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Smart Assistance for Blind People using Raspberry Pi

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ABSTRACT

This paper addresses the integration of a complete Text Read-out system designed for the visually challenged. The system consists of a webcam interfaced with raspberry pi which accepts a page of printed text. The OCR (Optical Character Recognition) package installed in raspberry pi scans it into a digital document which is then subjected to skew correction, segmentation, before feature extraction to perform classification. Once classified, the text is readout by a text to speech conversion unit (TTS engine) installed in raspberry pi. The output is fed to an audio amplifier before it is read out. The simulation is just an initiation of image processing i.e. the image to text conversion and text to speech conversion done by the OCR software installed in raspberry pi. The system finds interesting applications in libraries, auditoriums, offices where instructions and notices are to be read and also in the assisted filling of application forms.By using ultrasonic sensor we will measure the distance between the blind people and obstacle then the distance will be played through ear phones.

Keyword: *Raspberry Pi, Web Cam, Optical Character Recognition, Text to Speech Engine, Audio Amplifier.*

1. INTRODUCTION

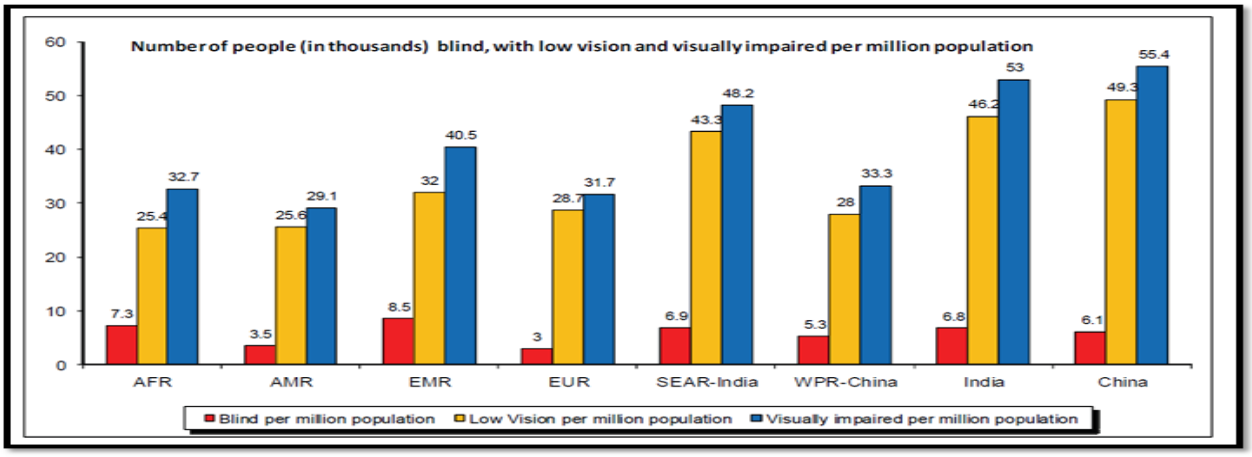
Visually impaired people report numerous difficulties with accessing printed text using existing technology, including problems with alignment, focus, accuracy, mobility, and efficiency. We present a smart device that assists the visually impaired which effectively and efficiently reads the paper-printed text. The proposed project uses the methodology of a camera based assistive device that can be used by people to read Text document. The framework is for implementing image capturing technique in an embedded system based on Raspberry Pi board. The design is motivated by preliminary studies with visually impaired people, and it is small-scale and mobile, which enables a more manageable operation with little setup. In this project, we have proposed a text read out a system for the visually challenged. The proposed fully integrated system has a camera as an input device to feed the printed text document for digitization and the scanned document is processed by a software module the OCR (optical character recognition engine). A methodology is implemented to the recognition sequence of characters and the line of reading. As part of the software development, the Open CV (Open source Computer Vision) libraries are utilized to do image capture of text, to do the character recognition. Most of the access technology tools built for people with blindness and limited vision are built on the two basic building blocks of OCR software and Text-to-Speech (TTS) engines. Optical character recognition (OCR) is the translation of captured images of printed text into machine-encoded text. OCR is a process which associates a symbolic meaning with objects (letters, symbols an number) with the image of a character.

It is defined as the process of converting scanned images of machine printed into a computer process able format. Optical Character recognition is also useful for visually impaired people who cannot read Text document, but need to access the content of the Text documents. Optical Character recognition is used to digitize and reproduce texts that have been produced with the non-computerized system. Digitizing texts also helps reduce storage space. Editing and Reprinting of a Text document that was printed on paper are time-consuming and labour intensive. It is widely used to convert books and documents into electronic files for use in storage and document analysis. OCR makes it possible to apply techniques such as machine translation, text-to-speech and text mining to the

capture / scanned page.The final recognized text document is fed to the output devices depending on the choice of the user. The output device can be a headset connected to the raspberry pi or a speaker which can spell out the text document loud.

SURVEY OF BLIND PEOPLE

Worldwide Blindness Statistics:



Global estimate of the number of people visually impaired by age, for all ages in parenthesis the corresponding prevalence (%)

Ages (in years)	Population (millions)	Blind (millions)	Low vision (millions)	Visually impaired (millions)
0-14	1,848.50	1.421	17.518	18.939
15-49	3548.2	5.784	74.463	80.248
50 and older	1,340.80	32.16	154.043	186.203
All ages	6,737.50	39.365(0.58)	246.024(3.65)	285.389(4.24)

2. LITERATURE SURVEY

Ray Kurzweil et.al [1] proposes A K-Reader Mobile number of portable reading assistants are designed specifically for the visually impaired. “K-Reader Mobile” is a mobile application which allows the user to read mail, receipts, fliers, and many other document.But these systems/ devices fail to give an economic solution to the problem and are available on specific platforms.

AthiraPanicker et.al [2] proposes smart shopping assistant label reading system with voice output for blind using raspberry pi.— This project aims at The document to be read must be nearly flat, placed on a clear, dark surface and contain mostly black text printed on white background and it does not read from complex backgrounds.

MarutTripathi et.al [3] proposes A Navigation System for blind people to navigate safely and quickly, in the system obstacle detection and recognition is done through ultrasonic sensors and USB camera. This system detects the obstacles up to 300 cm via ultrasonic sensors and sends feedback in the form of beep sound via earphone to inform the person about the obstacle.

DimitriosDakopoulos et.al [4] proposes A Wearable Obstacle Avoidance Electronic Travel Aids for Blind that presents a comparative survey among portable/wearable obstacle detection/avoidance systems (a subcategory of ETAs) in an effort to inform the research community and users about the capabilities of these systems and about the progress in assistive technology for visually impaired people.

X.Chen et.al [5] proposes Automatic detection and recognition of signs from natural scenes we present an approach to automatic detection and recognition of signs from natural scenes and its application to a sign translation task. We have applied the approach in developing a Chinese sign translation system, which can automatically detect and recognize Chinese signs as input from a camera, and translate the recognized text into English but its only work in Chinese language.

William A. Ainsworth [6] proposes a system for converting English text into speech the feasibility of converting English text into speech using an inexpensive computer and a small amount of stored data has been investigated but it’s not suitable for all memory range of computers.

ZoranZivkovic et.al [7] proposes Improved Adaptive Gaussian Mixture Model for Background Subtraction Background subtraction is a common computer vision task. We analyze the usual pixel-level approach. We develop an efficient adaptive algorithm using Gaussian mixture probability density. Recursive equations are used to constantly update the parameters and but also to simultaneously select the appropriate number of components for each pixel.

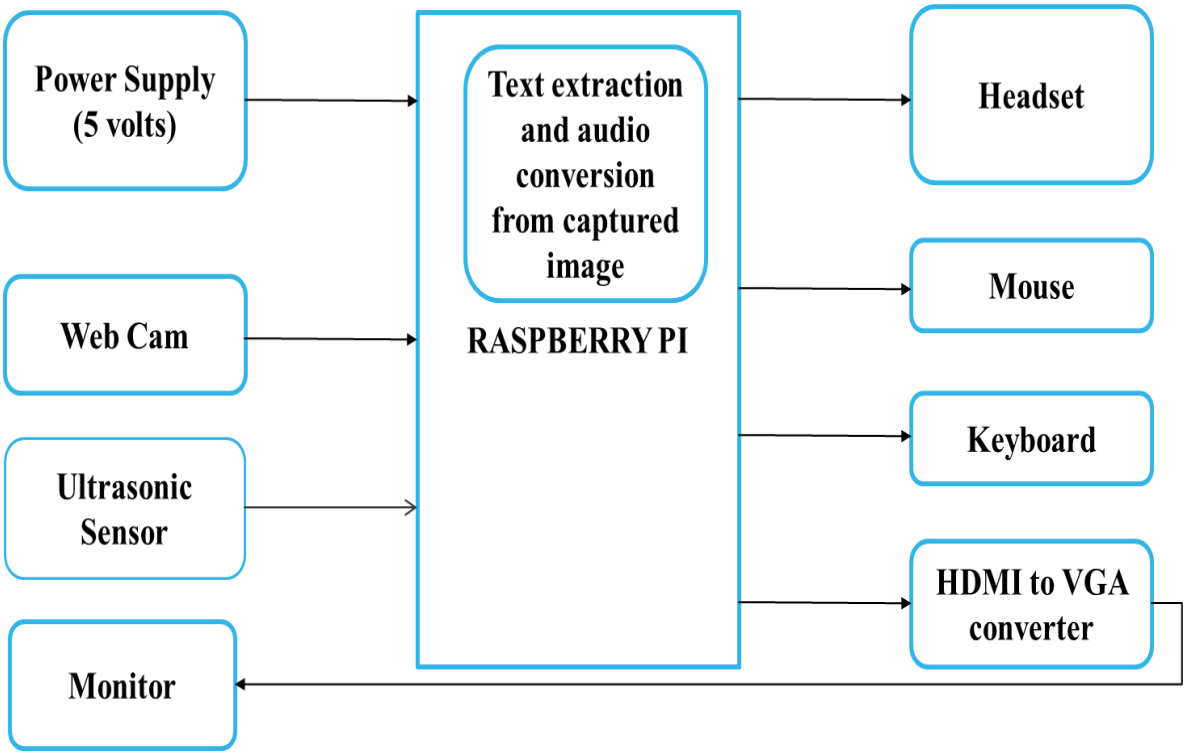
S. B. Shrote et.al [8] proposes Assistive Translator for Deaf & Dumb People Communications between deaf-mute and a normal person have always been a challenging task. The project aims to facilitate people by means of a glove-based deaf-mute communication interpreter system.

Michael McEnancy et.al [9] Finger Reader Is audio reading gadget for Index Finger We present a finger-worn device that assists the visually impaired with effectively and efficiently reading the paper-printed text. But the blind people can't aim the letters accurately.

Vasanthi.G et.al [10] proposes Vision Based Assistive System for Label Detection with Voice Output. A camera-based assistive text reading framework to help blind persons read text labels and product packaging from a hand-held object in their daily resides are proposed.

3. BLOCK DIAGRAM OF PROPOSED METHOD

The framework of the proposed project is the raspberry pi board. The raspberry pi B+ is a single board computer which has 4 USB ports, an Ethernet port for internet connection, 40 GPIO pins for input/ output, CSI camera interface, HDMI port, DSI display interface, SOC (system on a chip), LAN controller, SD card slot, audio jack, and RCA video socket and 5V micro USB connector.



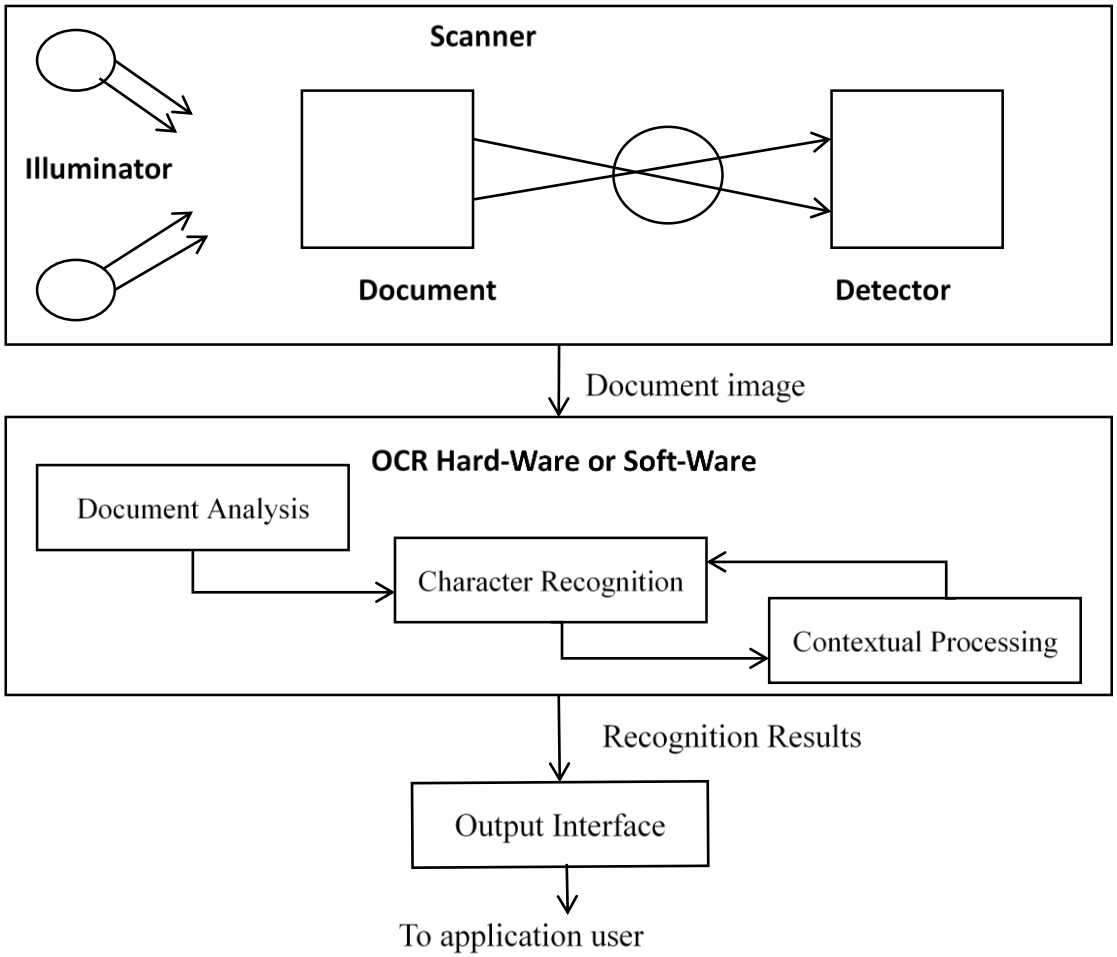
Block Diagram

The power supply is given to the 5V micro USB connector of raspberry pi through the Switched Mode Power Supply (SMPS). The SMPS converts the 230V AC supply to 5V DC. The web camera is connected to the USB port of raspberry pi. The raspberry pi has an OS named RASPION which process the conversions. The audio output is taken from the audio jack of the raspberry pi. The converted speech output is amplified using an audio amplifier. The Internet is connected to the Ethernet port in raspberry pi. The page to be read is placed on a base and the camera is focused to capture the image. The captured image is processed by the OCR software installed in raspberry pi. The captured image is converted to text by the software. The text is converted into speech by the TTS engine. The final output is given to the audio amplifier from which it is connected to the speaker. Speaker can also be replaced by a headphone for convenience.

ARCHITECTURE OF THE PROPOSED SYSTEM

The Architecture of the optical character recognition system on a grid infrastructure consists of the three main components. They are:-

- Scanner
- OCR Hardware or Software
- Output Interface



OCR Architecture

The image to text and text to speech conversion is done by the OCR software installed in raspberry pi. The conversion which is done in OCR.

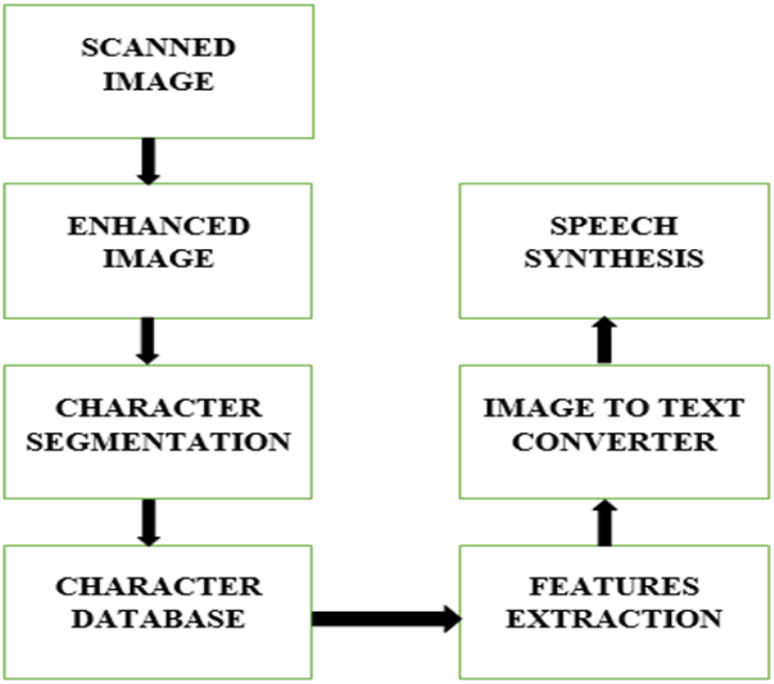
4. FLOW OF PROCESS

4.1 Image Capturing

The first step in which the device is moved over the printed page and the inbuilt camera captures the images of the text. The quality of the image captured will be high so as to have fast and clear recognition due to the high-resolution camera.

4.2 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.

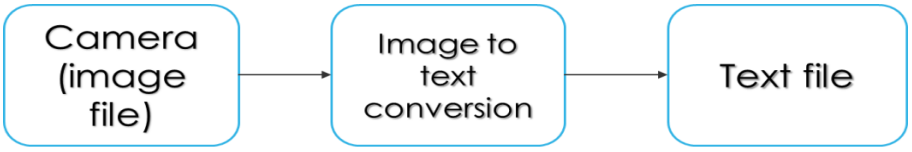


FLOW OF PROCESS

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.

4.3 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.



In order for OCR to be effective, it must support a wide array of file formats, including PDF, BMP, TIFF, JPEG, and PNG files. Once the file is loaded, the software can begin to work. These files can be scanned documents, photographs, or even read-only files. Regardless of the original format, OCR software will transform these files into easily accessible & editable data.

4.4 Ultrasonic Signal to Text Converter

The transmitter emits 8 bursts of a directional 40 KHz ultrasonic wave when triggered and starts a timer. Ultrasonic pulses travel outward until they encounter an object, the object causes the wave to be reflected back towards the unit. The ultrasonic receiver would detect the reflected wave and stop the stop timer. The velocity of the ultrasonic burst is 340m/sec in air. Based on the number of counts by the timer, the distance can be calculated between the object and transmitter. 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.

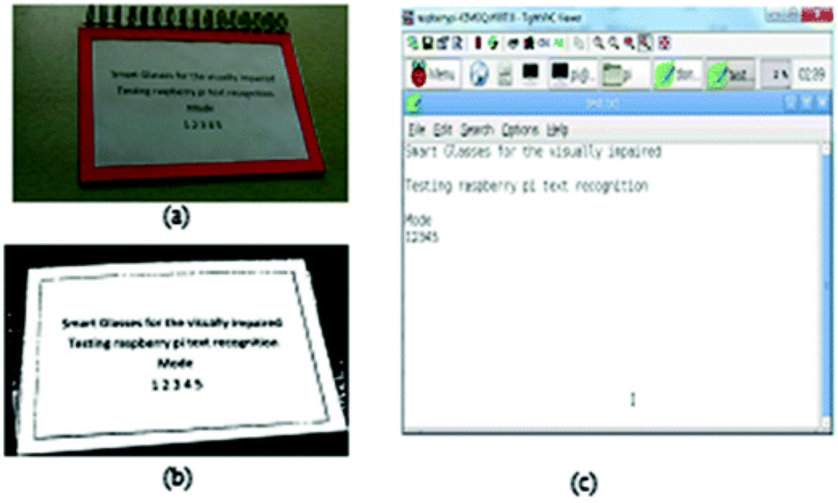
4.5 Text To Speech

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. Two options for attaching a microphone into Raspberry Pi. One is to have USB mic, another to have an external USB sound card.

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.

5. RESULT

Hardware setup



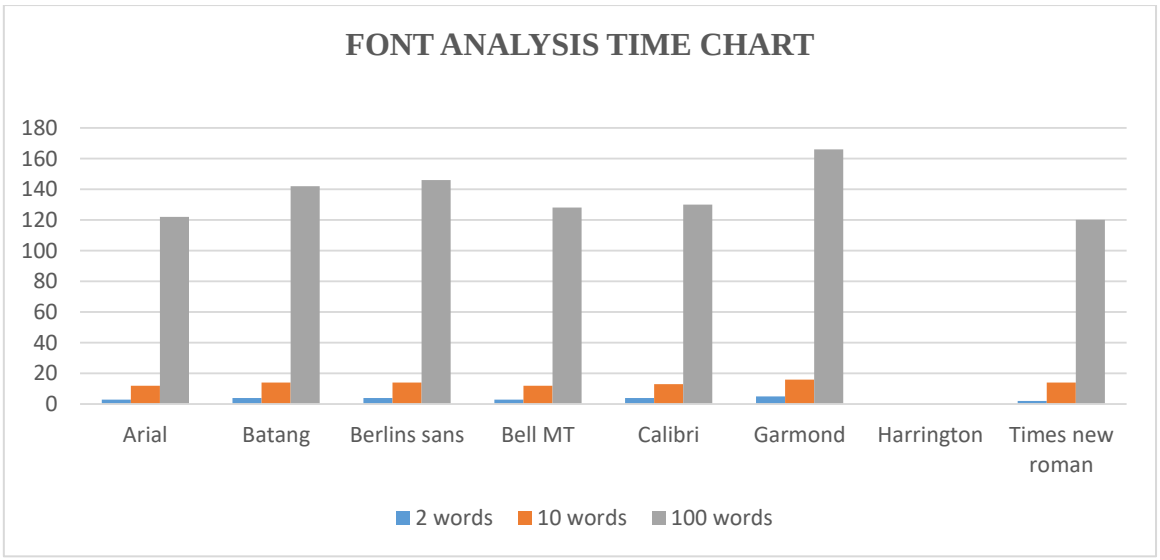
Audio Output

The webcam captures image from a given picture and the text from the captured image is converted into an audio output using Raspberry Pi.And also we measure the distance of the object using the ultrasonic sensor.Both outputs are heard in an audio.

RESULT ANALYSIS

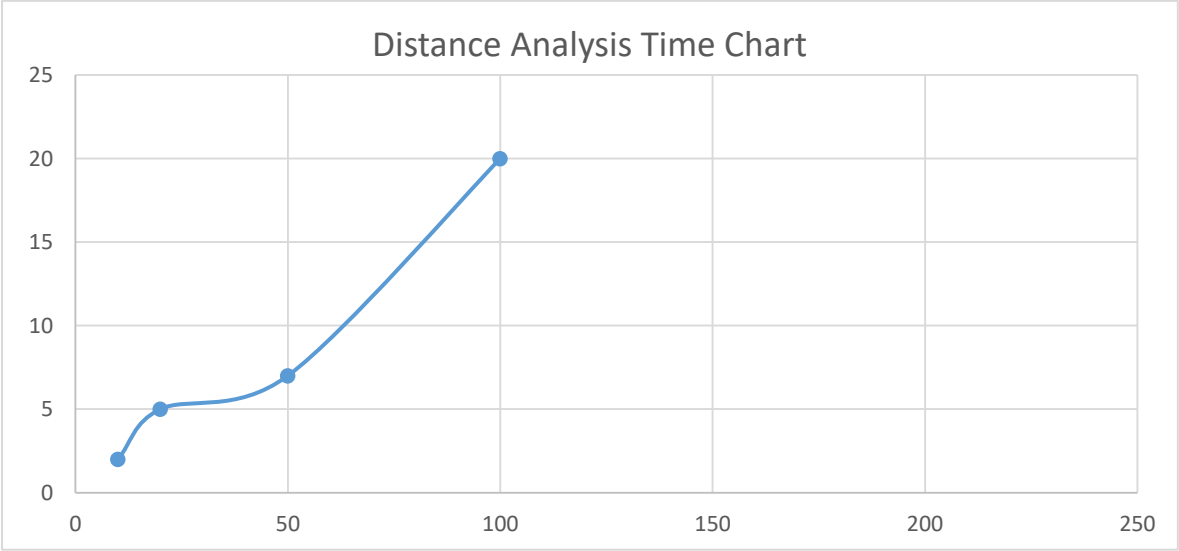
TYPE OF FONT	DURATION TO READ (SEC)		
	2 words	10 words	100 words
Arial	3	12	122
Batang	4	14	142
Berlin sans	4	14	146
Bell MT	3	12	128
Calibri	4	13	130
Garmond	5	16	166
Harrington	Can't recognize		
Times new roman	2	14	120

Font Analysis Time Chart



DISTANCE (CM)	DURATION (SEC)
10	**2**
20	**5**
50	**7**
100	**20**
200	**-**

Distance Analysis Time Chart



6. CONCLUSION

We have implemented an image to speech conversion technique using a raspberry pi. The simulation results have been successfully verified and the hardware output has been tested using different samples. Our algorithm successfully processes the image and reads it out clearly. This is an economical as well as an efficient device for the visually impaired people. We have applied our algorithm to many images and found that it successfully does its conversion. The device is compact and helpful to the society.

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