Braille Assist- A Low Cost Text to Braille converter with Refreshable Display

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Abstract—The braille system of encoding letters and numbers into an arrangement of up to six raised dots was devised back in the 1800s and has since been the method taught to visually impaired people. The Braille version of books is printed using special equipment which embosses the braille dots onto the paper. However, it's estimated that less than one percent of the books have a braille version. Also, the printing process being slower and more expensive than traditional printing naturally raises the price of braille books. Braille Assist is a text to braille scanner along with a unique low-cost refreshable braille display. The display generates all Braille characters by a sliding mechanism. It requires extremely low power, just to carry out linear sliding of the sliders making them far cheaper than all its counterparts. Braille Assist aims to make a visually challenged person more self-reliant as he or she doesn't have to depend on any person when they feel like reading a book of their choice.

Index Terms—Braille, Blind, Tesseract

Fig. 1. Bulky braille book

I. INTRODUCTION

Living life easy with eyes closed. It is obvious that this thought which has paved the way for a scrutiny of various technologies that can provide ways of reading for the blind which is often enough for them to visualize things. Of the 37 million people across the globe who are totally blind, over 15 million are from India, a situation that has left us crestfallen[1]. According to this statistic the visually impaired people cannot be ignored and remain stolid as they form a major part of our population. Anyway, there is no doubt that most o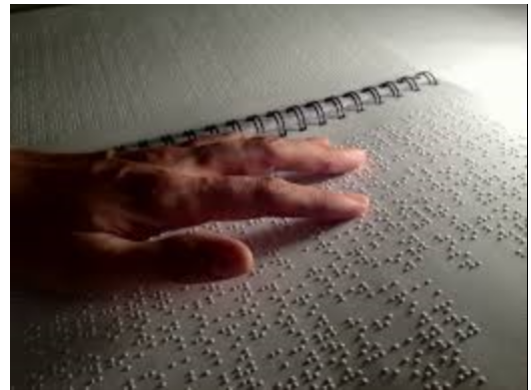f them are self-sufficient enough and Visual impairments have not imparted much restrictions in their path of learning as we have people like Helen Keller standing forefront in the worldly quest of success. However, the increasing percentage of blind have always left the question of how to improve their mode of accessing information. It had been revealed that Brain circuits which normally handle information from the eye can switch gears to tactile receptibility in visually impaired people which further accelerated the researches behind Braille devices but the fact that braille display technology has not changed significantly for 35 years is astonishing while the interaction

paradigms for personal computing is continually subjected to changes. The commercially available braille displays are
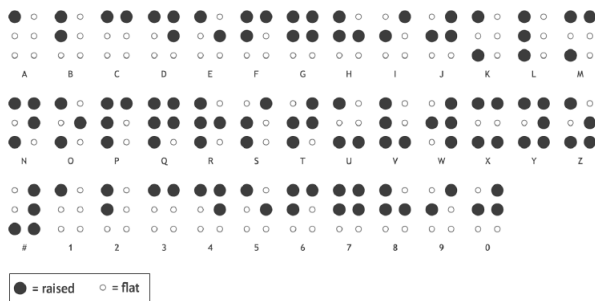

Fig. 2. Braille cells for the English alphabet

very expensive making them only accessible to the elite sections of the society. This project aims to remove that very constraint. [2]Developing of a Braille Display is no more a new technology but the wide variety of ways the braille display can be implemented is still a credible factor to be explored. Braille Assist proposed here is a system consisting of small motors and sliders to create braille display and with the integration of camera, a new world of possibilities have opened up because it enables the visually impaired to read any book they find.

II. SOFTWARE

A. Tesseract

The system utilizes Googles open source Optical Character Recognition (OCR) engine, which is a free to use and modify software package that allows the acquisition of text from images.[5] The system currently supports only English text, but it can be expanded to other languages as well.Tesseract is an Optical Character Recognition (OCR) engine for various operating systems. It is a free software, released under the Apache License, Version 2.0 and development has been sponsored by Google since 2006. It has been considered as one of the most accurate OCR engine.Since Tesseract scans the image pixel by pixel, reading an image with an average character height above 20 pixels will increase computation time. This step also helps eliminating one major flaw of Tesseract, where the OCR accuracy drops for characters below a height of 20 pixels.Binarization is the process of conversion of an image to black and white. The high contrast between the background and the characters make OCR more accurate. The process of binarization is done through thresholding the color image. There are two types of thresholding, one is global thresholding and the other being adaptive thresholding. Thresholding changes the pixel color value to a minimum if it is below a threshold or to a maximum if it is above the threshold value .Using this techniques efficiency of tesseract can be increased.

B. Raspberry Pi

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It is capable of doing everything expected from a desktop computer, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games. It has the ability to interact with the outside world, and has been used in a wide array of digital maker projects. It can enable controlling of motors and sensors. Since it supports python , tesseract can be integrated into raspberry pi . Camera module gives the image which is processed by raspberri pi using tesseract. 'pitesseract' is the module used for importing tesseract to python.

III. HARDWARE

A. Camera Module

Fig. 3. Camera Module

The Camera Module can be used to take high-definition video, as well as still photographs. It has a 5 megapixel native resolution sensor-capable of taking 2592 x 1944 pixel static images. Camera is supported in the latest version of Raspbian, Raspberry Pi's preferred operating system. Picture is taken by a push button. It is analyzed by tesseract.
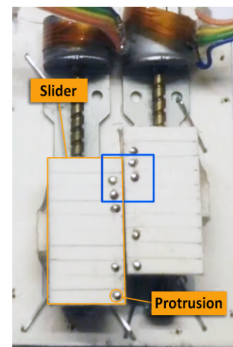
B. Stepper Motor

Fig. 4. Motor slider mechanism

Stepper motor can transform electric pulse into angular displacement. The angular displacement can be controlled by controlling the pulse number to achieve purpose of positioning accurately. In meantime, the rotational velocity and acceleration of motor can be controlled by controlling the pulse frequency to achieve the purpose of speed control. The rotational motion of stepper motor is transformed into linear motion by a rack and pinion gear. Slider is attached to this gear system

IV. WORKING PRINCIPLE

Camera is activated by push-button. Image is then processed in raspberry pi. After noise removal and thresholding, it is converted to text file with the help of tesseract and optical character recognition. First the captured image is enhanced.
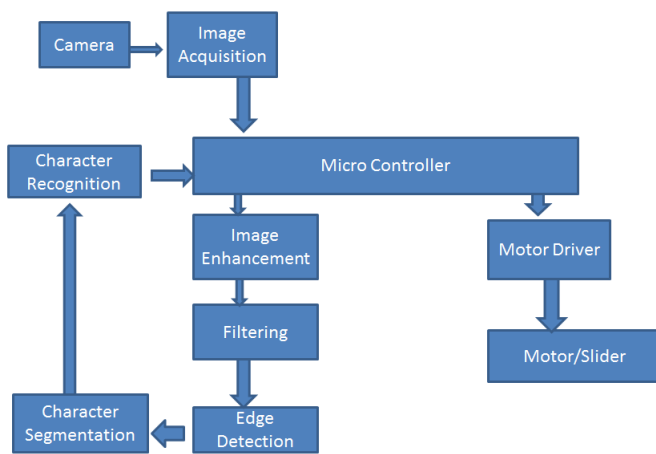
Fig. 5. Block diagram

Then it is filtered for noise. After the noise has been smoothed out, the process of thresholding takes place where each pixel is compared to a threshold value and the pixel is set to maximum colour if its above the threshold else its set to minimum colour. After this the edges are detected and characters are segmented. Segmented characters are recognized by the micro controller which will then give commands to motor drivers to rotate the slider. Sliders are moved to generate desired alphabet. The combination of the sliders is displayed in the slot where the visually impaired person can touch. The slider has 11 sections and each section contains a dot or a blank space in a particular design. Any letter can be created by the combination of the sliders by adjusting their position. The slider is attached to motor and each letter will require two sliders

OPTICAL CHARACTER RECOGNITION (OCR) -SIMULATION

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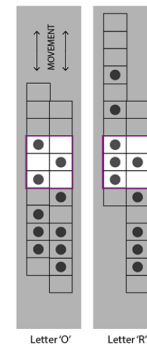
Fig. 6. Pattern displayed through slot

A. Drawbacks of the Tesseract Engine

Tesseract works just fine if the input image that is given to it is free from any kind of background noise. An example is shown in Fig. 7. This figure shown above is fairly clear and

Fig. 7. Input image with no background noise to Tesseract

free from any background noise. When we apply Tesseract OCR to Fig.7, the tesseract engine worked just fine. Now input

Fig. 8. Output of Fig.7

an image with a noisy background as shown in Fig.9. The output is shown in Fig. 10

Fig. 9. Input image with noisy background

B. Image Processing Using Python

1) Text Region Extraction: In order to extract the text regions, a document populated with words is shrunk to the level where the spaces between words become negligible. Thus when finding contours, only one contour encompassing all the words is obtained, and the unnecessary area around the paragraph can be cropped.
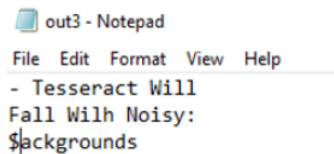
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out3 - Notepad
File  Edit  Format  View  Help
- Tesseract Will
Fall Wilh Noisy:
$ackgrounds
```

Fig. 10. Output of Fig.9

2) Image Resizing: Since Tesseract scans the image pixel by pixel, reading an image with an average character height above 20 pixels will increase computation time. This step also helps eliminating one major flaw of Tesseract, where the OCR accuracy drops for characters below a height of 20 pixels.

3) Binarization And Denoise: Binarization is the process of conversion of an image to black and white. The high contrast between the background and the characters make OCR more accurate. The process of binarization is done through thresholding the color image. There are two types of thresholding, one is global thresholding and the other being adaptive thresholding. Thresholding changes the pixel color value to a minimum if it is below a threshold or to a maximum if it is above the threshold value.

CONCLUSION

Even if there are many refreshable braille display available in the market, they are extremely costly. They use expensive machinery that are difficult to repair and replace. Motor based slider display can effectively provide a solution for this problem. Even though they are little bulkier than piezoelectric based displays, it is more cheaper to manufacture and to maintain thereby making it affordable to all sections of the society. A large scale production model can be made with much compact motors and specially designed sliders. This will make design further compact, light and very affordable when compared to other display methods. By integrating camera and push-buttons to the system, device is made more useful for the visually impaired people.

ACKNOWLEDGMENT

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