

# Integrating Pen Operations for Composition by Example

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## ABSTRACT

We propose a new pen-based text input method, which is an integration of software keyboards, handwriting recognition, and marking menus. With our method, a user selects a word from a list of candidate words filtered from a dictionary by specifying spelling, pronunciation, or the shape of its characters. Users can easily switch between using a software keyboard and using handwriting recognition systems, by tapping or writing strokes in the same area. Users can also show a menu of candidate words around the pen by stopping pen movement during operation.

**KEYWORDS:** Pen Input, Handwriting Recognition, POBox, Composition by Example, PBE, PBD, Marking Menu

## COMPOSITION BY EXAMPLE

A variety of corpuses, template texts and dictionaries are available online these days, and the style of text composition may change. In some cases, it is faster to search an existing text close to the requirement and make modifications according to needs rather than writing the text from scratch. Even to enter a single word it is sometimes faster to search for the word in a dictionary and select from candidates rather than specify all characters that constitute the word. This is especially true when users cannot use fast direct character input devices like keyboards, when entering text in East Asian languages where direct character input is extremely difficult, and when users do not remember the correct spelling of words they want to input.

For these reasons, we believe that entering words and phrases using dictionaries and example phrases is a promising approach for composing text in many situations, like using pen-based computers, writing formal letters, writing texts in East Asian languages, etc. We call this approach *Composition By Example*, or *CBE*, for short.

Several methods are used widely to enter characters on pen-based computers. One method is using a software keyboard displayed on the tablet; another is the use of handwriting

recognition techniques. In [2], we showed that CBE with a software keyboard is very effective, and similarly, we believe that using handwriting recognition techniques is also promising for CBE.

It would be convenient if users could use a software keyboard and handwriting recognition techniques at the same time. However, software keyboards and handwriting recognition are considered to be completely different methods. For example, on 3Com's Pilot, handwriting recognition is accomplished in a special recognition area, while the software keyboard is shown on the display, invoked by a special operation.

We propose a method for integrating the two techniques and any other gesture-based menu selection technique for performing CBE on pen computers efficiently.

## INTEGRATION OF PEN INPUT METHODS FOR CBE

The characteristics of pen movement differ greatly when using a software keyboard compared to using handwriting recognition techniques. A user usually releases the pen immediately after tapping the pen on the software keyboard, while in handwriting recognition, a user moves the pen for some amount of time before releasing it from the tablet. Our system can easily distinguish the two cases by analyzing the movement of the pen after it touches the tablet. In either case, users do not usually keep the pen in the same location while it is touching the tablet.

In the hierarchical marking menu system[1], the system recognizes the direction of pen movement and performs actions based on direction, like very simple handwriting recognition systems. When the user stops pen movement and stays at the same position, the system shows a menu around the pen to enable users to know what they can do next. In this way, handwriting recognition and menu selection are integrated in the marking-menu system.

Taking the above characteristics into consideration, we can integrate all three techniques with CBE, using the following strategies:

- The system displays a software keyboard, which also works as a handwriting recognition area.
- If the user moves the pen immediately after tapping the tablet, the system performs handwriting recognition. Otherwise, the system assumes that the user is using the soft-



Figure 1: Initial display

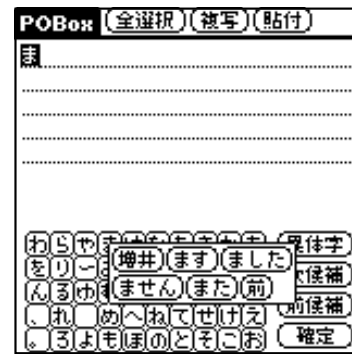


Figure 3: Tapping on the “ま” key and then pausing



Figure 2: After tapping on the “ま” key

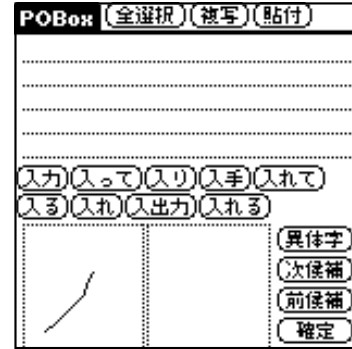


Figure 4: After writing the first stroke of character “入” in the software keyboard area

ware keyboard.

- If the user does not move the pen for a certain time, the system shows candidate words and phrases around the pen.
- If the user releases the pen from the tablet, the system shows a list of candidate words and phrases in a different location.

The following examples show how these strategies work using a pen-based text input system, POBox[2], implemented on the Pilot.

### EXAMPLES

Figure 1 shows the initial display of POBox. A software keyboard is shown at the bottom of the display. When the user taps on the “ま”(ma) key and immediately releases the pen, the system assumes that the user is trying to use the software keyboard, and shows the candidate words that begin with the pronunciation “ma,” as shown in Figure 2.

If the user taps on the “ま” key and waits a while, a pull-down menu appears and shows candidate words around the pen position. (Figure 3)

When the user moves the pen after touching the tablet, the system starts handwriting recognition and interprets the strokes incrementally, and shows candidate words that begin with the strokes. Figure 4 shows the display after the user has drawn a line from the center of the software keyboard to the lower left corner. This is the first stroke of the Kanji character “入,” and those words that begin with the character are shown as candidates. Unlike existing handwriting recognition systems that recognize characters only after all penstrokes that constitute

the character have been written, incremental recognition can greatly reduce the number of penstrokes users should write. This technique can be considered an extension of the *eggar recognition* method[3], where the system finishes recognition as soon as an input gesture becomes unambiguous.

In all cases, when the user stops moving the pen, a menu appears like that in Figure 3 to enable direct selection of a candidate word from the list, just as with marking menus.

### CONCLUSIONS

We have shown that software keyboards, handwriting recognition, and marking menus can be integrated for composing text on pen-based computers. We are planning to apply the same technique for drawing pictures, with a set of provided example pictures.

### REFERENCES

1. Gordon Kurtenbach and William Buxton. The limits of expert performance using hierarchical marking menus. In *Proceedings of ACM INTERCHI'93 Conference on Human Factors in Computing Systems (CHI'93)*, pages 482–487. Addison-Wesley, April 1993.
2. Toshiyuki Masui. An efficient text input method for pen-based computers. In *Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI'98)*, pages 328–335. Addison-Wesley, April 1998.
3. Dean Rubine. Integrating gesture recognition and direct manipulation. In *Proceedings of the Summer '91 USENIX Technical Conference*, pages 281–298, June 1991.