THE DESIGN AND IMPLEMENTATION OF READING AID TOOLS BASED ON RASPBERRY PI FOR BLIND EFL STUDENTS

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ABSTRACT

Because there is a dearth of accessible reading material, especially braille printed books, this blind reading aid was developed for EFL students. No longer will a blind learner have to rely on braille-printed books to learn and grow. This technology enables visually impaired EFL students to access the same literary works as their sighted peers. This study employs a qualitative approach to experimentation, with data gathered through observation, interviews, and a review of existing literature. This system planning is described using a flowchart and block diagram. The Blackbox testing approach was employed to conduct the tests in this research. The Raspberry Pi was used as the microcontroller, and the Push Button on the Raspberry Pi Camera was used to initiate the graphical capture and subsequent image file processing by Optical Character Recognition (OCR) and Text-to-Speech (TTS). This procedure yields an mp3 file that can be played through loudspeakers or speakers, allowing blind people to "read" printed text by osmosis.

Keywords: Blind, EFL students, Raspberry Pi, Reading

INTRODUCTION

The hurdles and challenges of studying in postsecondary institutions are greater for students with special needs than for others. Aside from the fact that universities have limited disability service sections, another reason is that not all professors understand the peculiarities of students with special needs. Lecturers are expected to know students with special needs, particular features, and needs and to foster innovation and creativity in learning so that all students, including students with special needs, can follow and meet the lecturer's learning aims. Visual impairment can be detrimental to a person's ability to study, function independently, grow socially, and adjust to new situations (Sarah Mboshi, 2018). Because of this, people who live with vision impairment have specific educational needs that are best met at an early age in life. Among these educational requirements are the maturation of conceptual understanding, the enhancement of listening skills, and the acquisition of study and research abilities. The majority of children who are visually impaired have a more complicated visual condition that has a variety of negative effects on their

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performance. Some students who are able to execute reading tasks effectively may be unable to skim maps or texts for information, while other students who require their educational materials to be adapted may be able to handle physical activities with ease (Aikin Araluce, 2002).

As a result of the adoption of Law Number 8 of 2016 Regarding Persons with Disabilities, this law is highlighted in Article 10, paragraph A that people with disabilities have the right to quality education in educational units across the board, including but not limited to all types, pathways, and degrees of education. Article 18 states that every person with a disability possesses the right to accessibility. Article 40, Paragraph 1 states that the government and local governments are expected to organize or facilitate education for persons with disabilities in every path, type, and level of education that falls within their respective responsibilities. Besides, everyone is encouraged to learn as much as they can and is even obligated to do so in order to avoid being foolish. It implies that all people have the same rights to an education, whether they are regular students or students with special needs (including visually impaired students), and that everyone has the same opportunity to pursue a high level of education (Nasution, 2020).

Different rules show that the government has been very good about making rules that help people with disabilities. In Indonesia, the law has received overwhelmingly positive feedback from citizens and academic institutions. It has been demonstrated, for example, that more than 70 public and private universities in Indonesia have made accommodations for students with impairments. There are currently more than 400 students enrolled in diploma, undergraduate, and postgraduate courses who have special needs. They are blind, deaf, disabled, etc., and they've overcome many difficulties to get here. They can be found in fields as diverse as early childhood education, languages, law, history, music, sociology, social and political science, computers, graphic design, sports, religion, extracurricular programs, counseling, fashion, makeup, psychology, and early intervention. Iswahyuni, et al (2016) conducted needs analysis to blind students in Brawijaya University. The demands of children with visual impairments in the classroom are shaped by the information gleaned from interviews and classroom observations. Both students and faculty at the school can benefit from this research because it will help them better prepare for teaching practice and meet the needs of visually impaired students. In UK, as it is stated by Croft (2020), Taking a student-led approach might tell a different story, which could add to the research on the experiences of blind and visually impaired students and help people stop thinking of themselves as blind or visually impaired students and start thinking of themselves as just students. This could change the way people think about where blind and visually impaired children should and can sit. This research employed 10 students identifying as either visually impaired or blind who were geographically spread across the UK.

The visually handicapped face a significant disadvantage compared to those with normal vision since the information they can glean from their
environment is drastically reduced. The term "visually impaired" is commonly used to describe someone with difficulties with their eyesight. Based on their degree of visual impairment, blind people are classified as either totally blind (total blind) or partially blind (poor vision). Those with severe visual impairment will benefit from specialized teaching methods or academic support. Print publications are a common form of mass communication. Posters, novels, and other printed works are all examples of printed media. However, books are more popular than other printed media for disseminating knowledge. Meanwhile, most published books do not accommodate the unique ways blind people read and learn.

According to data from the Central Statistics Agency (2016), disabilities processed from SUPAS 2015 include difficulty seeing, hearing, using hands or fingers, remembering or concentrating, behavioral or emotional disorders, speaking, and taking care of themselves. According to 2015 SUPAS data, there are 8.56% of the population with disabilities, where the highest is in North Sulawesi and the lowest is in Banten, Indonesia. If it is seen from the difficulty of seeing, 0.13% of the population cannot see at all, 0.72% have a heavy difficulty level of seeing, and 5.51% have a little difficulty seeing.

Based on the facts above, it is considered important to provide a reading aid that can convert text /printed writing from paper or book pages into a voice for EFL students with visual impairment to hear to solve the problem of the lack of reading media for blind people. This research objective is to provide a reading aid for people who are blind, which will be a medium for the visually impaired to get information from printed writing. Regarding the previous background, the formulation of the problem that will be discussed in this proposal is formulated, namely, "How to design and make a reading aid for blind EFL students based on Raspberry Pi?"

LITERATURE REVIEW

Here, knowing the model specs is crucial to constructing the gadget. The Raspberry Pi was used as the microcontroller in this tool's successful implementation as a push-button-activated device. At the press of a button, the Raspberry Pi camera will take a picture, creating an image file that will run through an Optical Character Recognition (OCR) system and a Text to Speech (TTS) converter to make the text audible. The end result of this sequence of steps is an mp3 file that may be played to blind EFL students, allowing them to "read" printed text indirectly through sound. In addition to being lightweight and easy to operate, this device is also compact. Detailed descriptions of the resulting model's features, characteristics, and other attributes are provided below.

Raspberry Pi Microcontroller System

The primary microcontroller for this system is a Raspberry Pi 3, which is also one of the system's components. The entered information originates from the push button input for the tool control, and then the Raspberry Pi camera is used to retrieve an image from the book page. Afterward, Optical Character Recognition (OCR) technology is utilized to extract the characters from the image of the book
page (Dinata, 2017). This is accomplished through the processing of images. This approach will result in creating a file that is in text format. The text is converted into sound using a technology called Text Speech (TTS), which is then applied to the converted text. The output is played through a single speaker. This device obtains its power from an adapter with a voltage of 5 volts; this adapter is the primary power source used by the entire system.

**Adapter, Push Button, Raspberry Pi Camera, and Mono Speaker**

Connecting the adapter to the Raspberry Pi's Power Port provides 5v of power that may be used to run anything plugged into the Pi. The two legs of the push-button are wired to GPIO 24 and GROUND on the Raspberry Pi. The Ribbon Cable attaches the camera to the Raspberry Pi Camera Socket. Speakers can be used as an output by plugging an Audio Jack Cable into Raspberry's Audio Port.

As a trigger for the tool, this approach utilizes a single push button that is normally in the on position. This button has two pins that need to be linked, while the other pin is attached to the Raspberry Pi's pin GROUND and pin 24 GPIO. This image will be processed using the image received from the input of this tool, which is accomplished through the usage of the camera included within this instrument. The Raspberry Pi Camera V.1.2, which has an 8-megapixel resolution, is the camera that is integrated into this program. In order to make use of the camera, you will need to connect it to the Raspberry Pi by inserting a ribbon cable into the camera's socket and then inserting it into the corresponding socket on the Raspberry Pi.

**Raspbian Operating System**

The Raspbian operating system, based on the Debian Linux operating system, is used in Raspberry Pi's software design; this operating system is available on the official Raspberry website. Python is the programming language used in software development, with several additional libraries for optical character recognition (OCR) and text-to-speech (TTS) processes (Firdaus et al., 2021). To clarify, here is an image of the system design flow in general, showing how an image obtained from a paper/book page can be processed and converted into speech.

The Raspberry Pi is a single-board computer (SBC) the size of a credit card. The Raspberry Pi has all of the functions of a full computer, thanks to an ARM SoC (System-on-a-chip) packaged and integrated into the PCB. This device uses an SD card for booting and long-term storage. The Raspberry Pi Camera Module is a Raspberry Pi Foundation-approved product. In 2013, a 5-megapixel model was released, and in 2016, an 8-megapixel v2 Camera Module was released. There is a visible light version and an infrared version for both iterations. Most photographic cameras have functions that allow you to view the scene, focus on the desired part of the scene, and control the exposure to not be too bright or too dark. Typically, the camera has a screen (LCD) that allows the
user to see the scene and adjust settings such as ISO speed, exposure, and shutter speed.

**Optical Character Recognition**

Optical Character Recognition (OCR) is converting an image of letters into ASCII characters that will recognize by the computer. The letter images in question can be scanned documents, screen print results of web pages, photos, etc. OCR is a long-established system. In 1914, Emanuel Goldberg began building an OCR system for telegrams and reading devices for the visually impaired. Even in circumstances in which the characters are difficult to recognize, the OCR system is still being enhanced today to produce results with more accuracy. The use of optical character recognition (OCR) makes it possible for computers to carry out additional processing, such as translation into foreign languages, searches, automatic reading systems for persons who are blind, data entry, and character recognition such as that found on number plates, CAPTCHA testing, or other text difficulties (Venkata Rao et al., 2016).

In some circumstances, it is possible to save the OCR results in ASCII format without saving the layout. Paragraphs, margins, and other formatting elements are said to be "laid out" when placed in the same places as in the final image. There must be a backup of the structure. Paragraphs and other textual elements must maintain their original formatting when a scanned book is converted into a.doc file. ALTO (Analyzed Layout and Text Object) is an XML (Extended Markup Language) format that can be used to save layouts.

**Text To Speech**

Text-to-speech converts text into digital audio and then 'speaks'. Most text-to-speech engines can be classified based on how they convert phonemes into audible sounds.

Word combinations: Although word strings are not combined, text-to-speech systems are widely used. The application designer records individual phrases and words in a word sequence machine. The machine then stitches the recording together to form a sentence or phrase. If you use voice mail, one of the machines will say, "[You get] [Three] [New Message]." "You Get," "All Digits," and "New Message" have all been recorded by the machine.

Synthesizing: A text-to-speech engine generates similar to those produced by human vocal cords. It employs various filters to simulate the length of the throat, oral cavity, lip shape, and tongue position.

A syllable sequence: A text-to-speech engine that uses syllable sequences, connects short digital audio segments and smooths the transitions between them to produce a continuous sound. For example, in a dip sequence, each segment consists of two phonemes, one beginning and one end, the sound.
METHOD

To complete the plan for developing a reading aid for blind EFL students based on Raspberry Pi, the research team has conducted research based on a method carried out in stages and in a planned manner. In this research, the type of research used was qualitative with experimental methods. The experiment is defined as a research situation in which the researcher deliberately manipulates at least one independent variable, called an experimental variable (Emzir, 2019). This type of research was chosen because the research team considered this type very suitable for the research appointed by the research team. After all, it developed a tool and carried out the development of a research tool in the form of an experiment on the research object of the research team. This research was conducted at the Language Laboratory, Faculty of Literature and Humanities, Makassar Islamic University.

The data source in this study is the research library, which collects data from several books, journals, theses, and other literature that can be used as a reference for discussion in this matter. This research has links to online or internet data sources or the results of previous studies as reference material for future researchers. This approach uses a scientific research approach, namely, an approach based on science and technology.

FINDINGS AND DISCUSSION

This learning innovation model aims to assist blind EFL students in reading a printed paper from a paper or book page. This learning media was built by using Raspberry Pi. Raspberry Pi is a mini-sized single-board computer capable of running high-resolution programs. Acting as a microcontroller, the camera from the Raspberry Pi will do a graphical capture of the book page, which will generate an image file automatically. After that, the image will go through an Optical Character Recognition (OCR) process to be converted into speech using the Text to Speech (TTS) process. This process series produces an MP3 file to be played to blind students. This MP3 will make it easier for them to ‘read’ the printed writings of the book pages. In addition, this tool also has high portability, which can be easily moved and used.

With the design of this learning innovation model, students with visual impairments can more easily get information without having to rely on the braille books they have been using. The lack of alternative reading media for blind people impacts their reduced reading interest. As technology advances, books are now in the form of audiobooks. For visually impaired blind people, this audiobook is a way out of their problems. In addition, this tool is also very efficient because it is very easy to move and easy to use. Only by placing the reading text on a series of tools and pressing a push button will this tool automatically scan the reading, process it, then program it in MP3 format.
The system of the testing method used by using Black Box testing. Testing is used to test the special functions of the software being designed. The correctness of the software being tested is only seen based on the output generated from the data or input conditions given the existing function without seeing how the process is to get the output. From the resulting output, the program's ability to meet user needs can be measured, as well as its errors. The development of this assisted technology has been successfully built with the Raspberry Pi as a microcontroller; with a trigger from the Push Button, a Raspberry Pi Camera will do a graphical capture and produce an image file that will automatically be processed by the Optical Character Recognition (OCR) process and converted into speech with the Text process to Speech (TTS) (Syahrullah, 2018). This series of processes produce an mp3 file to be played to blind people so that blind EFL students can read indirectly from printed writing from a paper/book page. This tool has several advantages, such as blind EFL students can add to their scientific repertoire no longer relying on braille printed books and conventional books that normal humans read in general. In addition, this tool also has high portability, can be easily moved and easy to use.

The functions of this learning innovation model can be described as follows:
1. Provides convenience in obtaining literature information for students with visual impairments
2. Converting printed papers from paper or book pages into speech as a reading aid.
Meanwhile, the benefits of this learning innovation model include the following:

1. This media is expected to be a reading method for people with visual impairments in literature, namely digital books or audiobooks.
2. Students with visual impairments can now use technology more effectively because they do not need braille textbooks, which can take time to read.
3. Since the output of this device is MP3, it is more efficient to use than heavier books for braille reading.
4. This media can replace the existence of braille reading books that are now rarely found.

With the design of this learning innovation model, students with visual impairments can more easily get information without having to rely on the braille books they have been using. The lack of alternative reading media friendly to blind people impacts their reduced reading interest. As technology advances, books are now in the form of audiobooks. For visually impaired blind people, this audiobook is a way out of their problems. In addition, this tool is also very efficient because it is very easy to move and easy to use. Only by placing the reading text on a series of tools and pressing a push button will this tool automatically scan the reading, process it, then program it in MP3 format.

CONCLUSION

From the discussion described above, the following conclusions can be drawn. As a tool built with Raspberry Pi as a microcontroller, this tool is designed to assist blind EFL students in reading printed text from book pages or paper. In addition to requiring a Raspberry Pi, this tool requires a push button. This object will produce an image file automatically processed through a series of Optical Character Recognition (OCR) and then converted into sound in the Text to Speech (TTS) process. This process will produce an mp3 file that will be played to EFL students as a substitute for braille writing. In addition, with this tool, EFL students with disabilities no longer rely on braille-printed or conventional books read by normal students in general. This device can save time for people with disabilities when 'reading', is easy to use, and is easy to move.

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REFERENCES


