A Smart Book Reader for Visual Impairment Persons Using Dot Matrix Mechanism

Ayesha Siddika[1], S M Bayazid Khan[2]
[1]Assistant Professor, Dept. of Computer Science and Engineering,
World University of Bangladesh, Bangladesh
[2]Dept. of ME, Dhaka University of Engineering & Technology,
Gazipur, Dhaka, Bangladesh

Abstract. A smart Book Reader for visually impairment people is a new innovation for the blind people. Here a camera module is used for capturing the image of the text. The camera's image is provided to the image processing section. For that, here a raspberry pi is used that detects the image content and provides an output signal in the form of an audio signal. OCR is used for image processing, optical character recognition is the process of identifying the printed characters using photoelectric devices and computer software. It converts images of typed, handwritten or printed text into machine encoded text from a scanned document or from text superimposed on an image. The microcontroller divides the text into a row-column format. It can consider segments as a 4x4 matrix. And finally servo motors pop up this text and also they can understand the text in the source of the sound.

Keywords: Visual impairment, raspberry pi, OCR, audio signal, pop up, servo motors, microcontroller

Introduction

According to the World Health Organization (WHO), globally, at least 2.2 billion people have a vision impairment or blindness. The current day scenario of reading for blind people is with the help of braille. Braille is a code – a system of dots that represent letters of an alphabet. All books are not written in Braille, thus the library of a visually impaired person is limited to the countable number of books. The technology currently used in the market is having a problem like focusing, accuracy, mobility, and efficiency. Hence here we want to propose a device that will solve all the problems.

The main purpose of this project is to make visually impaired people read the text content without anyone's help. The device first utters a word then pops up and pronounces each letter separately from that word. This device can be used at any time, in any place and it can be read from any device or from the books. In this project, a Smart Reader for BVI (blind and visually impaired), here presented the integration of a complete text read-out system with a dot-matrix mechanism system.

As per the statistics of WHO, prevalence of blindness (per thousand) in 2015 is as follows (Table 1).

Table 1. Statistics of blindness

Types of blindness	Urban	Rural	Total
Total blindness	4.43	5.99	5.40
Economic blindness	11.14	15.44	13.83
One eye blindness	8.23	7.00	7.46

Survey of Blindness

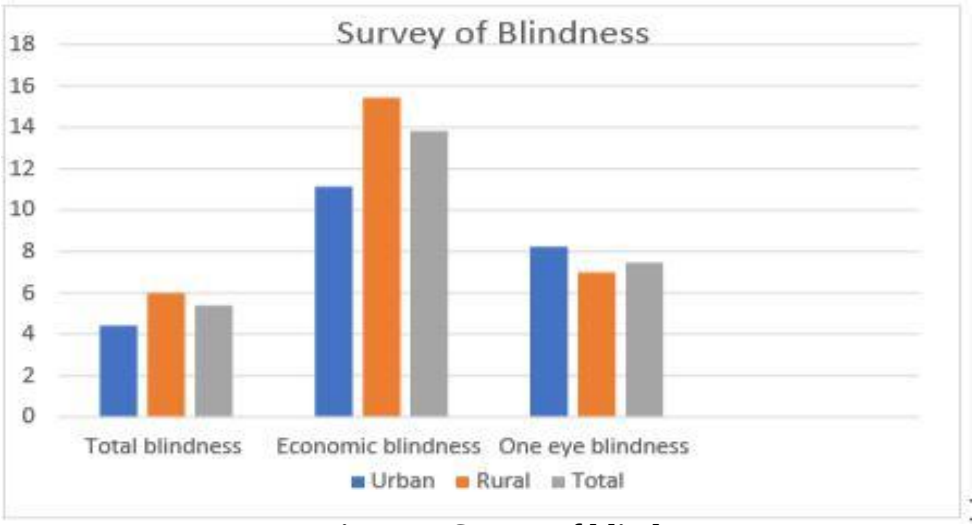

Figure 1. Survey of blindness

Objectives

- To design and development of a smart book reader for visual impairment person;
- To accurate character detection and pop up every character separately with pronunciation using dot matrix mechanism.

Literature Review

Researchers at the MIT Media Laboratory have built a prototype of a finger-mounted device with a built-in camera that converts written text into audio for visually impaired users. Many people in the convenience community were very excited by this prospect. Unlike other similar OCR (optical character recognition) apps that first scan and then process the page, the MIT device, dubbed the Finger Reader, reads the text in real-time. They introduce a novel computer vision algorithm for local-sequential text scanning that enables reading single lines, blocks of text or skimming the text with complementary, multimodal feedback. This system is implemented in a small finger-worn form factor that enables a more manageable eyes-free operation with trivial setup (Huber et al., 2015).

The idea of optical character recognition is used on this device. Optical Character Recognition (OCR) is a mechanical or electronic converting typed, printed or handwritten text to machine-encoded text. It accepts data extensively from any document. It is familiar with the process of digitizing printed text so that it can be edited electronically, searched, stored more compactly, displayed on-line, and used in machine processes such as text to speech, machine translation, key data, and text mining. The device will read the printed text aloud with the synthesized voice, with the help of heavily modified open-source software. A significant concern may be the weight of the device as it should be easily wearable and comfortable for the user. The system includes a text tracking algorithm that extracts words from a close-up camera view, integrated with a finger-wearable device (Deole & Kulkarni, 2016).

They design and develop a protocol that can convert the text to the speech signal. This prototype can convert the text which has the font size of 18 and above to speech signal, which is the output taken from the speaker or earphones. Visually impaired people or blind people are those people who lack in their visual perception, and they are unable to see the object. However, they have the hearing capability, and this capability makes them hear from the environment. This method is complicated to perform and requires practice. To improve this, the prototype is developed in which the text is converted into a speech signal and the blind people can observe

that sound and they can understand the text in the source of the sound (Muralidharan, Venkatesh, & Pritmen, 2018).

According to the journal paper, this project utilizes IoT technology with the use of an IoT device, IoT infrastructure, and service. Raspberry Pi, is used because it is energy efficient and uses only 5V power to run. It is also a high portability device with only a credit card size and can be carried out anywhere. Book readers will capture the picture of book pages using a camera and book readers will process the images using Optical Character Recognition software. By using this book reader, users will be able to enjoy both softcopy and hardcopy books, by using online text to voice converter with the help of IoT connectivity protocol such as Wifi and 4G services. For hardcopy books, a camera is embedded to capture the page (Harum et al., 2019).

Optical character recognition (OCR) is the process of identifying the printed characters using a photoelectric device and computer software. It converts images of typed, printed or handwritten text into the machine-encoded text from a scanned document or text superimposed on an image. These images are converted to audio output. OCR is mainly used in the field of research in character recognition artificial intelligence and computer vision, and it is also used for pattern recognition and to perform document image analysis. The work focuses on the OCR based automatic book reader for the visually impaired using Raspberry Pi. The aim is to assist the visually impaired at low cost and to demonstrate the easily designable version. The results of the text detection rate, accuracy, text to speech conversion rate and error rate are tabulated (Duraisamy & Manohara, 2018).

The system consists of a camera interfaced with a computer that receives the printed or handwritten text. This work proposes the novel implementation of a smart book reader with a raspberry pi controller. The system consists of a webcam interfaced with a raspberry pi smart book that accepts a page of printed text. The experimental results are done with the help of the raspberry pi controller. Controller coding for the Raspberry pi is done through the Python language. The audio output is obtained after the captured image is converted to text. The image captured by the camera is converted to text and displayed in the form window, and then the text is obtained as audio output. Raspberry pi has an audio port where the output can be heard through the headphone or the speaker (Vaibhav, Govekar, & Meenakshi, 2018).

Methodology

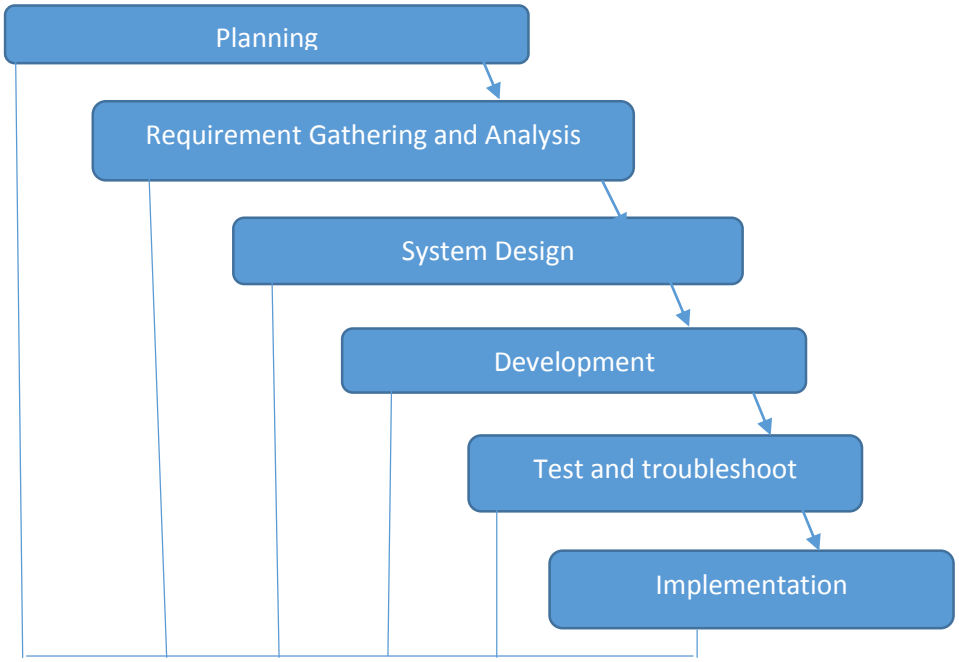

Figure 2. Methodology

Hardware Requirements

- Arduino Nano R3
- Raspberry Pi
- SG90 Micro Servo motor
- Servo Motor Driver
- Servo Tester Aircraft Model
- Pi Camera module
- Speaker 8ohm
- PAM8403 Mini digital Amplifier Board
- 5v Power Adapter
- Veroboard Normal Dotted
- Male & Female header pin.

Software Requirements

- Language C
- Python
- Arduino IDE
- Thonny IDE

Circuit Diagram

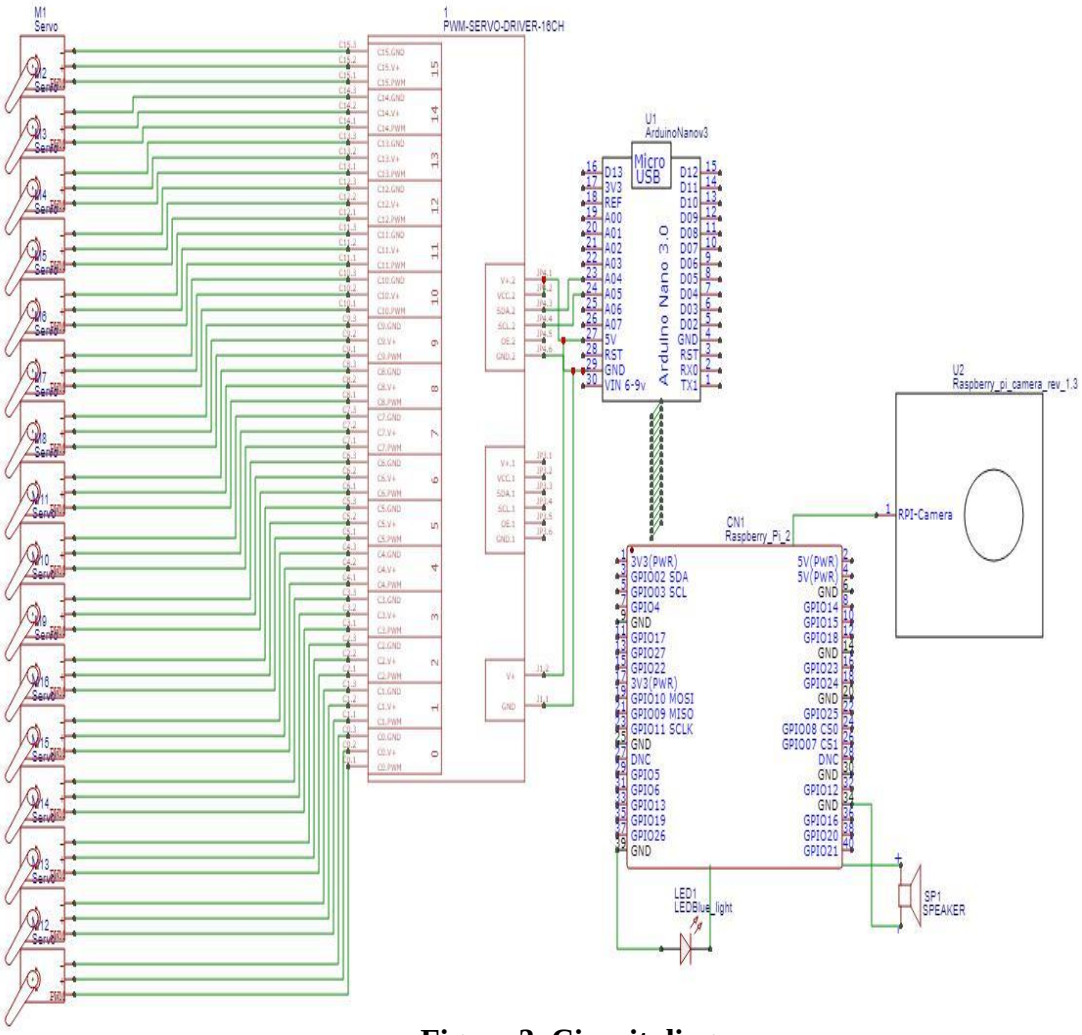

Figure 3. Circuit diagram

The camera module and speaker are connected to the raspberry pi. Here the camera module captures the image and servo motor used to pop up the letter in 4*4 matrics. There are three wires coming out of this motor and the wires are connected to the PWM servo motor driver. The GND and VCC pins of the servo motor driver are connected to the arduino nano. Speaker and LED are connected to the ground pin of Raspberry Pi. The main output of our device is that whenever the servo motor represses a character will be emitted via amplifier.

Demo of Project

Figure 4. Smart Book Reader for visual impairment person

Display of Project

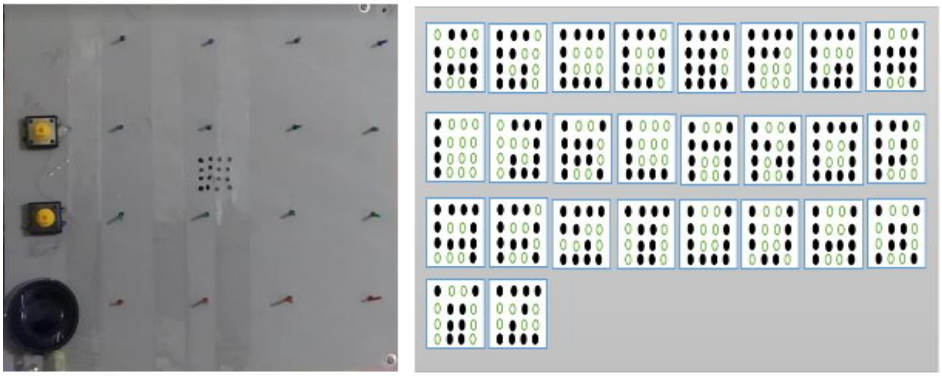

Figure 5. Display of this project

Conclusion

Reading is an important aspect to each and everyone but the blind people use the braille method to detect and to read the text. This method is very difficult to perform and requires practice. To overcome this the prototype is developed in which the text is converted into a speech signal and that sound can be observed by the blind people and they can understand the text by their finger.

Limitation

The device does not support any language other than English.

Future Work

A device that will be able to read all kinds of languages.

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