Smart Book Reader System for Visually Impaired

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ABSTRACT:

According to WHO (World Health Organization) approximately 1.3 billion have some form of visual impairment. In which 188.5 million people have mild vision impairment, 217 million people have moderate to severe vision loss and 36 million people have complete blindness. Though there are several existing system to assist a visually impaired person to read, none of them provide a reading experience similar to a sighted person. This paper aims at making a system using Raspberry Pi which can read a book aloud for visually impaired. Here the system can read a book aloud and also turn its pages automatically. An additional feature of recording the pages is also made available for future reference. A camera is used to capture the images of the book and then Image to Text conversion is carried out followed by Text to Speech conversion. OCR (optical character recognition) is used for Image to Text conversion. OCR is the recognition of text characters by scanning. It involves photo scanning of text characters-by-character and then converting it into its respective character value such as ASCII value. After the recognition of characters E-speak voice command software is used to convert the obtained text from OCR into speech signals. Finally a speaker which is connected to the Raspberry Pi is used to read aloud the speech.

Keywords: Raspberry Pi, OCR (optical character recognition), Image to Text conversion, Text to Image conversion, E-speak.

I.INTRODUCTION

Blind people and people having less vision mostly restricted to read books which are written in braille. Braille is a code—a system of dots that represent the letters of the alphabet. Here the disadvantage of this language is that only a few books are converted to Braille hence limiting the knowledge a visually impaired person can have. But to read books which are not in braille, some android apps such AIRS-LA, BARD Mobile, NFB NEWSLINE®, Sero (formerly iBlink Radio), and Voice Dream Reader, etc. are used. Through these apps only e-books can be read and again not every book is converted to e books. Hence our system aims at overcoming this particular problem.

We have developed a system which can track the area within the camera view and extract printed text information in English language. Our system can effectively handle different background patterns, and extract text information from any kind of hand-held objects or books. The overall process is capturing the current page of the book using a camera and then converting the recognized character into its respective ASCII values. That is, the image is converted into a grey scale image and then from the grey scale image individual characters are extracted and recognized. Optical Character Recognition algorithm is used to carry out all these process which involves stages like Scanning, Pre-processing, Segmentation and Feature Extraction. E-speak is a Text-to-Speech conversion engine used in the system to convert the recognized text into a speech signal. Lastly the recognized text is read aloud via a speaker which is connected to the Raspberry Pi. A rotating arm is mounted to the system which is driven by a motor, to turn the page automatically once the current page is completed. Upon users input through a keypad our system can also record a number of pages for future reference.

II.WORKING PRINCIPLE

Our proposed system performs mainly three functions and they are 1. Captures an image and reads the text from the book aloud, 2. Once the page is completed, turns the page automatically and 3. Upon users command stores a certain number of pages, so that it can be referred for future purpose.

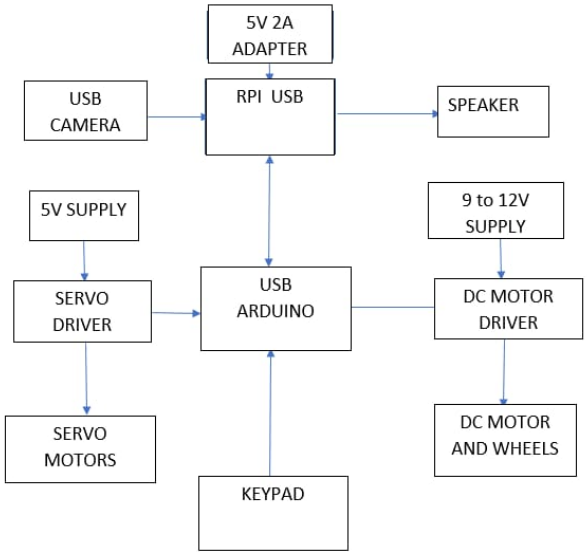
For reading the printed text document upon users command, this system captures the product image placed in front of the camera which is connected to the Raspberry Pi. After capturing the image it undergoes a process called Optical Character Recognition (OCR) Technology. OCR technology allows the conversion of scanned images of printed text or symbols into text or information that can be understood or edited using a computer program. In our system for OCR technology we are using TESSERACT library. Using Text-to-speech unit (TTS unit) the data will be converted to audio. Camera acts as main vision in detecting the image of the product or a book, then image is processed internally and separates label is given to the recognized text from image by using open CV library. The final recognized text document if fed to the output device which can either be a headset or a speaker based on users choice.

A mechanical setup consisting of a rotating arm is used to turn the page automatically. Once the system finishes reading the current page a signal is given indicating that the page is completed and the rotating arm starts rotating so that the system goes to next page automatically. Additionally the system has a next and previous button which will act as interrupt. If the user wants to skip to the next page or previous page he can do so by simply by pressing the next or previous button present in the keypad respectively. To store the pages he/she can press the record button present in the keypad, and to play the recorded pages play button should be pressed.

2.1 Block diagram

Fig. 1 Block diagram of proposed methodology

Figure.1 illustrates the block diagram of the proposed methodology. Here the main frame work of this project is Raspberry Pi board. Arduino Board which is connected to the Raspberry Pi board is used for page turn



ing mechanism the DC motors and the servo motors are connected to the Arduino Board. Keypad is connected to the Arduino Board which is used to give commands to the system.

III.FLOW OF PROCESS

3.1. Image Capturing

This is the first step in the system. The inbuilt camera captures the images of the printed text. The quality of the image captured should be high so as to have fast and clear recognition with the help of high Resolution camera.

3.2. Pre-processing

The resulting image may be corrupted with some amount of noise. Pre-processing stage consists of noise removal, and smoothing the digitized character and also normalization of the characters.

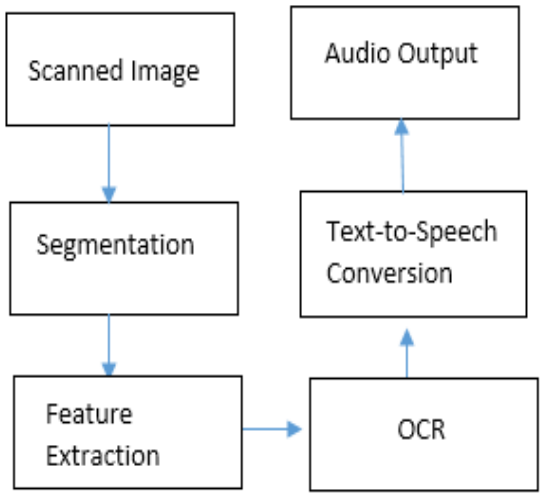


Fig.2 Flow of process

3.3. Segmentation

After pre-processing, the noise free image is passed to the segmentation phase. It is an operation that seeks to decompose an image of sequence of characters into sub-image of individual symbol (characters). The binarized image is checked for spaces between the lines. If spaces between lines is detected then the image is segmented into sets of paragraphs across the interline gap. The lines in the paragraphs are scanned for intersectional space horizontally with respect to the background. Width of the horizontal lines is detected using the obtained histogram of the image. For detecting the width of the words lines are scanned vertically which gives the vertical intersection. Finally in segmentation Character width computation is performed to decompose the words into characters.

3.4. Feature Extraction

Feature extraction in the individual image glyph is considered and extracted for features. First a character glyph is defined by the following attributes:

(1) Height of the Character;
(2) Width of the character;
(3) Numbers of horizontal lines present—short and long;
(4) Numbers of vertical lines present—short and long;
(5) Numbers of circles present;
(6) Numbers of horizontally oriented arcs;
(7) Numbers of vertically oriented arcs;
(8) Centroid of the image;
(9) Position of the various features;
(10) Pixels in the various regions.

3.5. Character recognition

The ASCII values of the recognized characters are processed by Raspberry Pi board. Here each of the characters is matched with its corresponding template and saved as normalized text transcription. This transcription is further delivered to the audio output.

3.6. Text to Speech

The scope of this module is initiated with the conclusion of the receding module of Character Recognition. The module performs the task of conversion of the transformed text to audible form. The Raspberry Pi has an on-board audio jack, the on-board audio is generated by a PWM output and is minimally filtered. A USB audio card can greatly improve the sound quality and volume. As the recognition process is completed, the character codes in the text file are processed using Raspberry Pi device on which recognize a character using Tesseract algorithm and python programming, the audio output listens.

IV.HARDWARE DESCRIPTION

4.1. Raspberry Pi Board

Raspberry Pi is a low cost, credit card sized computer that plugs computer monitor and TV and uses standard keyboard and mouse that uses python programming. There are two models of Raspberry Pi, model A and model B. These two are bit similar with few advance features on model B compared to model A. Model B has512 MB RAM, two USB port whereas Model A has 256 MB RAM and just a USB port. Besides, Model B has Ethernet port while Model A does not.

Fig.3 (Raspberry Pi 3 B+)

4.2. Raspberry Pi Camera

5MP OV5647 Sensor is a High Quality, great performance with a robustly built quality camera. The camera has Adjustable Wide Angle Fish-eye Lens with Night Vision mode capable of 2592 x 1944 pixel static images and also supports 1080 p @ 30 fps, 720 p @ 60 fps and 640 x480 p 60/90 video recording.

An adjustable focus can be manually adjusted according to the distance of the object. With 5MP OV5647 webcam sensor, 222 degree FOV, the vision is extremely open. This is a fisheye wide-angle camera for Raspberry pi 2 Raspberry pi 3B and 3B+, applicable occasions VR, AR, aerial photography, real-time photography of the car, indoor and outdoor monitoring, photographing and video recording.

Fig.4 Pi Camera

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4.3. Arduino Board

The Arduino UNO is an open-source microcontroller board. With ATmega328P microcontroller chip and developed by Arduino.cc. The board has a sets of digital and analog input/output (I/O) pins that can be interfaced to various expansion boards and other circuits. The board has 14 Digital pins, 6 Analog pins, which can be programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable.

Fig. 5 Arduino UNO

V. CONCLUSION

This system is very helpful for visually impaired persons since the text is recognised using a camera and then they are read with the audio output system. It becomes an open CV platform for the visually impaired when compared to the already existing platforms. It is efficient and easy to use. This particular system will be helpful for the visually impaired person to access information which is in the form of text.

VI. REFERENCES

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