
Braille teaching aids based on the combination of push button and voicing with voice chip aP89341

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Abstract: This research was aimed at developing an aid for teaching Braille letters by using Atmega 8535 microcontroller and voice chip aP89341 and the combination of Push Button Switch into the combination of Braille letters. The research method employed was Research and Development with combinations of vowels-consonants and punctuations of Braille letters in Bahasa Indonesia processed into voices by a microcontroller and a voice chip. This aid was validated by five teachers in the Yaketunis School for the Blind to test its feasibility as a teaching aid. The aid was tested on five blind subjects. The performance of the system showed that the aid could produce voicing for 254 combinations of Braille letters consisting of the introduction on the use of the aid, combination of Braille numbers from 0 to 99, combinations of Braille letters from a to z, combinations of Braille vowels and consonants from ba-bi-bu-be-bo to za-zi-zu-ze-zo and their combinations, combinations of Braille punctuations and several additional voicings. The experts' validations were: effectiveness = 81%, user friendliness = 78%, consistency = 78%, media organisation = 80%, and significance = 70%. The percentage of the feasibility test was 77%, categorized as very feasible.

Keywords: braille teaching aids, push button, voicing, voice chip

1. Introduction

As normal people, the blind also need education to develop their potential optimally. The blind need special treatments including the practice of reading and writing Braille letters, the use of the stick, orientation and mobility, and the practice of visual/functional sight. Due to their blindness, they need special treatment to rehabilitate their disability. Basically the strategy of teaching the blind is the same as that of teaching the normal people. Only in its implementation, modification is required in order that the message or the learning material can be

understood by them through the other functional senses.

The teaching aids employed to teach the blind children in some schools for children with special needs are the aids for writing Braille letters (reglet, pen, and Braille typewriter); the aids for reading Braille letters (letter board and optacom); the aids for calculating (cubaritma, abacus, speech calculator), and audio aids, such as the tape recorder.

A special aid for reading Braille letters is known as *pantule*, a short form of *Papan Tulis Braille* (Braille Blackboard). It consists of nails which can be attached onto a board

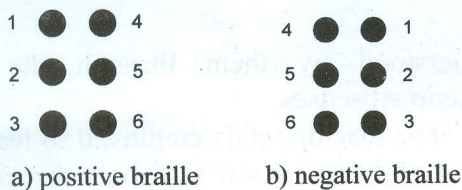
to form a combination of Braille letters. It looks like a drawer made of a wooden board with holes to put the metal pins into. One of its weaknesses is that the pins are easily detached from the board so they are often lost. Besides, *pantule* is relatively big and made of wood so that it is too heavy to carry around.

According to experts, teaching aids can be defined as:

- any kind of aids used to transmit information (Association for Educational Communications and Technology/AECT, 1977).
- instructional aids and instructional media. Instructional aids are defined as equipment or tools to help teachers clarify materials (messages) that will be presented. That is why instructional aids are also called teaching aids (Anderson: 1987).

A Braille letter consists of six raised embossed dots. The format is 2 columns x 3 rows of dots. Each of the dots is numbered, 1, 2, 3, 4, 5, and 6.

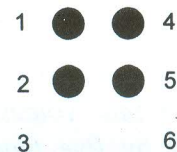
Figure 1. The Format of the Elements of Six Dot Braille Letters



Braille letters can be described in two positions, namely positive and negative positions. The positive position refers to the Braille letters which can be read by the blind and/or sighted people, whereas the negative position refers to the position of the Braille letters which are in the process of printing. In the negative position, numbers 1, 2, 3 are on

the right and numbers 4, 5, and 6 are on the left. With this dot numbering, the Braille characters can be stated by mentioning the number of the dots. The chosen number of dots causes protrusion on the printing media (media can be plastic or paper), while the dot numbers which are not chosen do not. For example, to make letter "g", the Braille code is seen in Figure 2.

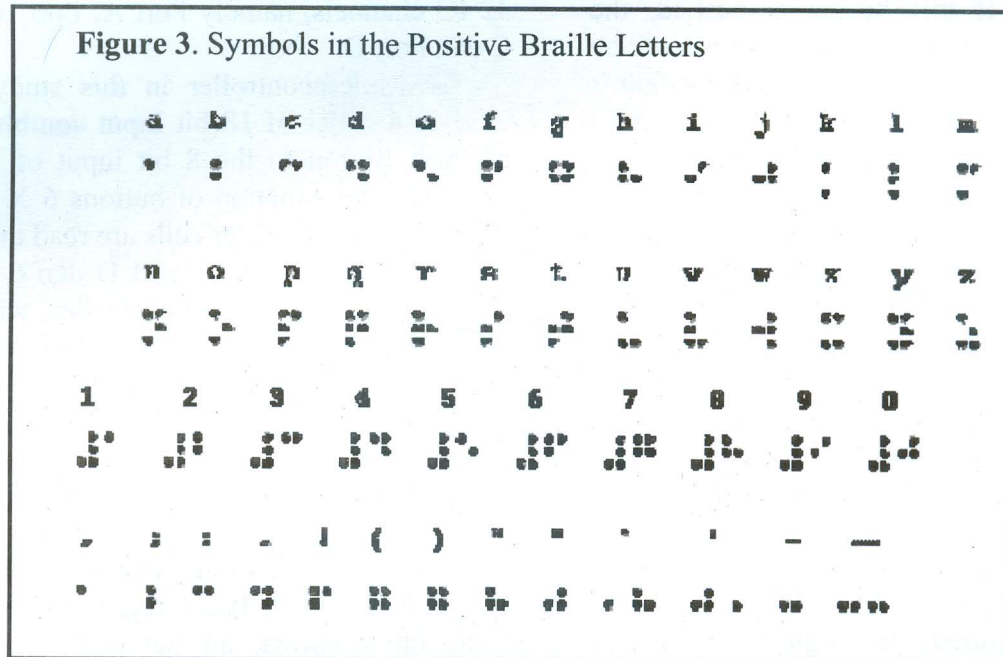
Figure 2. Braille Code for the Letter 'g'



The Braille code above belongs to the positive Braille code stated with numbers 1, 2, 4, and 5. In the same way, by giving numbers to the six embossed dots in the Braille signs/letters, the positive Braille letters can be stated in the following symbols (Figure 3).

Besides consisting of the combination of six dots, the Braille letters also consist of the combination of six dots to represent composition signs and punctuations. Composition signs are special signs which do not exist in the writing system for the sighted. They include capital signs, cursive signs, number signs, and restoring signs. The Braille characters with these composition signs will have another function. These signs are needed due to the limited possible configurations of Braille.

The Braille printer or embosser is an aid for writing and forming symbols for the characters of Braille letters consisting of the combination of 2 x 3 dots for columns and rows. They are of different kinds. The simplest one is in the form of 2 x 3 dot pattern or a small blackboard equipped with



stylus. This tool helps the blind to form rows of Braille letters on the thick paper or cartoon paper pressed by a board.

Karsidi (2006) states that, to do their daily life activities, the blind have to employ alternative techniques, namely those using other senses to replace the function of the sight sense. He mentions that the hearing and feeling senses are the most efficient channels of receiving information after the sight sense. Therefore, the alternative technique generally uses the hearing and/or feeling senses.

In relation to the technique of using senses other than the sight senses, some instructional technologies of Braille letters use the mechanism that can produce sounds and objects. This technique can produce different surfaces on the flat space.

Different from sighted people, the blind read by feeling (tactile) which refers to the activity of understanding the symbols of sounds printed embossed to get information from the symbols by using fingers. In their book on the characteristics of the blind in the physical/sense and motor/behavior aspects, Tilman & Osborn (1969) say that blind children show better sensitivity in their

hearing and feeling when compared to sighted children.

Olson & Mangold (1981), Karsidi (2006) state that good (fluent) Braille readers are those who:

1. show a little backward movement on the fingers vertically and horizontally when reading;
2. use very little pressure when feeling the Braille dots;
3. use a reading technique with two hands: the left hand is for finding the beginning of the next row, while the right hand is for finishing reading the previous row;
4. always use at least four fingers;
5. show the ability to read Braille letters fast and are not confused with the opposite of other letters.

To become fluent Braille readers, the blind have to understand the symbols of Braille letters mentioned in the beginning of this article.

Push Button is an electronic/electric component that functions as a switch. The actuation method used is by pressing the finger (push).

In this study the type of push button used is a toggle. If this button is pushed, the position of the button will move down and be endured. It will return to its initial position if pushed again. The Push Button character will be used to represent the dots in the Braille letters.

The Push Button will be arranged in accordance with the rule combination of Braille letters, in which one character of a Braille letter is represented by minimally six combined dots. One dot of a Braille character is represented by one Push Button.

The Microcontroller is a component of Integrated Circuit (IC) with the ability to process data (information) based on the sequence of given instructions. It has a Central Processing Unit (CPU) which can carry out arithmetic and logical instructions in the ALU (Arithmetic Logic Unit) system it has. Furthermore, it has Oscillator (OSC) circuit, memory (EEPROM/Flash ROM), output interface in the form of Port-port I/O, Timer/counter, ADC/DAC, PWM, and some other functions.

The Microcontroller can work based on the expected function when already programmed by using programming devices consisting of programming software (Basic compiler, C compiler, Assembly, etc.) and programming hardware (downloader). Programming can be performed through parallel interfacing (Parallel Mode) and serial interfacing (ISP Mode). In this study AVR Atmega8535 microcontroller was used. It has the architecture of 8 bit RISC, so all instructions are packed in 16-bit code (16-bits word) and most of the instructions are executed in one cycle of clock instruction. The AVR is classified into 4 classes, namely ATtiny, AT90Sxx family, ATmega family, and AT86RFxx family. What differentiates one from another is the size of *onboard memory*, *on-board peripheral* and the function, but the architecture and instruction of all types are the same. The choice of Atmega8535 or Atemga 16 microcontroller is based on the consideration of its

architecture. One of its features is that it has 32 IO channels, namely Port A, Port B, Port C dan Port D.

The microcontroller in this study was used as a coder of 18 bit input combination of Push Button to the 8 bit input of Voice chip. The combination of buttons 6 X 3 (18 bit) of Braille character cells are read through 6 bit of port C, 6 bit of port D dan 6 bit of port B of ATmega microcontroller, whereas port A was for the output of the conversion result of button reading which would be out into the Voice chip input.

The Code Vision AVR software was used as a code editor microcontroller so that the microcontroller can function as a coder of 18 to 8 bit. The Code Vision AVR is a compiler C, which has Integrated Development Environment, an automatic program generator equipped with In Systems Programmer for the family of AVR microcontroller.

A button combination has information related to Braille characters. The combinations of some buttons are required so that the information saved in the button configuration can be interpreted by the system. The technique of reading the buttons is commonly implemented by scanning some buttons arranged in the matrix of columns and rows. This scanning technique will detect which button is pushed at a certain time. Pushing the button will result in the bit value in the matrix of columns and rows where the bit value will change according to the button pushed.

A Voice chip is a component of an Integrated Circuit (IC) which can be programmed to save files with wav sound format (wav is a file of wave/Waveform Audio File Format type (<http://en.wikipedia.org/wiki/WAV>) compressed into ADPCM. (Adaptive differential pulse-code modulation) and PCM (Pulse-code modulation). There are some kinds of this IC with different functions of recording, methods of sound activation, recording capacity (memory), time duration, signal outputs, and some

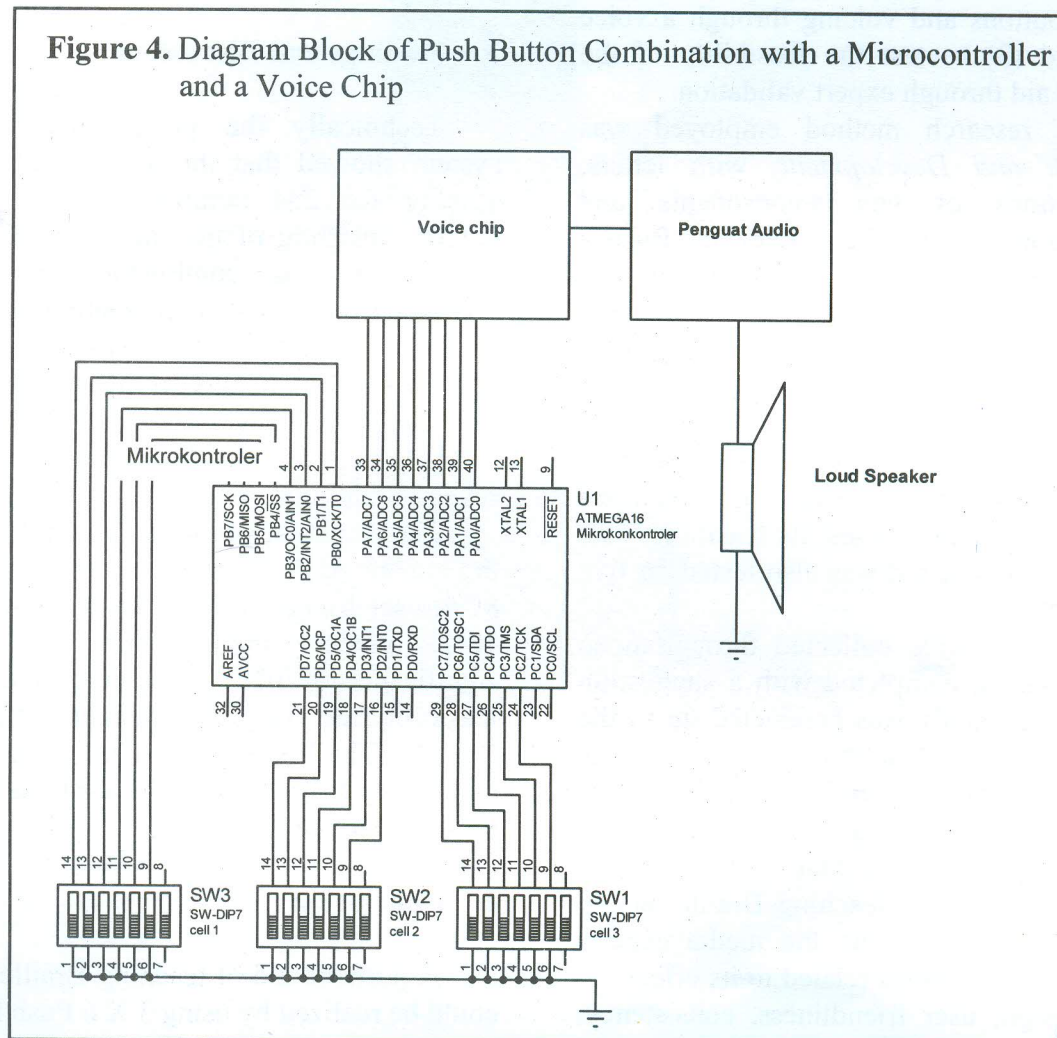
other functions. In this study voice chips of aP8942A and aP89341 types were used to record sound files that would be used as voicing data.

Voice chips aP8942A and aP89341 are classified as OTP (One Time Programming) type produced with the standard of CMOS process in which there is 1 Mb of EPROM memory. This IC can save up to 42 seconds of voice message for aP8942 and 341 seconds of voice message for aP89341 with the compression format file, 4 bits of ADPCM (Adaptive Differential Pulse Code Modulation) in the sampling ratio of 6 KHz. Another choice of saving the voice format file is by using format 8 of PCM bit (Pulse Code Modulation). Voice activation can be carried out in two ways: a) with the combination of 8 input buttons, b) with 5

inputs from the microcontroller. Voice files can be recorded into the chip by using aP89W24USB programming device and software.

In this system, the audio power amplifier functions to turn up the voice from the signal produced by voice chips. The audio signals produced by the voice chips aP89341 are mono signals, compressed into a PCM, sampling rate of 11 KHz, so that the system can use a mono audio power amplifier with sufficient power to move the loudspeaker and have a small circuit dimension. The audio power amplifier used in this study is IC TDA 2003, with the output power of 10 Watt.

The working of the Push Button Combination with a microcontroller and a Voice chip is diagrammatically summarized in Figure 4.



2. Method

This study proposes the following research questions to be answered: (1) How is a portable teaching aid of Braille letters by using six Push Button Switches connected to a microcontroller and voice chip developed so that it can produce voices according to Braille letters?; (2) How is the performance of the Braille teaching aid using the combination of 3 X 6 push buttons and voicing through a voice chip?; and (3) How feasible is the Braille teaching aid using the combination of 3 X 6 push buttons and voicing through a voice chip? Following these, the research objectives are: (1) to develop a portable Braille teaching aid by using a microcontroller and *voice chip*, (2) to find out the performance of the Braille teaching aid by using the combination of 3 X 6 push buttons and voicing through a voice chip, and (3) to test the feasibility of the teaching aid through expert validation.

The research method employed was *Research and Development*, with letters, combinations of vowels-consonants and punctuations of Braille letters in Bahasa Indonesia which has been processed into voices by a microcontroller and voice chip as the objects of the study. The following are the stages: (1) Needs Analysis, (2) Design, (3) Implementation, (4) Test, and (5) Maintenance (Pressman, 1992). The aid was validated by five teachers in Yaketunis school for the blind to test its feasibility as a teaching aid. The aid was also tested on five blind people.

The data were collected through open questionnaires, completed with a suggestion column. The study was conducted up to the stage of media validation by media experts using a media validation instrument. This instrument was used to measure the feasibility level of Six Dot Push Button to Speech as an aid in teaching Braille letters. The instrument used by the media experts consisted of questions related to its effectiveness, design, user friendliness, consistency,

and significance to be used as an aid of teaching Braille letters. The data analysis technique used in this study was descriptive analysis technique. It was conducted by using descriptive statistics. Descriptive statistics is the statistics used to analyze data by describing the collected data as they are without intending to draw a conclusion that applies to all or generalization (Sugiyono, 2007: 164).

To determine the feasibility category, the Likert scale was used. With this, scale numbers are obtained and then interpreted qualitatively (Sugiyono, 2007:35). From the obtained data, the feasibility percentage was measured by comparing the observed score and the expected score and then multiplied by 100%. Finally, the percentage of the result was checked in the table of the feasibility test.

3. Findings and Discussion

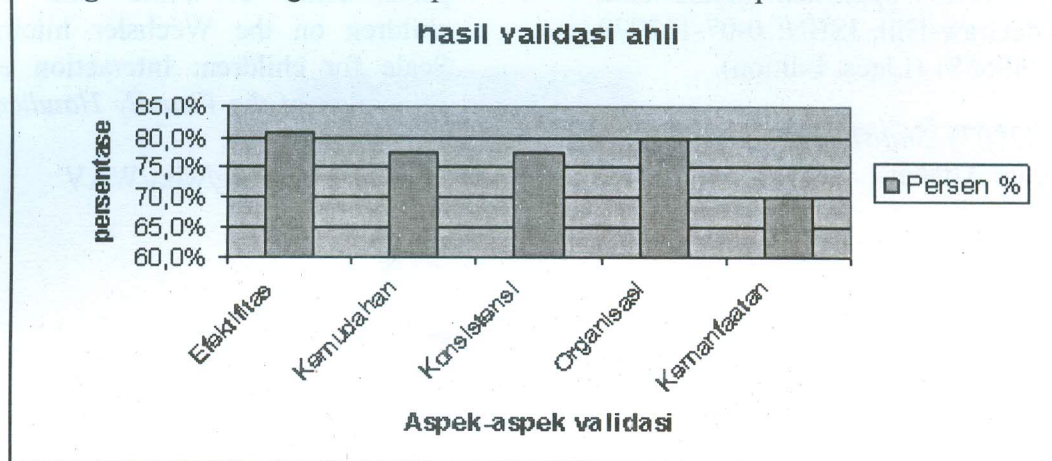
Technically the performance of the system showed that the aid could produce voicing for 254 combinations of Braille letters consisting of the introduction on the use of the aid, combination of Braille numbers from 0 to 99, combination of Braille letters from a to z, combination of Braille vowels and consonants from ba-bi-bu-be-bo to za-zi-zu-ze-zo, and their combinations: combination of Braille punctuations and several additional voicings.

The results of validation by the expert on the aid for each aspect were effectiveness = 81%, user friendliness = 78%, consistency = 78%, media organisation = 80%, and significance = 70%. The percentage of the feasibility test was 77%, categorized as very feasible. The percentage of the data on the media expert judgment for each aspect is presented in the Figure 5.

4. Conclusion

A portable aid of teaching Braille letters could be realized by using 3 X 6 Push Button

Figure 5. Bar Diagram of Expert Validation for all Aspects



Switch attached in every port (ports B, C, and D) of ATmega 16 microcontroller, in which it was programmed to read the eighteen buttons to change into the 8 bit combination of output data (Port A) as a controller of voicing addresses in the voice chip. The voice chip was programmed to record voice data with a mono ADPCM compressed format. Voice files were recorded with the address of 8 bit to stimulate the voicing of 254 voice groups. To provide louder voicing whose volume can be set, output voice chip was connected to a 10 watt mono audio power amplifier by using IC TDA2003.

Technically the performance of the system showed that the aid could produce the voicing for 254 combinations of Braille letters consisting of the introduction on the use of the aid, combination of Braille numbers from 0 to 99, combination of Braille letters from a to z, combination of Braille vowels and consonants from ba-bi-bu-be-bo to za-zi-zu-ze-zo, and their combinations: combination of Braille punctuations and additional voicing. The system used 220 Volt supply ac rectified into 5 Volt voltage to supply the microcontroller and audio power amplifier, whereas voice chip was supplied with 3,6 volt voltage.

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81%, user friendliness = 78%, consistency= 78%, media organization = 80%, and significance = 70%. The percentage of the feasibility test was 77%, categorized as very feasible.

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