Design of interactive learning media to pronunciation characters and words English for blind children

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Abstract. This paper aims the study of designing an English learning system for blind children. Instrument designed is interactive learning media so hopefully blind child will be easy to be interested and active to learn. The processing hardware used is Raspberry Pi (as its main brain). Learning system mode is made of two kinds, namely learning mode (text to speech method) and question mode (speech to text method). The result of this research is a model for learning letters recognition and English pronunciation tool. The design of this tool using Raspberry Pi 3, because the Raspberry Pi 3 is a computer system that is integrated with the supporting components required in voice recognition processing and text to voice conversion. The design of this model does not cost much, because it only uses a mini PC that is Raspberry Pi 3 as the main component. However, in previous research, interactive learning of braille for children using linguistics requires a lot of hardware and requires teachers in its use. the learning media is expected to help the blind child in learning the characters and English words and also expected this instrument can be used for use in the school blind.

1. Introduction

This paper describes the building of English learning system tool for blind children. That is the interactive learning media design for the pronunciation of characters and English words for children with visual impairment. The first World Disability Report ever published in June 2011 [1]. Based on the estimated population of 2010 (6.9 billion) and the estimated prevalence of disability in 2004 (World Health Survey and Global Disease Burden), more than a billion people including children (or about 15% of the world's population) are estimated to be living with disabilities [1]. The report also reveals that 110 million people have significant functional difficulties, while 190 million have 'severe disability' - equivalent to the inferred disability for conditions such as quadriplegia, major depression or blindness [2]. Today the internet offers new opportunities for people with disabilities to participate in the community. By using the internet, they have easier access to information and new ways and alternatives to interact with others [3].

The improvement of orientation and mobility capability through virtual environments for the blind is one of the past search and future potential explanations and examinations of 21 virtual environments developed specifically to support people who are blind in collecting spatial information before arrive at new locations and to help people who have recently gained practice orientation and blind mobility during rehabilitation [4]. There is also research investigating the design of an architecture that addresses accessibility issues experienced by blind users while exploring geographic maps, by

providing more efficient information. In web exploration, ensuring accessibility to the blind means in enabling the screen to read properly [5].

According to the English First language educational institution, First World that the world's largest ranking of English skills has issued a rating of English proficiency, which shows that Indonesia is ranked 39 out of 80 countries, the rankings fall into the middle category with a score of 52.94 [6]. One of the studies aimed at developing the English for Disability (EFORD) application on Android has been done for Grade VIII Students with Visual Impairment [7]. The Radecki A. paper proposes the presentation of a sonification algorithm that serves to present images on mobile devices for blind children using an interactive auditory screen. The use of the touch screen on Android is applied to Sonification which uses HSV color images and software being written [8].

One of the related research topics that has been done by other researchers is blind and deaf communicators conducted in 2012 [9]. In response to the needs of developing tools including children with visual impairment (VI) for teaching computer programs to novice learners, we explore Torino - a physical programming language for teaching program construction and computational thinking for children ages 7-11 [10]. Another research that has been done is interactive learning of braille for children using linguistics conducted in 2017 [11]. However, tools that have been made in the study was built using a laptop and a microcontroller, so it requires a lot of cost. Another research topics that has been done by other researchers is blind aid: a self-learning braille system for visually impaired conducted in 2014. The designed system serves as Braille writing and reading tutor, so visually impaired people can enhance their Braille writing and reading skills without the assistance of a Braille teacher. The designed system takes the input through Braille keyboard and produces the speech output and it also has the capability to read documents. However, tools that have been made in the study did not have a feature for pronunciation [12].

Research and study related to the research topic for our proposed English learning is pretty much done in Indonesia, but in general there is no pronunciation of characters or words that must be done by the blind child. One of the advantages of the design that we offer is the pronunciation of characters and words specifically designed for the blind child. This is the advantage of this research. Based on the above background it is necessary to create a learning media that can attract their learning interests. The research focus will be on learning English for blind children. The tool designed is an interactive learning media so hopefully the blind child will be easily interested and active to learn. In this tool used Raspberry Pi as the main brain. This tool is designed using two modes, namely learning mode, and question mode. In learning mode, the blind child can press the numeric keys or the letter keys on the tool and then the tool will issue a pronunciation sound of the letter or number that has been pressed. The method used to convert is a text to speech method by utilizing the open source ESpeak library. In question mode, the tool will issue a question to the child to pronounce the letters or words, then tools that identify the pronunciation and who assess whether pronunciation is true or false. In question mode, used speech to text method using open source speech recognition Sphinx, where speech recognizer used is Pocketsphinx.

2. Methods

Design is the most important stage of the whole process of making the tool. The design of this system is divided into three parts, namely the design of input modules, design of the controller/processor, and the design of the output. The design of the system block diagram is shown in figure 1.
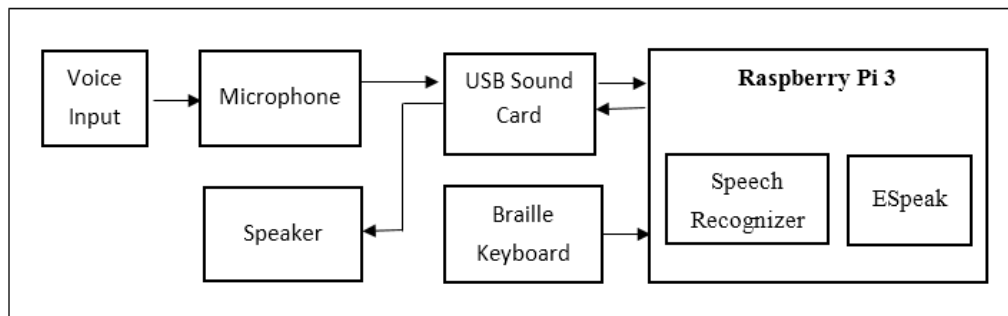
Figure 1. System block diagram.

Explanation of system block diagram as follows, Raspberry Pi used to main brain in this system. Raspberry Pi 3 is the third generation of the Raspberry Pi family. Raspberry Pi 3 has 1GB of RAM and Broadcom Video Core IV graphics at higher clock frequencies than ever running at 250MHz. Raspberry Pi 3 replaces Raspberry Pi 2 model B in February 2016. Python is the main programming language that supports Raspberry Pi in addition to other programming languages such as C / C ++ [13]. Voice input used to enter the voice pronounced by the blind child via microphone. Microphone and speakers connected to Raspberry Pi 3 via USB sound card. In question mode, the instrument will issue a question to the child to pronounce the letters or words then the instrument to make an introduction to the pronunciation performed and declare true or false to the pronunciation performed. In this mode of question, the speech to text method is used. Sphinx-4 speech recognition system is one of the open source voice recognition software developed by Carnegie Mellon University (CMU), Sun Microsystem Laboratory and Mitsubishi Electric Research Laboratories (MERL). The Sphinx is built using the Java programming language [14]. Sphinx speech recognizer from CMU provides acoustic model for speech recognition based on Hidden Markov Model (HMM). Pocketsphinx is a library speech recognizer that relies on another library called SphinxBase that provides general functionality among all CMUSphinx projects [15]. Then for learning mode, the blind child can press the number keys or letters (braille keyboard) on the instrument and then the instrument will issue a pronunciation sound of the letter or number that has been pressed. Braille keyboard has 64 keys commonly used on self-service vending machines, unattended payment solutions, ticket vending machines, gas station, kiosk solutions, public phone machines. Software used to convert letters to sound is ESpeak. ESpeak is a tool to convert text into sound / speech that is used on LINUX operating system through command line. This tool supports English and many other languages [16].

3. Results and discussion
Figure 2 shows the flowchart of learning mode. In learning mode, Raspberry Pi will wait for input characters typed by the user via the braille keyboard connected to Raspberry Pi. Furthermore, the input characters received will be compared. If the comparable input is found in accordance with the characters specified in the program, it will be issued through the speaker by using ESpeak library related characters found. This learning mode will end if the user presses the exit button from this mode. (Figure 2)
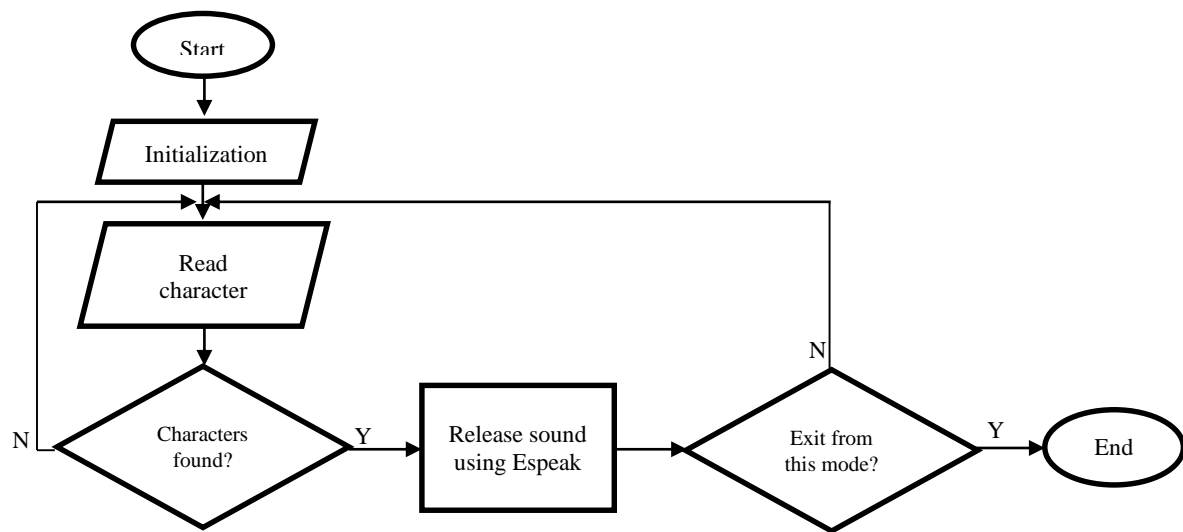
Figure 2. Flowchart of learning mode.

Figure 3 shows the flowchart of question mode. In question mode, Raspberry Pi will activate Sphinx in continuous mode. Then the program will open the file and read one line from the txt file contents randomly. The character of the fetched row will be inserted into a variable x and will be issued in voice using the ESpeak library to be pronounced by the user. Next, the program will wait for voice input from the user to pronounce the question. The received sound will be converted into text and stored into a variable by utilizing Sphinx and PocketSphinx speech recognizer. If the variable of the conversion result and the variable x are the same, the correct voice notification will be issued "Good, you're right" but if it is wrong then the voice notification will be issued incorrectly "Wrong, please try again". This mode will end if the user presses the exit button from this mode. (Figure 3)
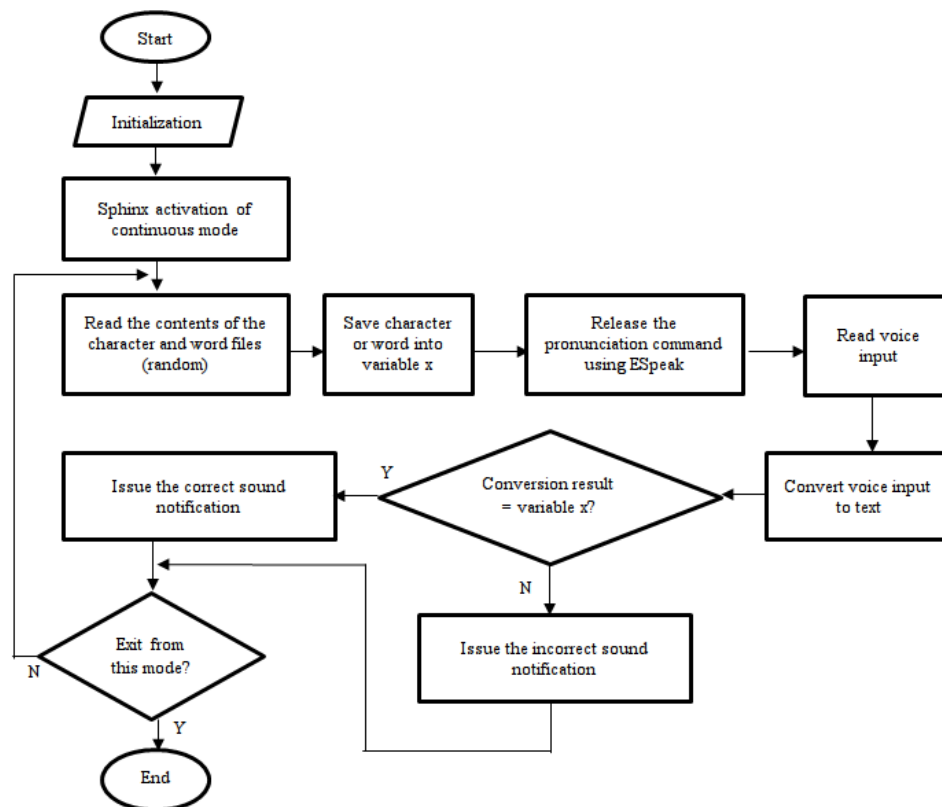
Figure 3. Flowchart of question mode.

The design of this model does not cost much, because it only uses a mini PC that is Raspberry Pi 3 as the main component and can provide pronunciation feature. However, in previous research, interactive learning of braille for children using linguistics requires a lot of hardware and requires teachers in its use [11] and another research blind aid: a self-learning braille system for visually impaired did not have a feature for pronunciation [12].

4. Conclusion

The design of the system for interactive learning media for people with disabilities, especially blind children in learning to pronounce English letters and words can be completed. The results of this system design are expected to be tested. Both laboratory testing and direct testing of visually impaired children. A follow-up study of this built-in system is how to conduct direct trials involving blind children to be able to identify the additional features needed and feedback from them in order to make them more perfect. The tool designed is an interactive learning media so hopefully the blind child will be easily interested and active to learn English character, English words and pronunciation of English characters or English words.

Acknowledgements

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