Pen-based Electronic Mail System for the Blind

Nobuo EZAKI † Kimiyasu KIYOTA ‡ Shinji YAMAMOTO† †

† Toba National College of Maritime Technology, Mie 517-8501, JAPAN, ezaki@toba-cmt.ac.jp

‡ Kumamoto National College of Technology, Kumamoto 861-1102, JAPAN, kkiyota@tc.knct.ac.jp

† † Toyohashi University of Technology, Aichi 441-8580, JAPAN, yamamoto@parl.tutkie.tut.ac.jp

ABSTRACT

We have developed a pen-based Japanese character input system for the blind (particularly persons with acquired blindness). The user of this system is able to directly input Japanese characters without using a keyboard. This system is composed of a personal computer and a control board with an electric tablet. The blind person is able to get the screen information by using a voice synthesizer. We have investigated the various problems when the blind person edits the document by using this system and solved those problems. From the experimental results, we have confirmed that our proposed system makes easy to input Japanese characters for the novice blind user without the training. We apply to the electronic mail system for the blind person by utilizing this system.

1. INTRODUCTION

In recent years, computer application support for the blind has become an important theme. The reason for this is that a blind Japanese person needs to use many characters of various kinds. There are about 4,000 commonly used characters such as Kanji (Chinese characters), Kana, Katakana, and the Roman alphabet and numerical characters. Braille word processing using an accompanying keyboard is commercially available for blind. However, they have to learn to use the software conversion of Kana to Kanji, which uses a keyboard. This software has to be able to select the correct Kanji character from various candidates of the same Kana-sound (these are called homonyms). Therefore, inputting Japanese characters with a keyboard is quite cumbersome for novice blind users.

As a solution to these problems, we propose an on-line character input system using handwritten character recognition technology instead of a keyboard. Although the user still must select the candidate character for input, the burden on the user is reduced by the development of a high accuracy character recognition algorithm. We have investigated various problems encountered by blind person when they input and edit documents using this system and have solved each of these problems.

2. OUTLINE OF THE SYSTEM

2.1 SYSTEM CONFIGURATION

Our proposed pen-based Japanese character input system is composed of a personal computer with a control board including an electronic tablet as shown in Fig.1. The system automatically starts in the character input mode after the computer boots up. The blind person is able to get screen information using a voice synthesizer. The user

inputs characters by using the electronic tablet. The control board, which only has seven buttons, is used for all computer command operations without any use of the keyboard. The control board operation is very simple and thus the novice blind user is able to operate the system. There are various modes of the system, such as command, character input, file control, editing and mailing modes. The user can easily switch from one mode to another by using the seven buttons on the control board. The voice synthesizer announces when the screen information changes, so the blind user can follow the results of his input. To reiterate, this pen-based system makes it easy for a blind Japanese novice user to input Japanese characters with very little training.

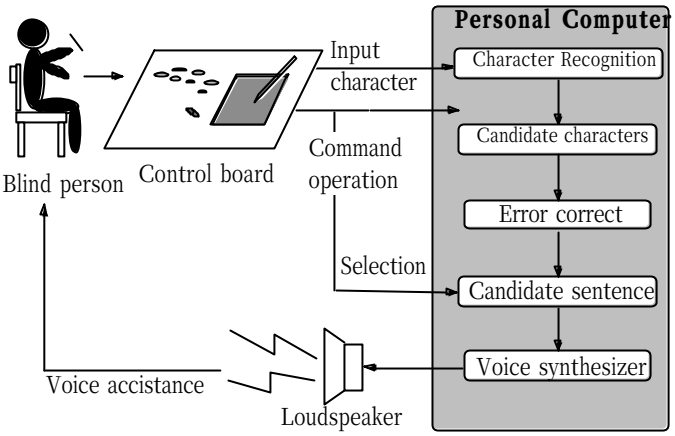

Fig. 1 System configuration

2.2 CONTROL BOARD

The blind person uses tactile sense information effectively. To enable the smooth command input for the blind person, the user's both hands should be fixed in the regular position on the control board. Therefore the control board is designed that the command button is operated by the left hand, and the electric tablet is operated by the right hand, respectively as shown in Fig. 2. Furthermore there is a step in a character input area for the easy description of the blind person. The command buttons of the control board consist of 7 push-type buttons and 1 dial-type button. The push-type buttons are used for the character input control and the command mode change. As these buttons are different size, the user is able to distinguish the option buttons by the size. The dial-type button is used for the cursor movement and the selection of menu options.

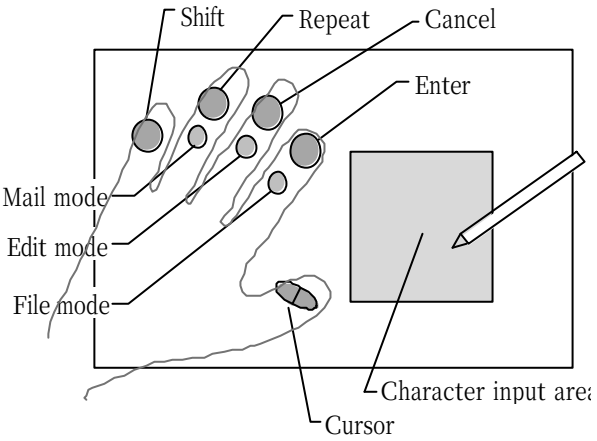

Fig. 2 Control board

3. CHARACTER RECOGNITION

3.1 RECOGNITION METHOD

A structural analysis method is very useful for the handwritten character recognition. However, as the stroke positions become unstable for the character written by blind person, the above method is no longer useful. We have investigated characteristics of Japanese Kanji characters written by many blind persons. From analysis result, we

found the following some stable features [1].

(1)The same blind person can write almost the same stroke shape, stroke number and stroke writing order.

(2)The relative position of the stroke representative points in the partial pattern is stable.

Two kinds of character recognition algorithm; namely, the RDS method and the LSDS method have been proposed for this system by using the above features.

The RDS method is based on the relative direction between two strokes in a writing order. We represent each stroke of the Kanji character by three typical points (a starting point, a middle point and an ending point).

This recognition method is called the LSDS method (the method based on the line segment directions in a stroke) in this paper. A stroke is divided into several line segments by the same segment length. A feature parameter set is expressed as a set of eight direction codes that correspond to each line segment.

The combination of the two methods is desirable to recognize all type of Japanese character written by the blind person, because these methods use different type feature. This method is named the fusion method in this paper.

3.2 ERROR CORRECTION METHOD

From recognition experimental result, it was difficult to distinguish similar characters to use the fusion method that is the recognition algorithm for the one character order. Therefore we adapt the two error correction methods. The first method is by using a tree search algorithm that uses word dictionary and Japanese grammar; namely, Japanese phrase search algorithm based on the Japanese linguistic information. The second method is by using n-gram model, a Japanese phrase is selected by using transition probability and each characters probability. Some candidate Japanese phrases are estimated using these methods.

We examined the recognition test for 11 subjects. The character samples for the recognition are about 250 characters of the illustrative sentence of a letter per one person. From the experimental result, the total average recognition rate was a 90.2% for the fusion method. Furthermore we adapt two error correction methods for the same test samples. The recognition accuracy was improved to a 92.5%. Therefore we confirmed that these methods corrected mis s-recognized Japanese characters (Kanji, Hiragana, Katakana, numerals and symbols).

4. DOCUMENT INPUT PROCEDURE

The document input is as following procedure. At first, the blind person writes one character to the electric tablet by using stylus pen. He pushes the [enter] button on the control board. Then, the system begins to recognize the character by using the fusion method. Next the system changes to the character write mode again. The user writes a next character by repeating this procedure. After the one phrase input, the [enter] button is pushed again. Then error correction software starts automatically, and then the voice synthesizer announces the first candidate phrase. If a correct answer is announced, the user pushes the [enter] button of the control board. If a wrong answer is announced, the user pushes the [cursor] button. The system then announces the next candidate phrase. When there is no correct phase in the candidate phrases, the system returns automatically to the re-writing mode.

Hence the cursor movement is a serious problem for the blind person who cannot see the cursor position. So, we

regard a Japanese sentence as the character sequence of one dimension. Here the [cursor] button is used for one character movement. It is a basic cursor movement operation in this proposed system. Furthermore we prepare two options of the cursor movement. The cursor movement of one phrase is implemented by pushing the [cursor] button with the [shift] button. To move the cursor position to the beginning/ending of the sentence, the user pushes the [cursor] button and the [escape] button with the [shift] button. Then the system announces the cursor position by the voice synthesizer. Therefore the blind person is able to get the cursor position by above procedure.

5. ELECTRONIC MAIL MODE

In recent years, many blind persons want to use an electronic mail system. However almost all commercial electronic mailing software is not taking use of a blind person into consideration. Therefore we have also added the function of the sending, receiving and managing electronic mail with voice support in our system.

The electronic mail sending method is very simple. After the blind user inputs document, he pushes [Mail mode] button. The system shows the mail mode menu. Then the user selects the send mail mode from the menu. Finally he just only choices an E-mail address from his address book.

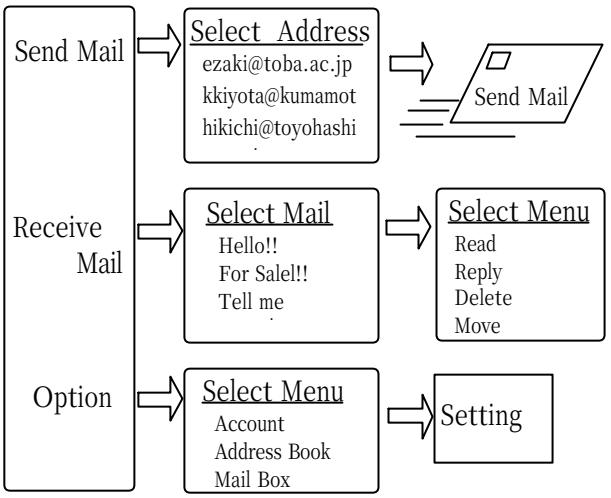

Fig. 3 Electronic mail mode

6. EXPERIMENT

We made experiments to examine the user-friendliness of this system. We measured the time of a keyboard input and a pen input to the same sentences that include 300 characters for the 3 subjects. Total average results of the experiment are shown in Table1. Our experiment showed that the keyboard input method was faster for a user who is skilled in keyboard operation. However, we also confirmed that a novice blind user was able to send an electronic mail using our proposed system without training. Moreover, the voice output time of our system was much more efficient than the commercial Braille word processor. Therefore, it is conceivable that our system would be useful and effective for a novice blind person.

Table 1 Result of the sentence input time [S]

	Pen input		Key input	
Input time	Write down	395	Typing	147
	Recognition	10		
	Error correct	51		
Candidates Selection	121		251	
Total time	577		398	

7. CONCLUSION

We proposed the pen-based input system for blind persons. This system works to the information devices as the simple Japanese input system for the novice blind person without training. The system also gives a pleasure to write the Japanese character by his hand. We showed that a pen-input method is easier than a key-input method for a novice blind user from the experimental results. We have also applied the electronic mailing mode for the proposed system. When there is an Internet connection for this electronic mailing system, we expect that a novice blind person could be able to communicate with all the people on his address list by using this system.

At present, the prototype is experimentally produced based on the proposed basic concept. Future work is the evaluation experiment by utilizing this system on the school for the blind and the social welfare organization.

REFERENCES

[1] K.Kiyota, T.Sakurai, and S.Yamamoto, "Deformation analysis and classification of on-line handwritten Chinese character for the visually disabled persons." , Trans. IPS Japan, Vol.36, No.3, 1995, pp.636-644.

[2] K.Kiyota, N.Ezaki, T.Yanai, and S.Yamamoto, "A basic design of on-line Japanese input interface for visually disabled person",Vol.J79-A, No.2, 1996, pp.310-317.

[3] K.Kiyota, T.Sakurai, and S.Yamamoto, "On-line character recognition for the visually disabled person based on the relative position of stroke representative points.", IEICE Trans. Inf. & Syst., Vol.J80-D-II, No.3, 1997, pp.715-723.

[4] K.Kiyota, T.Yanai, N.Ezaki, and S.Yamamoto, "An improvement of on-line Japanese character recognition system for visually disabled persons", Proc. of the 14th International Conference on Pattern Recognition, 1998, Vol.II, pp.1752-1754.

[5] N.Ezaki, T.Hikichi, K.Kiyota , and S.Yamamoto, "A pen-based Japanese character input system for the blind person", Proc. of the 15th International Conference on Pattern Recognition, 2000,Vol.IV, pp.372-375.