Immediate User Performances with Touch Chinese Text Entry Solutions on Handheld Devices

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ABSTRACT
"Immediate usability" is more important for mobile text entry solutions [7]. We compared immediate user performance of four touch Chinese text entry solutions on mobile devices including two Chinese handwriting recognition (HWR: full screen and 3-box) and two pinyin virtual keyboard (VKB: consonant plus vowel and QWERTY) solutions with novice users. It was found that users make more errors with Chinese HWR solutions than VKB solutions although there are no significant differences between the two solutions in each category. Users are significantly slower with the consonant plus vowel pinyin keyboard than the other three solutions although the consonant plus vowel keyboard is better on the measure of key stroke per character (KSPC).

Categories and Subject Descriptors
H5.2. [Information interfaces and presentation]: User Interfaces -- Input Devices and Strategies, Evaluation/methodology.

General Terms
Performance, Experimentation.

Keywords
Chinese, Handheld Device, handwriting recognition, virtual keyboard, usability.

1. INTRODUCTION
In recent years, handheld devices with touch screen got much attention from both researchers and practitioners. Chinese text entry solutions on such devices consist of two main categories: handwriting recognition (HWR) and virtual keyboard (VKB) solutions. Moreover, Short Message Services are heavily used in China and more than 58 billion short messages were sent averagely per month in year 2008 [2].

The HWR technique fits better into languages with complex character sets like Chinese [1, 7]. Discrete HWR, which means system recognize written texts character by character, is still the main stream for handheld devices. Virtual keyboard solution is another thread of method for entering Chinese texts [3, 4]. *Pinyin* is the standard coding system that encodes the Mandarin pronunciation of Chinese characters in the form of Roman characters [6, 8]. Pinyin marks usually consist of two parts: a consonant and a vowel, with a few including only a vowel [5]. We conducted the study to compare user performances and preferences of different designs for Chinese HWR and pinyin VKB.

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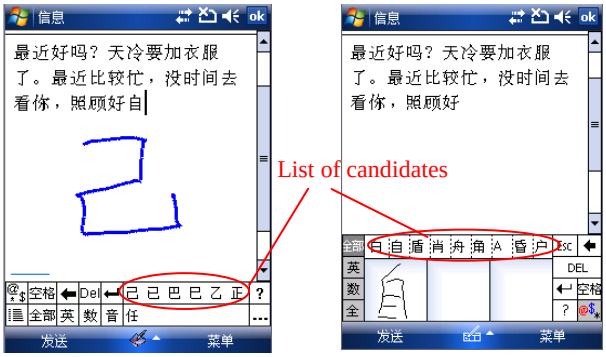
2. EXPERIMENT
2.1 Objective
We tried to learn effects of different designs on user performances and preferences for both the Chinese HWR and the pinyin VKB.

Figure 1 shows the design solutions we compared in the study: the full screen and the 3-box designs for discrete Chinese HWR.



a. the full screen design: users can write anywhere on the screen; a timeout (a duration of time) is used to initiate the recognition process.

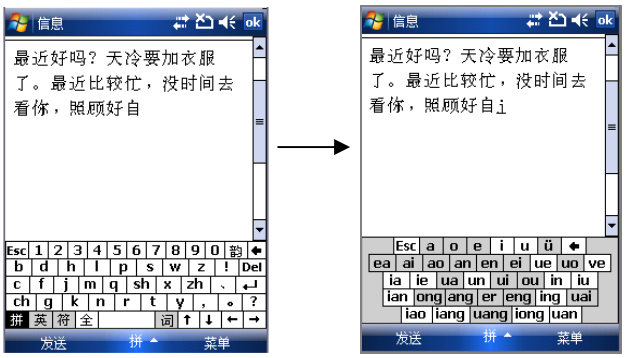
b. the 3-box design: users need to write in boxes; writing in alternative boxes would initiate the recognition and users needn't to wait for a timeout.

Figure 1 The full screen and the 3-box design for discrete Chinese HWR

Figure 2 (a) shows the two pinyin VKB designs compared in the study.

2.2 Methods
The experiment was a within-subject design. Test orders were counter-balanced with the Latin-square technique.

Twelve users (5 male and 7 female) volunteered to attend the study. Their age ranged from 25 to 34 years old with an average of 26.3 years (SD=2.96). All participants were right handed and novice users of Chinese HWR and the VKB solutions.



a. the consonant + vowel keyboards: users input a consonant with the consonant keyboard and then the vowel with the vowel keyboard to complete a pinyin mark.

b. the QWERTY keyboard: A pinyin mark is complete by entering its alphabets one by one with the keyboard.

Figure 2 The consonant + vowel and the QWERTY designs

The experimental task was to copy and enter presented Chinese short messages. Device used was the Dopod p800.

3. RESULTS

3.1 Error Rate

Table 1 shows the descriptive results and the ANOVA test results on error rate. ANOVA test showed a significant difference of the method on error rate ($F_{(3, 47)}$ =7.90, p<.001). Further t-tests indicated that the differences between any Chinese HWR and VKB solutions are significant. But in each method category, the differences are not significant.

Table 1 Descriptive and t-test results on error rates (delete actions per character)

	Chinese HWR		Pinyin VKB		F	P
	Full screen	3-box	Con+ vow	qwerty		
Mean	0.29	0.21	0.053	0.050	7.90	0.0003
SD	0.212	0.163	0.061	0.109		

3.2 Text Entry Rate

Table 2 shows the descriptive and the ANOVA test results on text entry rate (Word per Minute). The results indicated that there is a significant difference of the input solutions on text entry rate ($F_{(3, 47)}$ = 5.81, p<.05). Further t-tests indicated that all other methods are significant faster than the consonant plus vowel pinyin keyboard solution.

Table 2 Descriptive and t-test results on text entry rates (WPM)

	Chinese HWR		Pinyin VKB		F	p
	Full screen	3-box	Con+ vow	qwerty		
Mean	15.17	14.97	9.66	14.32	5.81	0.0019
SD	3.300	4.266	3.637	3.729		

We also compared the keystrokes per character (KSPC) results of the two keyboard solutions and the t-test result shows the Consonant plus vowel keyboard is better (Table 3).

Table 3 KSPC results of the two pinyin keyboard

KSPC	Con+vow	qwerty	T	p
Mean	2.96	4.14	-9.690	0.000
SD	0.424	0.113		

3.3 Conclusions

We compared immediate user performance of four touch Chinese text entry solutions on mobile devices including two Chinese handwriting recognition (HWR: full screen and 3-box) and two pinyin virtual keyboard (VKB: consonant plus vowel and QWERTY) solutions with novice users. It was found that users make more errors with Chinese HWR solutions than VKB solutions although there are no significant differences between the two solutions in each category. The consonant plus vowel pinyin keyboard is significantly slower than the other three solutions although it is better than the QWERTY VKB on the characteristic of key stroke per character (KSPC).

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