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Smart Reader for Blind and Visually Impaired (BVI)

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***Abstract*- Visually impaired people cannot access the information which is in the printed format and hence the information is made available for them through a symbolized format like Braille. Though there are many existing solutions for the visually impaired our solution brings out a smart and autonomous system that assists by reading out the page along with page turning mechanism.**

The project presents integration of a complete text read out scheme with page turning mechanism and dictionary query feature. Smart reader consists of a web cam which has Raspberry pi as interface to accept the printed book producing an image document [2]. Once the image is pre-processed, OCR package connected in raspberry pi converts it into a digital text document. Finally, the text to speech conversion component of raspberry pi reads out the text through the speaker or headphone and it maintains the overall page turning mechanism and dictionary query.

***Keywords*- Blind and Visually Impaired (BVI), Optical Character Recognition (OCR), Text to Speech, Image to Text, Raspberry Pi, Open CV Library.**

I. INTRODUCTION

A visually impaired person cannot access the printed text easily which makes reading difficult. Reading is one of the main problems faced by blind and visually impaired people.

Although, they have Braille to grasp the information, with the help of Braille blind people can read out several information but the drawback of Braille is, if the person has mistaken to understand will bring about seek incorrect information [1]. Therefore, for a person in order to read out any printed book with ease we have developed a scheme which is cost efficient and informal to use. This system is developed in such a way that, all that the user has to do is place a book in front of the system and the system does the remaining tasks like reading out the text, turning the page after the text in the present page has been done reading [3]. It also helps the user in understanding the meaning of any word with the help of dictionary where the user interrupts the system and asks for the meaning of the word.

Below Table 1 represents the global(2010) estimate of the number of people who are visually impaired in terms of age.

TABLE 1: Survey of Blind and Visually Impaired people

Age (in years)	Population (millions)	Blind (millions)	Visually Impaired (millions)
0-14	1848.50	1.421	18.939
15-49	3458.2	5.784	80.248
50 and older	1340.80	32.16	186.203
All ages	6737.50	39.365	285.389

II. WORKING

The System consists of three main parts Input, Processing unit and the Output. The input for the smart reader is via the camera, microphone and the number keypad. The printed text is captured by the camera. The microphone is used for dictionary queries. The processing unit consists of the Raspberry Pi module [2]. The output consists of the speaker/headphone and the page turning implement. Through digitization process the printed text is captured by a camera which is then processed by the Optical Character engine. Character Recognition is made through Open Source Computer Vision libraries (Open CV).

The text is captured by a camera and the image is detected using the processor and then extracted using OCR [4]. The Text to Speech Conversion unit (TTSC) converts the extracted image into a speech signal. The converted audio signal is read out on the speaker.

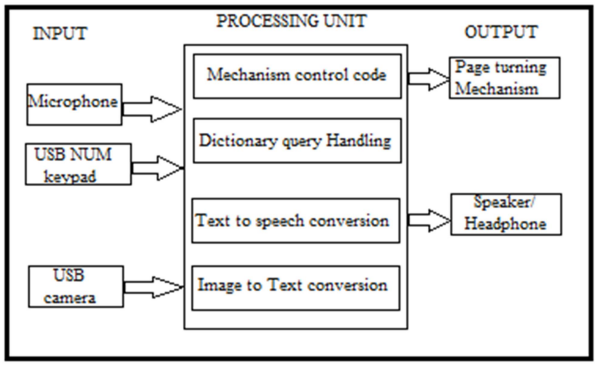

Fig 2.1: Block diagram of Smart Book Reader

III. COMPONENTS USED

3.1 Hardware Components:

1) *USB Camera* – as an input device for capturing the image of the book's page.
2) *Microphone* – as an input device for dictionary query feature.
3) *Push Buttons*- as an interrupt button for BVI user interaction.
4) *Raspberry Pi 3 (Model B)*– as a processing unit.
5) *Speaker/Headphone* – as an output device for listening to the speech output.
6) *Servo Motors* – as actuators for the roller wheel, lifter and turner arms.
7) *Microphone* – as an input device for dictionary query feature.
8) *Bench support* – a rectangular plywood for hosting the mechanism, Camera, and RPI system all together tightly.
9) *Book* - the main source of knowledge, for capturing image and turning mechanism.
10) *Monitor* – as a display device for Verification and Debugging.

3.1.1 USB Camera:

USB Camera is the main input device that feeds the processing unit with appropriate quality image. It is USB plug-n-play device that can be programmed through python Open CV library. It supports USB 2.0 protocol with mini USB port.

It's usually available as 2MP, 5MP, 8MP, 13MP, 25MP resolution camera.

The more the MP, more good the quality of an image and more is the accuracy of the converted text and ultimately the speech.

The camera is placed at certain height right above the page with the help of a host stand with a clip to clutch the camera. The stand is calibrated such that the camera captures clear image.

Fig 3.1. USB Camera

3.1.2 Microphone:

Microphone is an audio input device which converts sound signals into electrical signals. It does this transducing action with different technologies embedded in it like Condenser, Dynamic, Piezoelectric, Fibre optic.

Fig 3.2 Microphone

3.1.3 Push Buttons:

A push button is a mechanical switch which closes the switch when it is pressed and opens it on release. This action of opening and closing is the logic for reading input. Push buttons are most commonly used as interrupt buttons.

3.1.4 Raspberry Pi (RPi):

The heart and brain of the project design are best suited with Raspberry Pi3. It acts as a Microprocessor and Controller. Supports OS, programmable GPIO pin out.

Processor – An SoC of Broadcom BCM2387 chipset with 1.2GHz clock speed, Quad-Core ARM.

GPU – Dual Core Video Core IV® Multimedia Co-Processor.

Memory – 1GB LPDDR2 DRAM

Operating System – The pi boots from Micro SD card, running a Debian based OS like Raspbian,

Power – The Pi can be easily powered up using micro USB socket 5V, 2.5A
GPIO – The Pi comes with 40-pin expansion headers arranged as 2x20 strip, providing 27 GPIO pins as well as +3.3 V, +5 V and GND supply lines.

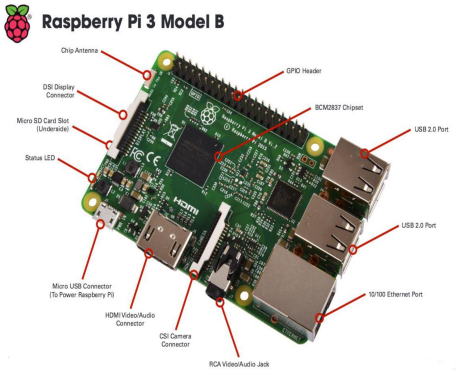

Fig 3.3 Raspberry Pi

3.2 Programming Modules:
The raspberry pi is instructed through Python 2.7 programming platform. The various modules installed on Python are:

1) Open CV library –for image capture and pre processing
2) Google Cloud Vision API or Python-Tesseract– Image to Text conversion engine.
3) GTTS – Google Text To Speech conversion engine.
4) Python-VLC – sound player.
5) Py Dictionary – for dictionary query feature.
6) Speech Recognition – for speech to text conversion

IV. FLOW OF PROCESS:

4.1.1 Image Acquisition:
The image of the printed text which is placed in front of the device is captured by the inherent camera. The high resolution camera used in the device produces high quality image for clear recognition [8]

4.1.2 Image Enhancement:
It removes the unwanted noise present in the captured image before further processing and adjusts the captured image so that the results are more suitable for display.

4.1.3 Character Segmentation:
After image enhancement, the processed image is sent to the subsequent phase that is segmentation. In this phase the images are converted into sub images of exclusive characters [7].

4.1.4 Feature Extraction:
Feature extraction helps in extracting the related information from the input data in order to analyse the feature matching. In this the task of classifying the pattern is made easy by considering individual image glyph for extracting the features [8]. Some of the attributes which define the Character glyph are: Height, width and Number of horizontal and vertical lines present in the character. This method is parallel to Edge orientation histograms.

4.1.5 Recognition of optical Character:
Recognition of Character is the last part of the extraction process. In this stage the binary text is converted to ASCII text.

4.1.6 Image to Text conversion:
By using a USB camera, image is captured and stored on the Raspberry Pi. This image then undergoes pre-processing. After pre-processing, the text from the image is extracted and pasted in a text document [3].

4.1.7 Text to Speech conversion:
This is done by an API called Google text to speech. This API takes in the input as a text and gives the output in the form of an audio file. This audio file is later saved as .mp3 or .m4a or any other format.

This .mp3 image is first converted into text document and this text is later converted into speech. The audio file is played with the help of an audio player, such as VLC player [5].

4.1.8 Dictionary Query:
This feature helps in providing the meaning of a given word to the user. The user interrupts the system by pressing a button and speaking a word into the microphone. The system then takes in the word and converts this into text and send this text over to Web Note to fetch the meaning which is handled by Py-Dictionary Module. This meaning is placed in a text document. This text is again converted into speech and read aloud. After this the system resumes the previous task.

4.1.9 Page turning mechanism:

The Page Turning mechanism is an Electro-Mechanical System to turn the page of the book when user requests.[6]

It involves three main components:

- Roller Wheel
- Lifter Arm
- Turner Arm

All are actuated by Servo motor and controlled by Raspberry Pi.

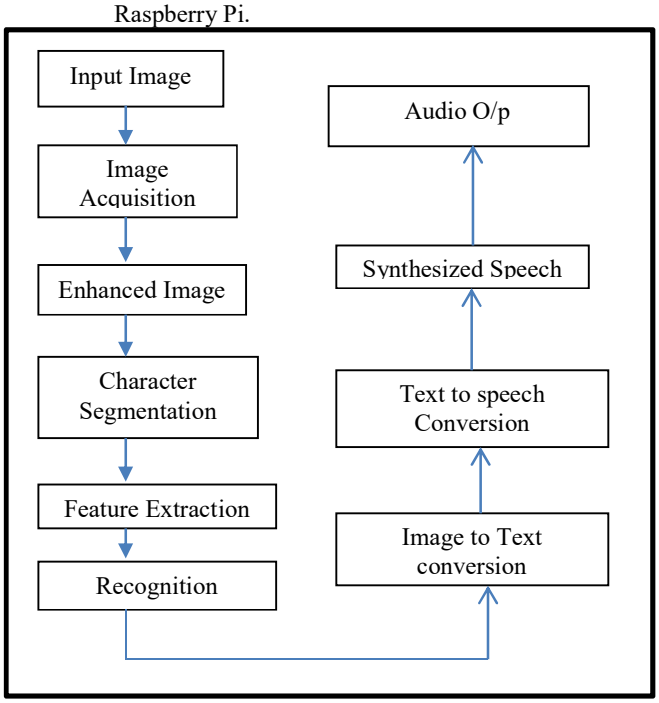

Fig 4.1 Flow of Process

V. FUTURE SCOPE

In future, this system can be extended to support language other than English. The system can provide the bookmark feature. If the user feels any sentences or paragraphs important, he/she can save them and keep them for ease of access. If the user wants to navigate to a particular page number, the system should actuate page turning mechanism to go to that particular page.

VI. CONCLUSION

Here we propose a new idea where the system provides autonomous page turning mechanism and interactive dictionary querying feature, ultimately giving a feel of comfort for BVI. Once developed it can act as a perfect personal device for the user. The system even finds small applications in Schools, Libraries etc.

VII. REFERENCES:

[1]. Zafar Iqbal M., Sojib N, "Single cell Bangla braille book reader for visually impaired people": *International conference on Bangla speech and language processing*; 2018. P. 1–5

[2]. Sharma S, Bhat D, Hegde NR, Yajnesh AP, Mythri D. Drusti – "A smart reader for visually impaired people". *Int J Eng Res Technol.* 2018*;6(15)*:1–4.

[3]. Muthusenthil B, Kishore S, Joshuva J, Narendiran K, "Smart assistance for blind people using raspberry pi". *Int J Adv Res Ideas Innov Technol.* 2018;*4(2):1–8.*

[4]. Monisha M ,James SA, Sanjana S, , "OCR based automatic book reader for the visually impaired using raspberry pi". *Comput Commun Eng.* 2016;*4(7):1–8*

[5]. Navya Pant, Ayushi ,Trivedi Pinal Shah, Simran Sonik and Supriya Agrawal, "Speech to text and text to speech recognition systems", *IOSR Journal of Computer Engineering , Volume 20, Issue 2, Ver. I (Mar.- Apr. 2018), PP 36-43*

[6]. Junseok Lee, Wonseok Jeon, Youngsu Cha and Hyunseok Yang, "Automatic Page Turning Mechanism with Near-Field Electro adhesive force for Linearly Correctable Imaging", *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) September 24-28, 2017.*

[7]. Mr. Vaibhav V. Govekar and Meenakshi A, "A Smart Reader for Blind People", *International Journal of Science Technology & Engineering, Volume 5, Issue 1,* 2018.

[8]. L Latha,V Geethani, M Divyadarshini, P Thangam, " A Smart Reader for Blind People*"*, *International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-8, Issue-6S3,* 2019.