characters [5]. By considering the frequency of characters and the possibility of a continuous input of two characters that appear in the English sentences, the method improves the performance of the multi-tap method.

	abc	def
ghi	jkl	mno
pqrs	tuv	wxyz

Fig. 1. Standard multi-tap keypad.

tdq	ayk	icb
rlz	euw	hm.
sfv	npj	ogx

Fig. 2. Keypad using frequency information of characters and bigram.

Fig. 3 shows a method that presses a character and a number at the same time in order to input some character [8]. For example, we must press two buttons of 'A' and '3' at the same time to input the 'c'. This method is hard to enter by the one hand, but the input strokes are less than the conventional methods and there is no problem in a continuous input.

Recently, it has been widely used a QWERTY keypad that is same as an array of traditional computer keyboard as shown in Fig. 4. However, the method has a large number of arranged keys and is smaller the distance between the keys. Therefore, the method has a disadvantage of high mistype ratio. In addition, a technology called Swype [9] that remembers the drawing points of finger until when user's finger does not get off is applied. The method inputs the characters of the stored lo-

A abcde	F fghij	K klmno
P pqrst	U uvwxy	Z z.,?!
1	2	3
4	5	Aa

Fig. 3. Keypad of simultaneous input method.

Fig. 4. QWERTY Keypad.

cations in order when the finger gets off.

3. PROPOSED ENGLISH KEYPAD METHOD

The number of input strokes can be reduced through a gesture in touch screen environment. For example, it should be pressed up to four times for input of one character when four characters are bound to a single button on the general 3×4 English keypad. Also, the touch-drag method which allows 4 gestures of top, bottom, left side, and right side on a button can input a character for one time touch and drag. But this touch-drag method is hard to learn. Even though the drag keypad is fast and accurate than conventional keypad, the unfamiliar user of drag input may not want to use the drag because of the refusal to dragging. For this reason, a keypad using the gesture should have an intuitional design of screen and has a simple input rule also needs to select a gesture which the user does not feel a refusal.

The proposed method uses a picker. The picker is frequently used to get input of date or time for Android as the user interface and is used to select numbers or characters that are listed in the order.

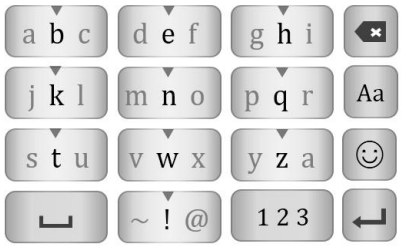

Fig. 6. Initial state of proposed keypad.

Fig. 5 shows an example of inputting a character using a picker. Within the picker, a flick gesture is used to touch the center of the character 'n' in Fig. 5 and input it, or to move to another character.

Flick is a gesture which is based on touch screen device. It means that a list is scrolled to the direction which a finger is pressed on any one point and drawn to some particular direction [10]. This flick is able to move an English character for minimum finger movement. In this method, the user might not feel a refusal because it is just touch and added a little bit drag. Flick gesture is divided left side and right side without a size of gesture and is able to move one English character at a time. The divided pickers are displayed as shown in Fig. 6.

The proposed method has 5 states: 'initial', 'standby', 'input by touch', 'input by expired time of standby', and 'input by focus shift'. First, the pickers are on 'initial' state as shown in Fig. 6. When a string of certain picker rotates through the user's flick input, the state is on 'standby' and another touch or flick must be inputted within 0.5 seconds as shown in Fig. 7. For example, [a b c] picker is rotated as [z a b] by Right_Flick, then the state becomes 'standby' during 0.5 seconds to wait for next input. After 0.5 seconds, a centrally

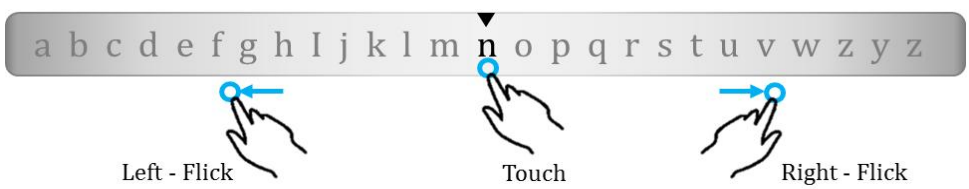

Fig. 5. Example of picker interface.

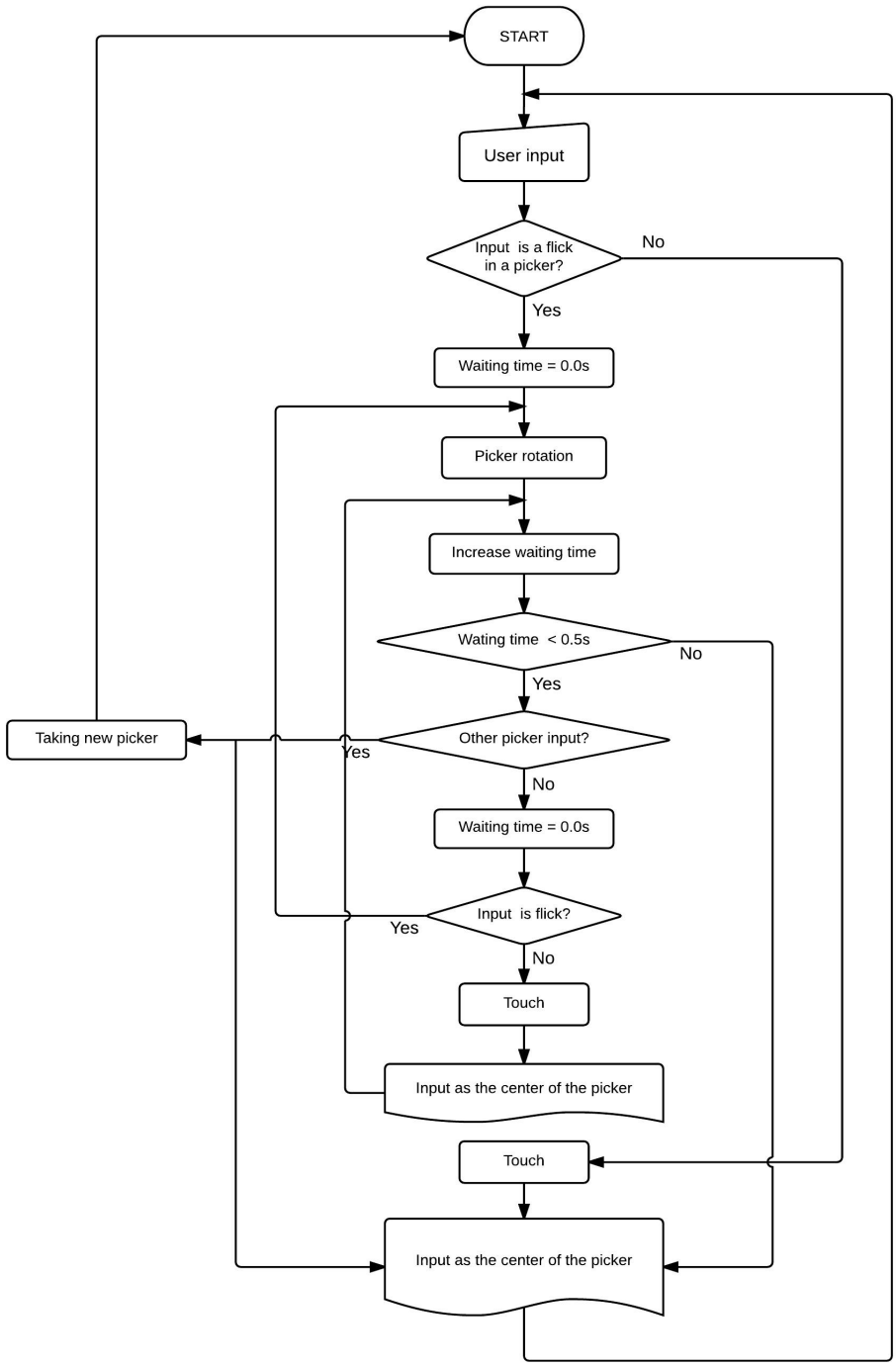

Fig. 7. Flow of the proposed method.

located alphabet 'a' is inputted by 'input by expired time of standby' and it is initialized to [a b c]. The waiting time of the picker is initialized each time when there is the user's touch or more flick. The state of 'input by focus shift' quits immediately the state of 'standby' and allows the input of character

when there are a picker of 'standby' and input by the other picker from the user. This is for preventing the error of changed character order when the user inputs quickly.

When a sequence of characters is entered, the proposed method is more efficient than the traditional multi-tap method. In order to input the "oo" in the traditional multi-tap method, we have to press [m n o] button of Fig. 1 three times and wait a few seconds, then again press [m n o] button three times. It must be pressed. On the other hand, the proposed method aligns the [m n o] picker by Left_Flick to the center of 'o', then touch it. Immediately, 'o' is inputted and after 0.5 seconds the 'o' is inputted once more by the 'input by expired time of standby'.

Fig. 8 and Fig. 9 show the input examples for 'dog' and 'yahoo'.

Because flick gesture is a very simple, the proposed method can input easily the repetitive English characters. Input required for one alphabetic character is at a time. Also, each picker rotates alphabet from a to z so there can be possible as 9 kinds of the input for one English character.

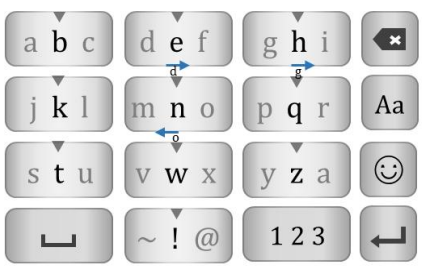

Fig. 8. Input example for "dog".

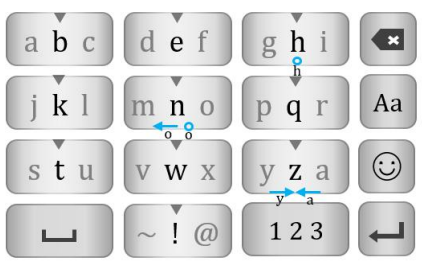

Fig. 9. Input example for "yahoo".

This feature gives the user the degree of freedom for input. For example, if the user has to input by using only right hand, it is better to use [y z a] picker instead of [a b c] picker.

In the proposed method, the waiting time is set at 0.5 seconds by the simulations but it looks like to adjust by depending on user's skill. Also, it needs to recognize to users by twinkle effect of the picker when a character is inputted.

4. SIMULATION RESULTS

In order to evaluate the performance of keypad, basic 3 × 3, simultaneous input, QWERTY, and the proposed methods are compared. The performance criterions are the key strokes, the finger movement distance, the number of buttons that use to type character, keypad speed, and accuracy.

The key stroke is measured by KSPC (Key Strokes Per Character) as follows [11].

$$KSPC = Total\ number\ of\ strokes\ (NT) / total\ number\ of\ characters \quad (1)$$

Fig. 10 shows a result of KSPC by comparing each keypad methods.

"Method a" is 3 × 3 multi-tap input, "Method b" is simultaneous input, "Method c" is QWERTY, and "proposed" is the proposed method. The proposed method is better than other methods because all characters can be inputted through one time touch or flick, so that KSPC has been always 1.

Finger Movement Distance (FMD) means a

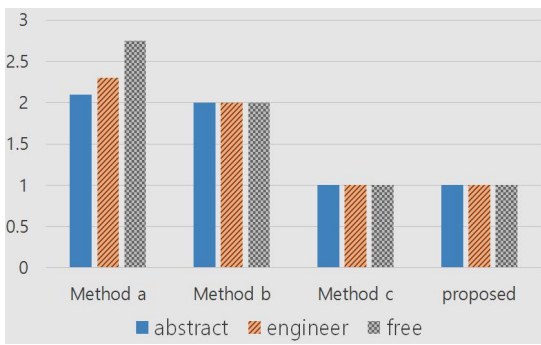

Fig. 10. KSPC comparison.

moving distance between buttons when the characters are inputted as follows [12,13].

$$FMD = Total\ number\ of\ strokes\ (NT) + Key\ distance \quad (2)$$

FMD is better in case of the fewer KSPC, the shorter distance between the current and next buttons for input. The proposed method is possible to make KSPC by one for every character. In some cases, KSPC will be increased but FMD will be reduced. For example in order to input 'h', when we use [j k l] picker and do not move the [g h i] picker after using [j k l] picker, KSPC is increased but FMD is reduced.

KSPC of the proposed method is same as QWERTY method, but FMD of the proposed method is shorter than QWERTY method. Also, FMD of the proposed method can be shorter, depending on how to use since it is possible for the character to input in a number of ways.

Table 1 shows a input process of the proposed method for a sentence of "I bought a green balloon". Table 2 compares the results of measuring

Table 1. Input example of proposed method for sentence of "I bought a green balloon"

Alphabet	Picker	Input
I	[g h i]	←
b	[a b c]	•
o	[m n o]	←
u	[s t u]	←
g	[g h i]	→
h	[g h i]	•
t	[s t u]	•
a	[a b c]	→
g	[g h i]	→
r	[p q r]	←
ee	[d e f]	• •
n	[m n o]	•
ba	[a b c]	• →
ll	[j k l]	← •
oo	[m n o]	← •
n	[m n o]	•

Table 2. Keypad performance comparison for a sentence of "I bought a green balloon"

Keypad	NT	KSPC	FMD	Number of buttons used
3×3 multi-tap	45	2.25	55	8
Simultaneous input	40	2	44	10
QWERTY	20	1	30	20
Proposed	20	1	25	7

the performance of each keypad to the above sentence. The spaces were skipped from the sentence. KSPCs of QWERTY and the proposed method were the best. For the measurement of FMD, the simultaneous input method is calculated separately FMD to push the alphabet for [A-Z] or number, then two FMDs are added. For QWERTY method, by considering many buttons arranged on a line, two buttons are calculated a space between key input.

From the simulation results, we can see that the proposed method is a superior performance compared to the conventional methods. The proposed method has the advantages of shorter FMD and a small number of used buttons, compared to the QWERTY keypad, but may drop slightly learning efficiency in terms of using two gestures.

Table 3 compares the results of measuring the keypad speed and accuracy. For the measurement of the keypad speed, the times required for the input are calculated with respect to 10 samples sentences, and then the average value per second (characters/sec) is measured. The accuracy is determined subject to the type with both hands by

Table 3. Comparison of keypad speed and accuracy

Keypad	Speed (cps)	Accuracy		
		4.0 inch	5.3 inch	8.4 inch
3×4 multi-tap	1.65	92.0%	93.0%	93.5%
Simultaneous input	1.98	86.5%	88.2%	88.2%
QWERTY	2.40	84.1%	87.0%	96.3%
Proposed	2.30	92.1%	93.3%	94.6%

changing the size of the touch screen. The results of simulation show that the keypad input speeds of both QWERTY and the proposed methods are faster than other keypad methods. The proposed method has the highest accuracy for 4.0 inch and 5.3 inch sizes of the typical smart phone, QWERTY has the highest accuracy for 8.4 inch size of the tablet PC. QWERTY input method has advantage of quick speed, but disadvantage of high probability of typos for smaller touch screen.

5. CONCLUSION

In this paper, we propose a method to input English character by placing the 9 pickers and through the touch and flick gestures. The proposed scheme is intuitive and requires a single stroke for one character and does not generate any problem in a continuous input, and reduces the input strokes significantly compared to the conventional methods. In addition, the proposed method can provide a flexible input interface to the user because each picker is possible to input the all of 26 alphabets. In the simulation, measuring the input strokes by KSPC and movement distance by FMD, the proposed method is confirmed excellent as compared with the conventional keypads. Future plans are to reflect the user's requirements by distributing the proposed method to verify the keypad effectiveness in the Android environments and then to improve the performance of keypad.

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