Raspberry Pi Based Reader for Blind People

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Abstract *This paper presents the automatic document reader for visually impaired people, developed on Raspberry Pi. It uses the Optical character recognition technology for the identification of the printed characters using image sensing devices and computer programming. It converts images of typed, handwritten, or printed text into machine encoded text. In this research these images are converted into the audio output (Speech) through the use of OCR and Text-to-speech synthesis. The conversion of printed document into text files is done using Raspberry Pi which again uses Tesseract library and Python programming. The text files are processed by OpenCV library & python programming language and audio output is achieved.*

***Key Words*: Character recognition, Low power, Document Image Analysis (DIA), Raspberry Pi 3B, Speech Output, OCR based book reader, OpenCV, Python Programming**

1. INTRODUCTION

Used for the detection and reading of documented text in images to help the blind and visually impaired people. The overall algorithm has a success rate of 90% on the test set as the unread text is significantly small and distant from the camera. We have proposed a technique to extract text from typed documents, convert them into machine encoded text, create the text files and then process them using Digital Image Analysis (DIA0) to convert the text into audio output. Our focus is on enhancing the capabilities of blind people by providing them a solution so that the information can be fed to them in the form of a speech signal. This project can also be implemented for the automatic detection of road signs, warning signs, in other terms to improve the blind navigation on larger scale.

2. BLOCK DIAGRAM

Figure 1 shows the block diagram of the proposed book reader. In this system, the printed text is to be placed under the camera view by the blind person to ensure the image of good quality and fewer distortions. Then an applicable blind-assistive system, a text localization algorithm might prefer higher recall by sacrificing some precision. When the

application starts at first, it checks the availability of all the devices and also for the connection. The GUI displays the status of the image clicked from the camera and a status box for representing the image. The Raspberry Pi has integrated peripheral devices like USB, ADC, Bluetooth and Serial. Raspberry Pi 3B uses Linux based operating system named Raspbian.

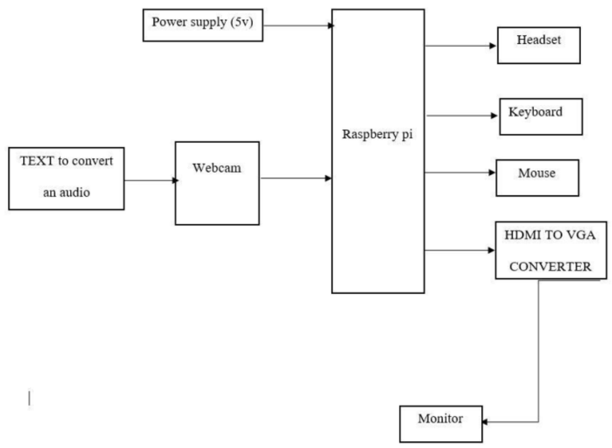


Fig- 1: Block diagram of book reader with Raspberry Pi

3. WORKING PRINCIPLE

When capture button is clicked, this system captures the document image placed in front of the camera which is connected to ARM microcontroller through USB .After selecting the process button the captured document image undergoes 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 library the data will be converted to audio. Camera acts as main vision in detecting the image of the placed document, then image is processed internally and separates label from image by using open CV library and finally identifies the text which is pronounced through voice. Now the converted text into audio output is listened either by connecting headsets via 3.5mm audio jack or by connecting speakers via Bluetooth.

4. HARDWARE IMPLEMENTATION

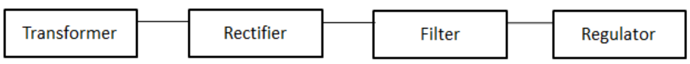
Raspberry Pi is a low cost, credit card sized computer that plugs into computer monitor or TV and uses standard keyboard and mouse.There are two models of it, Raspberry Pi 2 and Raspberry Pi 3. These two are bit similar with few advance features on Pi 3. Compared to the Raspberry Pi 2 it has:

- A 1.2GHz 64-bit quad-core ARMv8 CPU
- 802.11n Wireless LAN
- Bluetooth 4.1
- Bluetooth Low Energy (BLE)
- 4 USB ports
- 40 GPIO pins
- Full HDMI port
- Ethernet port
- Combined 3.5mm audio jack and composite video
- Camera interface (CSI)
- Display Interface (DSI)
- Micro SD card slot
- VideoCore IV 3D graphics core

Fig -2: Block diagram of book reader with Raspberry Pi

The hardware components of the Raspberry Pi include power supply, storage, input, monitor and network.

Power Supply Unit is the device that supplies electrical energy to the output loads.



It gives a well regulated power supply of +5v with a output current compatibility of 100 mA.

Camera feeds its images in real time to a computer or computer network, often via USB, Ethernet or Wi-Fi.

HDMI to VGA Converter is used to connect the Raspberry Pi board to the Projectors, Monitors and TV.

5. SOFTWARE IMPLEMENTATION

Operating system: Raspbian (Debian)

Language: Python2.7

Platform: Tesseract, OpenCV (Linux-library)

Library: OCR engine, TTS engine

The operating system under which the proposed project is executed is Raspbian which is derived from the Debian operating system. The algorithms are written using the python language which is a script language. The functions in algorithm are called from the OpenCV Library. OpenCV is an open source computer vision library, which is written under C and C++ and runs under Linux, Windows and Mac OS X. OpenCV was designed for computational efficiency and with a strong focus on real-time applications. OpenCV is written in optimized C and can take advantage of multi-core processors.

6. OPTICAL CHARACTER RECOGNITION

Optical Character Recognition is a text recognition method that allows the written text or printed copies of the text to be rendered into editable soft copies or text files. OCR is used for the scanning of text from the images and converting that image into the editable text file.

It is a common method of digitizing printed text so that they can be electronically edited, searched, stored more compactly, displayed online and used in machine processes such as cognitive computing, machine learning and translation, Text-to-speech etc.

OCRs are of two types- For recognizing printed characters and for recognizing hand written text.

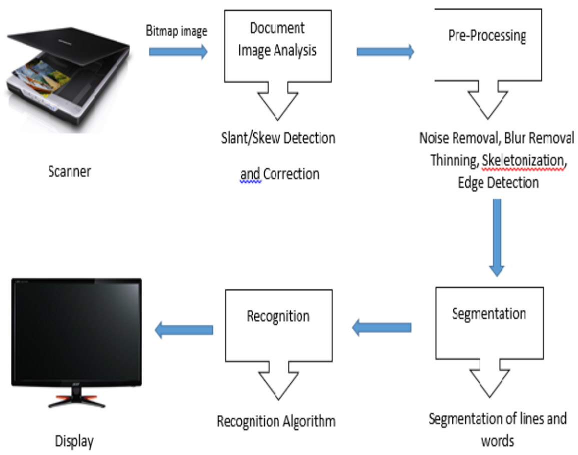


Fig -3: OCR Process Details

The process includes scanning, document image analysis (DIA), pre-processing, segmentation and recognition.

7. FLOW OF PROCESS

7.1. IMAGE CAPTURING

The first step is the one in which the document is placed under the camera and the camera captures an image of the placed document. The quality of the image captured will be high so as to have fast and clear recognition due to the high-resolution camera.

7.2. PRE-PROCESSING

The pre-processing stage consists of three steps: Skew Correction, Linearization, and Noise Removal. The captured image is checked for skewing. There are possibilities of the image getting skewed with either left or right orientation. Here the image is first brightened and binarized.

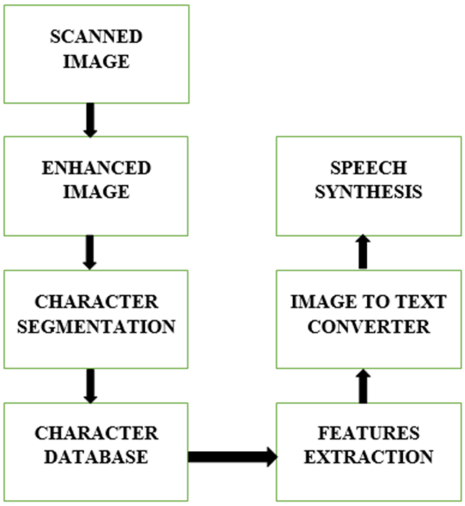


Fig -4: Flow of Process

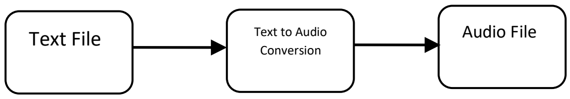
The function for skew detection checks for an angle of orientation between ±15 degrees and if detected then a simple image rotation is carried out till the lines match with the true horizontal axis, which produces a skew corrected image. The noise introduced during capturing or due to the poor quality of the page has to be cleared before further processing.

7.3. IMAGE TO TEXT CONVERTER

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.

7.4. 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.

8. PYTHON PROGRAMMING

Following are the windows of the programming used in this project.

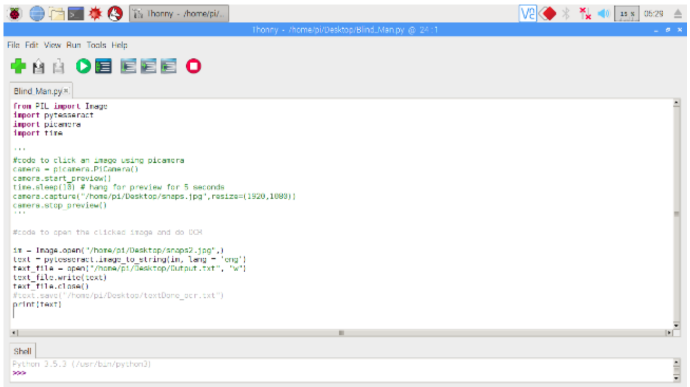


Fig -5: Running camera to click a picture

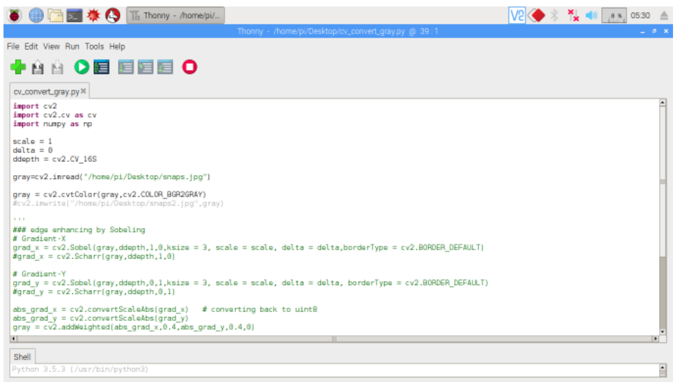


Fig -6: Using open CV library to enhance image

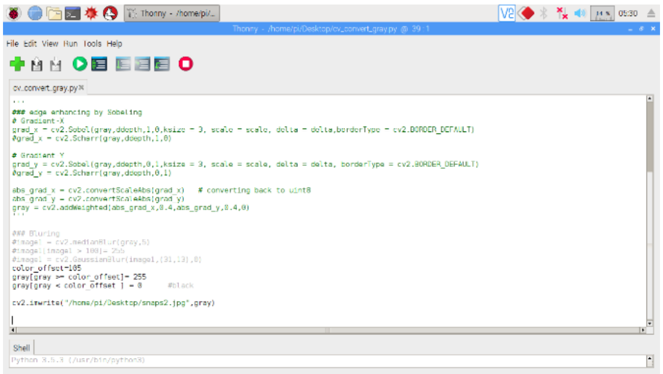


Fig -7: Using open CV library to enhance image

9. RESULT

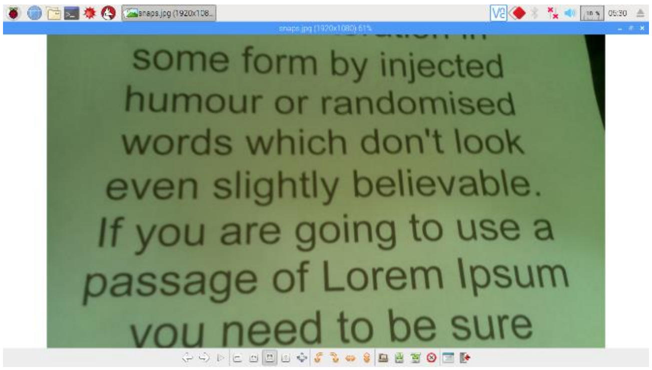


Fig -8: Clicked Image by Raspberry Pi camera

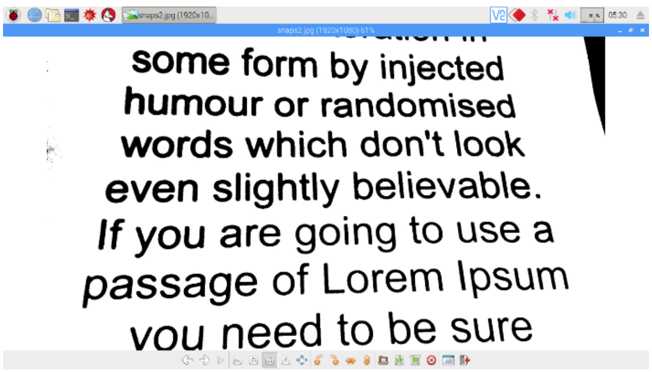


Fig -9: Enhanced Image with Open cv library

10. CONCLUSION

In this analysis, we've got represented a epitome system to scan written text and handheld objects for helping the blind individuals. To extract text regions from advanced backgrounds, we've got projected a completely unique text localization formula supported models of stroke orientation and edge distributions. The corresponding feature maps estimate the worldwide structural feature of text at each component. Block patterns project the projected feature maps of a picture patch into a feature vector. Adjacent character grouping is performed to calculate candidates of text patches ready for text classification. Associate degree Adaboost learning model is utilized to localize text in camera-based pictures. OCR is employed to perform word recognition on the localized text regions and rework into audio output for blind users. During this analysis, the camera acts as input for the paper. Because the Raspberry Pi board is high-powered the camera starts streaming. The streaming knowledge are going to be displayed on the screen victimization GUI application. Once the item for text reading is placed ahead of the camera then the capture button is clicked to produce image to the board. Using Tesseract library the image are going to be born-again into knowledge and also the knowledge detected from the image are going to be shown on the standing bar. The obtained knowledge are going to be pronounced through the ear phones using Text-to-speech synthesis.

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