A Noble Heuristic Reading Device for Blind People

SHIEH-SHING LIN[†,A], KING-TAN LEE[††], SHIH-CHENG HORNG[†††], KUANG-YAO LIN[†], TSENG-LIN HSIEH[†], JIA-HAU CHEN[†] AND HEN-CHIA HSU[†]

[†]Department of Electrical Engineering
St. John's University
499, Sec. 4 Tam King Road, Tamsui, TAIWAN, R. O. C.
[††]Department of Electrical Engineering
Lee-Ming Institute of Technology, Taipei, Taiwan, R. O. C.
[†††]Department of Computer Science and Information Engineering
Chaoyang University of Technology, Taichung, Taiwan, R. O. C.

[a]sslin@mail.sju.edu.tw

Abstract: In this paper, the authors present a noble heuristic reading machine for blind people. The goal of this paper is to use intelligent-control method to settle down the reading machine by a touch-pat device for blind people. The proposed "A noble heuristic reading device for blind people" can efficiently help blind people for reading and train the blind people learning the dot-touched words as well. First of all, the feedback control theorem associated with some sensors is used to accomplish the action of automatic fixed position of the reading machine. Second, a heuristic program used to analyze a certain word by converting dot-touched signals into meaningful code will transfer word-code into phonetic signals and speak out for blind people effectively and precisely through personal computer interface. There are three units in the proposed design, which includes the hardware structure, the analysis for certain word-meaning and the phonetic output of the specified words. The test results show that the proposed smart reading machine can effectively prompt learning and reading effects for blind people.

Key-Words: Intelligent control method, touch-pat, heuristic program, feedback control theorem and phonetic signal, programming

1 Introduction

The disadvantages of traditional reading machine for blind people [1] are slow to read, inefficiency, high misjudgment, and especially, not easy to learn for those who become blind by accident. In this study we used the corresponding technique of processor [2]-[10], and the corresponding technique of interface control skill [11]-[26] combined with intelligent microcomputer and optician scan to automatically recognition of dot-touched display and speak it out for blind people effectively and precisely through personal computer interface. There are three units in this design: the hardware structure, the analysis for certain dot-touched word meaning and the phonetic output of the scanned dot-touched world specified words [27], [28]. For the hardware structure, we used scanner scanning the dot-touched words, this is the combination with stepper motor to fixed position [29]-[30] and optician scan to read the

dot-touched words. A technique of feedback control by stepper motor is used to accomplish the automatic fixed position of the reading machine. Then, a smart program [27], [28] used to analyze a certain word by converting dot-touched words signals into meaningful code will transfer word-code into phonetic signals and speak out for blind people. The features of intelligent reading machine list as below:

1) Interactive speak out for operating assistance
2) Intelligent analyze one certain word by converting dot-touched
3) Automatically recognition of dot-touched format
4) Completed phonetic database
5) High compatibility of other phonetic system

The paper is organized in the following: Section 2 states "A noble heuristic reading device for blind people". The hardware implementation of the noble heuristic reading device for blind people is described in Section 3. Finally, we made a brief conclusion in Section 4.

2 A Noble Heuristic Reading Device for Blind People Reading

To improve the traditional way of blind people use their fingers to read, this study is to investigate the intelligent reading machine for blind people. Figure 1 shows the noble heuristic reading device block diagram. Firstly, a command come from personal computer interface to control the microcomputer sends out a signal which driving the stepper motor and the optician scan to read the dot-touched display. A technique of feedback control by stepper motor is used to accomplish the automatic fixed position of the reading machine. Then, a smart program used to analyze a certain word by converting dot-touched words signals into meaningful code will transfer word-code into phonetic signals and speak out for blind people. There are three units in the noble heuristic reading device for blind people.

2.1 Hardware Structure

We use scanner scanning the dot-touched words signals. The mechanism is the dot-touched display with A4 size paper. A technique corresponding to the feedback control by X-Y axis stepper motor is used to accomplish the automatic fixed position to drive the optician scan dot-touched display then send the scanned result to microcomputer for adjustment. The advantage for adopting the above way is to reduce the complexion of hardware, this is because the microcomputer is processing fast therefore; feedback control will not affect the hardware.

2.2 Analysis for the dot-touched words

When microcomputer receives the data, the system starts to analyze the data immediately, and stored the scanned dot-touched words signal into computer buffer. We build a heuristic program to handle the analysis. The smart system of the proposed noble heuristic reading device for blind people is according to the dot-touched words rules of phonetic 2 dots or 3 dots to analyze effectively. The system is design as easy to maintain, also can analyze word-meaning correctly. For calculate the phonetic signals just use formula will do.

2.3 Phonetic output of the scanned dot-touched words for blind people

This unit can separate into 2 subunits, record and output. For the recording subunit, the Chinese phonetic system is according to the phonetic database which store in the computer to record the tones of words. Corresponding to the outputting subunit, load from the phonetic database and through the speaker to display the sound.

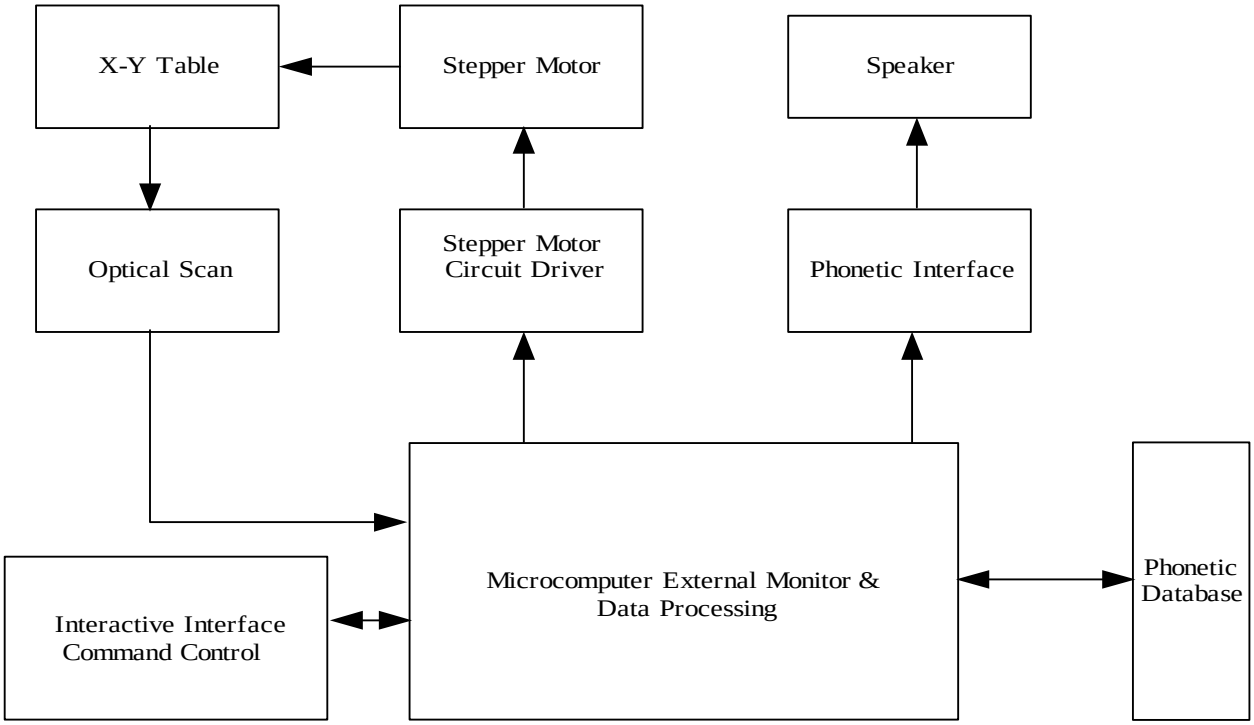


Fig. 1. Block diagram of the noble heuristic reading device for blind people.

3 Hardware Implementation of the Heuristic Reading Device for Blind People

This section is to explain the hardware Implementation of the noble heuristic reading device for blind people:

3.1 Hardware structure

There are three subunits of hardware structure, mechanism, stepper motor fixed positioning and optician scan. The mechanism is according to an A4 size paper which takes X-Y 2 D image feedback control to come up with X-Y axis image scanner [29]. The fixed position is use of PMM8713 stepper motor drivers IC and 1:2 ratio of gear wheel, the distance between each driving step is 0.002667mm, the formula is:

$$(D \times n_{g-step} / n_{g-screw}) / (360 / \theta_{s-step}) \qquad (1)$$

Where the notations can be described in the following:

n_{g-step} denotes the numbers of gear wheel on the stepper motor; $n_{g-screw}$ denotes the numbers of gear wheel on the screw; D denotes the distance of axis slide with screw winding; θ_{s-step} denotes the angle when stepper motor move every step in which step represents the distance of driving axis slide movement. Figure 2 shows X-Y axis stepper motor driving circuit flowchart, the microcomputer response for control the production of pulse frequency, and monitor the status of 8713 and record the X-Y axis for fixed position purpose. Figure 3 shows that the connection of the address port and the data bus with the computer.

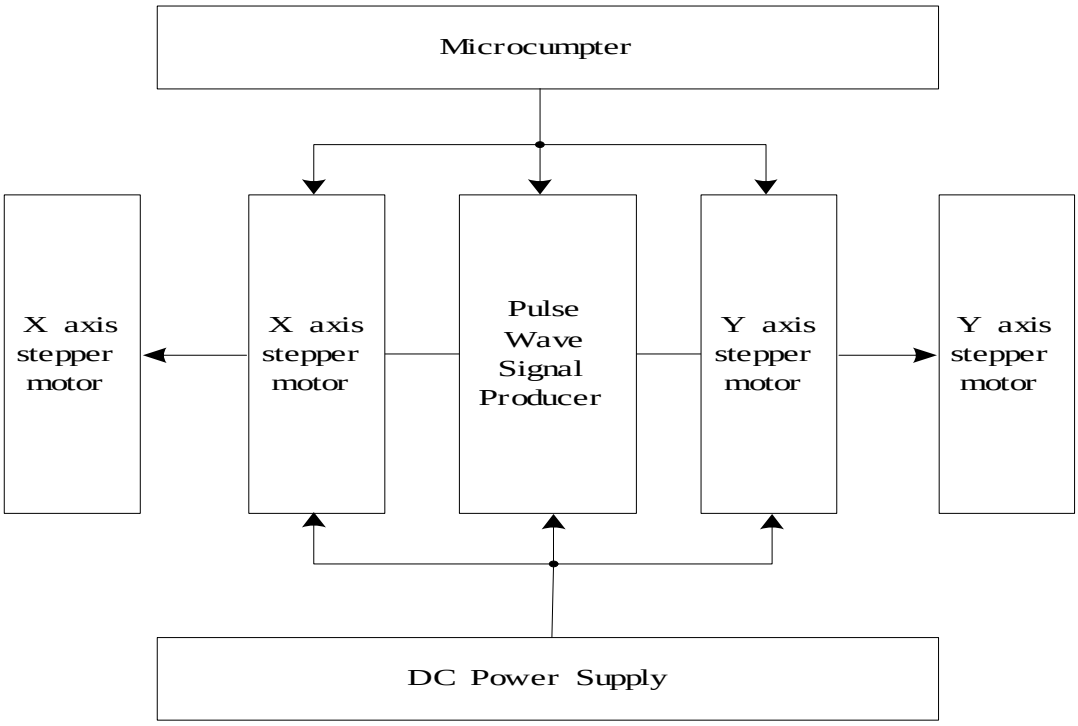


Fig. 2 X-Y Axis Stepper Motor Diagram

The optician scanner uses KNOTEC KS-C2GA to detect, when the sensor detected a black dots, the interface will send a High signal to the microcomputer, in opposite will send a Low signal to the microcomputer. The hardest part is when touch the concavity and raised dot, different people will touch in different way. Therefore, some of the dots are damages or become flat which is hard to detect correctly. The solution to this problem the system adds a function which can determine the ambiguities, which reach 95% of accuracy.

3.2 Analysis for the scanned dot-touched word meaning

To analyze the certain word-meaning of the scanned dot-touched words, firstly we need to understand the dot-touched rules; however the complete rules for dot-touched is very complex to learn, therefore, in this paper we only explain the basics of the dot-touched. There are 6 fixed raised dots shows as follow:

$$\begin{pmatrix} 1\bullet & \bullet 4 \\ 2\bullet & \bullet 5 \\ 3\bullet & \bullet 6 \end{pmatrix} \quad (2)$$

There are 64 combinations of these 6 dots word, each dot can represent either phonetic or science and math symbols, in Taiwan the dots represents the Chinese phonetic. When microcomputer receives the dot word signal it will interrupt the main program and the sub-program, the flowing chart of the dot-touched word analysis processing is shown in Figure 4 and the process steps are listed below:

Step 1 Firstly, interrupting the sub-program allow determining and memorizing the dot in X and Y, if the judging result not belongs to dot 6 then it will verify with database and go to *Step 2*. If the judging result not belongs to dot 6 then it will end of sub-program

interruption.

Step 2 To determine whether it is the phonetic or not? If yes, save the data first and continue to determine whether it is the tone or not. If yes, verify the dots for analyze the word meaning, otherwise end with sub-program interruption. If the determining result is not the phonetic then go to *Step 3*.

Step 3 To determine whether it is the numbers or not? If yes, the numbers will send for calculate the sub-program. If the determining result is not the numbers then go to *Step 4*.

Step 4 To determine whether it is the punctuation marks or not? If yes, analyze will postpone for a while to process the sub-program of phonetic. If the determine result not belong to the punctuation marks then it will end of sub-program interruption.

The difficult part is irregular dots words when process the optician scanning. It is hard to scan when the dots words are distanced irregular. The solution to this problem is by using the X-Y axis to verify the location of the dot and scan the dot from its middle in a cross shape (±100steps). This practice has been proof can analyze the scanned irregular dots correctly.

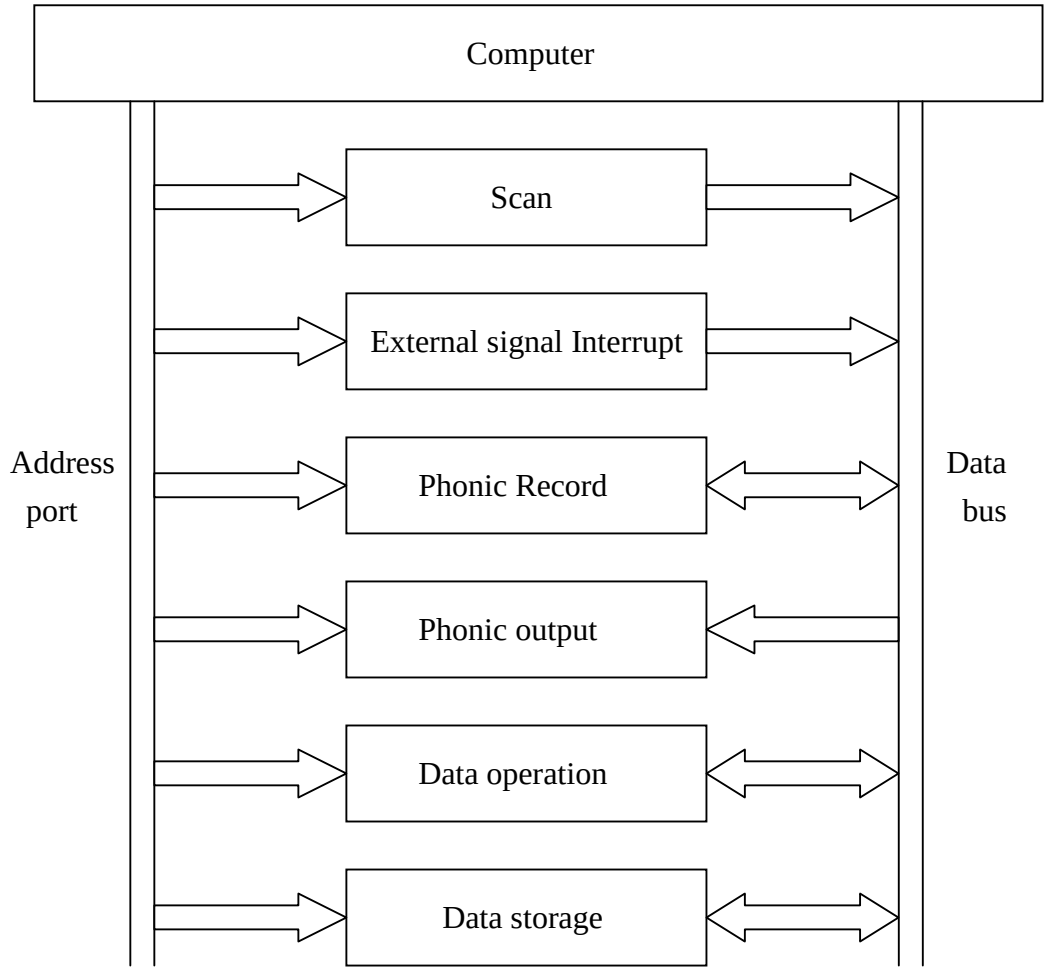


Fig. 3 The connection of the address port and the data bus with the computer.

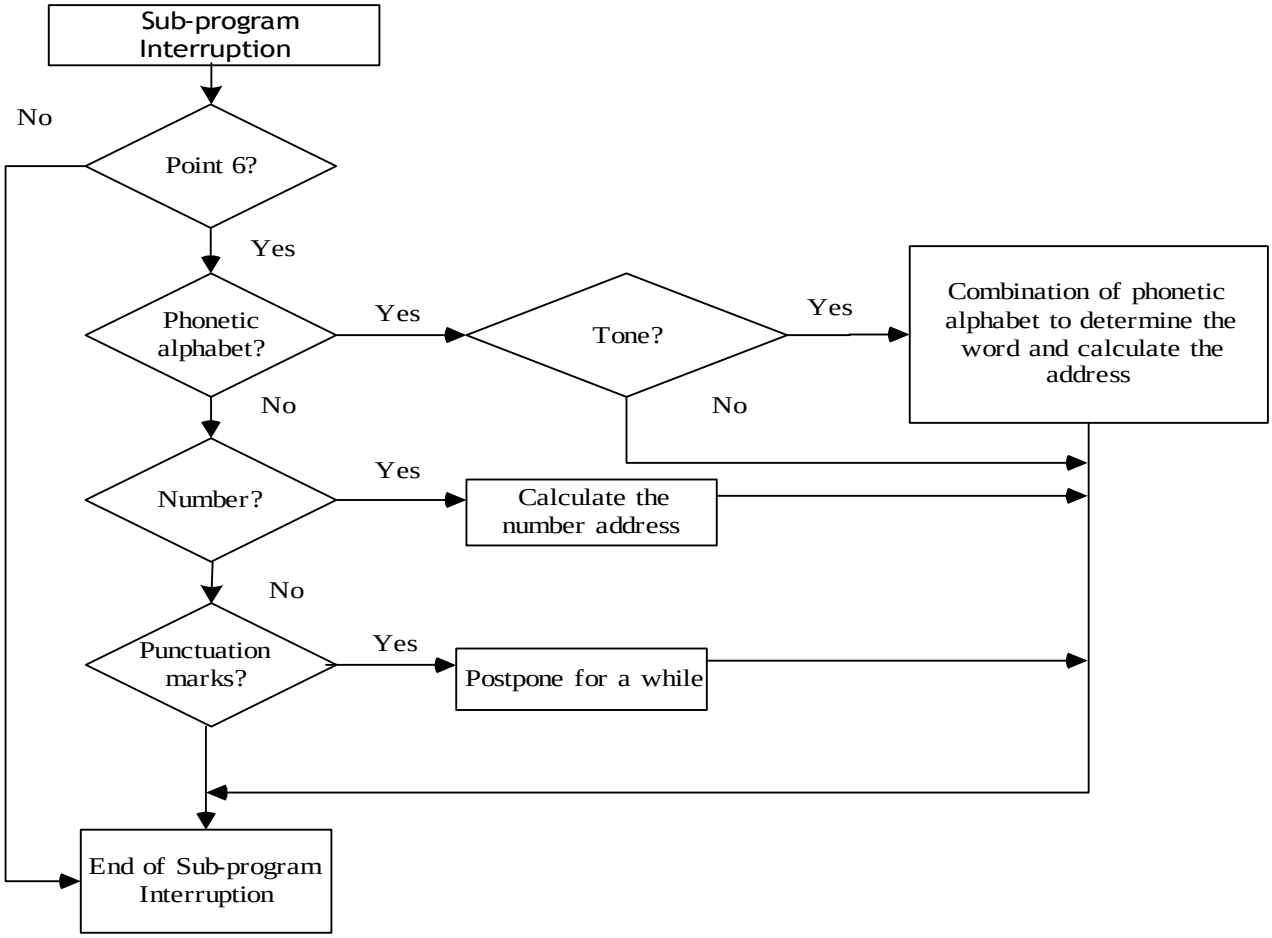


Fig. 4 Flowchart of the dot-touched word analysis processing.

3.3 Phonetic output of the scanned dot-touched words

There are four processing steps (*Proc. 1-4*) to output of the scanned dot-touched specified words: the setting of output interface status processing, the phonetic data processing, the phonetic recording processing and the phonetic output processing.

Proc.1 Set output interface status: The output interface set according to its hardware design, such as, input / output, interruption and DMA channel, then store into Autoexec.bat file, and the set up can refer to the manual.

Proc.2 Phonetic data process: When words specified, microcomputer can get a phonetic address, according to this address to load the data. To recording the phonetic it will save as VOC file format. According to the identification of VOC file, the phonetic data can process into the right address. Once the address been verified, use ct_voice() function to find out the output of phonetic data.

Proc.3 Phonetic record: Phonetic database is run by C language to function the recording. Under the frequency of 22050Hz through the microphone to recording 1313 Chinese

words in an alphabetic order and save as VOC file format.

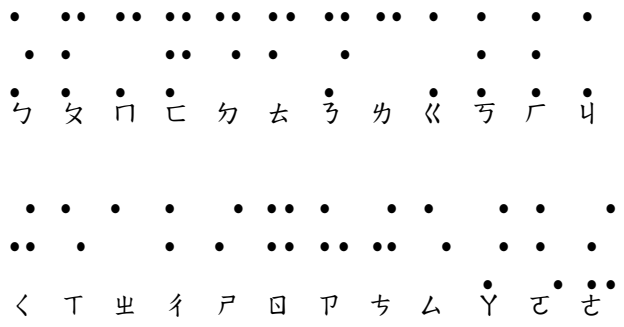
Proc.4 Phonetic output: To output the phonetic, firstly open up the VOC file and use Ctvd_speaker() function turn on the DAC speaker, then output the ctvd_output function, finally according to the ctvd_end() function to end of phonetic output.

Remark: The hardest part is the right tone for a sentence, to pronounce a right word is easy but to pronounce a right tone for a sentence to express the feeling is hard. This can be referred to the Intelligent System [27] and [28] Theory.

4 Simulations and Test results

We have made numerous tests as to the proposed design and pick up typical examples stated in the following:

The first one of simulation is to test the basic alphabets, some special symbols, and some numbers in Chinese as to the dot-touched words read by blind people and its associated meaning in Chinese are shown below the dot-touched words. Figure 5 shows the corresponding contents of the basic alphabets, some special symbols, and some numbers of dot-touched words.



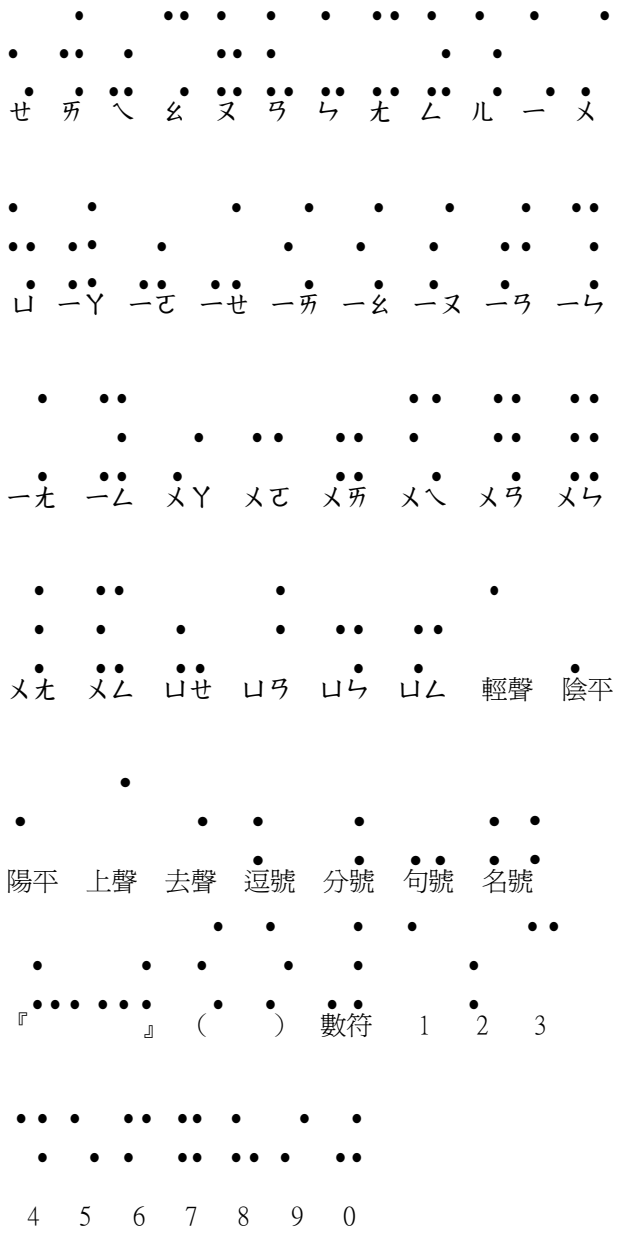


Fig. 5 The corresponding contents of the basic alphabets, some special symbols and some numbers of dot-touched words.

We have made 1000 simulations in each test by using the proposed design to read the dot-touched words of each word of the basic alphabets, some special symbols, and some numbers. The test results show that the proposed design can correct output the phonic sound of the dot-touched words.

The second one of simulation we input two sentences of dot-touched words ("微電腦" and "點字機" in Chinese and its meaning are of the "Macro-computer" and "dot-touched machine") and the corresponding dot-touched words and its associated meaning in which the terms are shown below the dot-touched words. Figures 6 and 7 show the dot-touched sentence and its meaning are of the "微電腦" and "點字機" in Chinese, respectively.

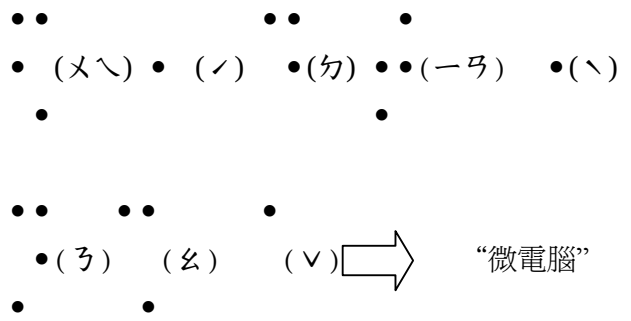


Fig 6 The dot-touched sentence and its meaning are of the "微電腦" in Chinese.

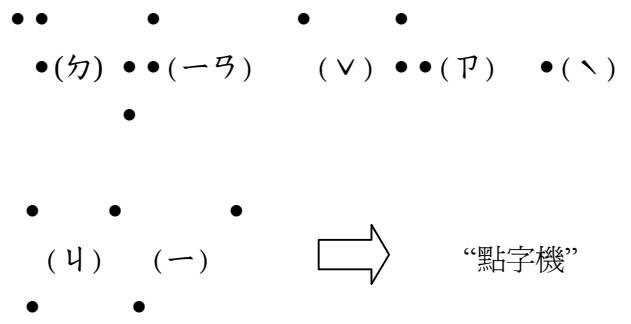


Fig. 7 The dot-touched sentence and its meaning are of the "點字機" in Chinese.

We also have made 1000 simulations in each test by using the proposed design to read the dot-touched words of each sentences described above. The test results show that the proposed design can correct and efficiently output the phonic sound of the dot-touched words.

These test results demonstrated the proposed design can correctly and efficiently help blind people in reading instead of using their finger to read.

5 Conclusions

To effectively help blind people learning and reading dot-touched words, in this paper, the authors presented a noble heuristic reading device for blind people. The goal of this paper is to use the corresponding intelligent-control method associated with some interface skills to settle down the reading machine by a touch-pat device for blind people. The real implementation shows that the paper studied specification of system design; practical experimental and software design which successful build-up a smart and intelligent reading machine for blind people. The intelligent reading machine use stepper motor to fixed position of X-Y axis, also combine optician to scan the data then process with a smart program used to analyze the certain word by converting dot-touched signals into phonetic signals and speak out for blind people.

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