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# Text Reader for Blinds and Visually Impaired

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**ABSTRACT**: According to the World Health organization (WHO), 2.2 billion people are estimated to be visually impaired worldwide, among which 90% live in developing countries and 41.9 million are blind individuals worldwide. Numerous researchers have worked on developing a mechanism that allows blind people to read the written, typed or printed text. In particular, there is a need for a portable text reader that is affordable and readily available to the blinds and visually impaired community. We proposed a system which facilitates the visually impaired people by converting the text into voice signal based on raspberry pi.

This project proposes a smart reader for visually challenged people using Raspberry Pi. The project addresses the take input, integration of a complete Text Read-out system designed for the visually challenged. The system consists of a camera 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. Once it is scanned, the text is read out 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 image to text conversion and text to speech conversion is done by the OCR software installed in Raspberry Pi. The system finds its interesting applications in libraries, auditoriums, offices where instructions and notices are to be read

**KEYWORDS**: Image processing, Blinds and visually impaired people, Optical Character Recognition, Raspberry pi model b+, Raspberry Pi camera Module 2.

## I. INTRODUCTION

An Embedded System is a combination of computer hardware and software, perhaps additional mechanical parts, designed to perform a specific function. An embedded system is a micro-processor based, software driven, reliable, real-time control system, autonomous, human network interactive, operating on diverse physical variables in diverse environments sold into a competitive and cost-conscious market. A smart device that assists the visually impaired which effectively and efficiently reads paper printed text. The recent development trends in computer vision, digital cameras, and portable computers make it feasible to assist these individuals by developing camera-based products that combine computer vision technology with other existing commercial products such OCR systems. Accessing and reading text documents is troublesome for visually impaired people in many situations.

In this project the goal is to allow blind and visually impaired users to capture printed text images and receive speech output in real-time. The development of such systems requires the usage of two technologies that are central to these systems, namely optical character recognition for Text Information Extraction (TIE) and Text-To-Speech (TTS) to convert this text to speech.

Text Information Extraction is the primary and important function of any assistive reading system and is an integral part of OCR because this process determines the intelligibility of the output speech. Recent developments in computer vision, digital cameras, and computers make it possible by developing camera-based products that merges with computer vision technology with other existing beneficial products such as optical character recognition systems. OCR is used to recognize words. It can recognize characters, words and sentences without any mistakes. OCR has a high rate of recognition which is the electronic conversion of photographed images of typewritten or printed text into computer-readable text.

Text-To-Speech (TTS) synthesizer is a computer-based system that should be able to read any text aloud, when it is directly introduced in the computer by an operator. It is more suitable to define Text-To-Speech or Speech-To-Text.

Learners with visual impairment are a heterogeneous group with varied nature of difficulties in reading and learning the content from the book, that require a flawless reading and aid in order to achieve good academic performance when placedin regular or main stream institutions. It is also found that in the field of education and employment, the visually impaired people are finding very difficult to survive. In order to eradicate this problem in the society, we have proposed a product that would help them read the captured image in the form of audio output. It can also be used by the normal person to read a huge document in a short span of time. So such systems integrate optical character recognition (OCR) software to offer the function of scanning and recognition of text and some have integrated voice output.

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## II. RELATED WORK

The literature survey has been carried out to study the projects and researches previously performed on the same topic. We have found many related researches and chose the below five papers that motivated us to do the project.

1.T. Rubesh Kumar [1] proposed reading is obviously essential in today's society. Printed text is everywhere in the form of reports, receipts, bank statements. There are already a few systems that have some promise for portable use, but they cannot handle product labeling. But a big limitation is that it is very hard for blind users to find the position of the bar code and to correctly point the bar code reader at the bar code [1]. T.Rubesh Kumar, C.Purnima have proposed a camera-based assistive text reading framework to help blind persons read text labels and product packaging from hand-held objects in their daily lives. Main contributions embodied in this prototype system are: 1) A novel motion-based algorithm to solve the aiming problem for blind users by their simply shaking the object of interest for a brief period; 2) A novel algorithm of automatic text localization to extract text regions from complex background and multiple text patterns; and 3) A portable camera-based assistive framework to aid blind persons reading text from hand-held objects.

2.Pooja Sharma [2] proposed Blindness is a state of lacking the visual perception due to physiological or neurological factors. In this proposed work by Pooja Sharma, Mrs. Shimi S. L. and Dr. S. Chatterji, a simple, cheap, friendly user, virtual eye will be designed and implemented to improve the mobility of both blind and visually impaired people in a specific area [2]. The proposed work includes a wearable equipment consists of head hat, mini hand stick and foot shoes to help the blind person to navigate alonesafely and to avoid any obstacles that may be encountered, whether fixed or mobile, to prevent any possible accident. The main component of this system is the ultrasonic sensor which is used to scan a predetermined area around blind by emitting-reflecting waves. The reflected signals received from the barrier objects are used as inputs to Arduino microcontroller. The microcontroller carries out the issued commands and then communicate the status of a given appliance or device back to the earphones using Raspberry pi speech synthesizer. The proposed system is cheap, fast, and easy to use and an innovative affordable solution to blind and visually impaired people in third world countries.

3.Anusha Bhargava [3] proposed Majority of the visually impaired use Braille for reading documents and books which are difficult to make and less readily available. This gives rise to the need for the development of devices that could bring relief to the agonizing tasks that the visually impaired has to go through says Anusha Bhargava, Karthik V. Nath, Pritish Sachdeva and MonilSamuel. This project aims to study the image recognition technology with speech synthesis and to develop a cost-effective, user-friendly image to speech conversion system with help of Raspberry Pi [3]. The project has a small inbuiltcamera that scans the text printed on a paper, converts it to audio format using a synthesized voice for reading out the scanned text quickly translating books, documents and other materials for daily living, especially away from home or office. Not only does this save time and energy, but also makes life better for the visually impaired as it increases their independency.

4.Nagaraja L [4] proposed that the method is a camera based assistive text reading to help blind person in reading the text present on the text labels, printed notes and products [4]. The proposed project involves Text Extraction from image and converting the Text to Speech converter, a process which makes blind persons to read the text. This is carried out by using Raspberry pi, where portability is the main aim which is achieved by providing a battery backup and can be implemented as a future technology. The portability allows the user to carry the device anywhere and can use any time. To extract the text from image we use optical character recognition technique (OCR). A Text-To-Speech (TTS) synthesizer is a computer-based system that should be able to read any text aloud, whether it was directly introduced in the computer by an operator or scanned and submitted to an Optical Character Recognition (OCR) system.

5.Mallapa D.Gurav [5] proposed that this project presents a smart device that assists the visually impaired which effectively and efficiently reads 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 on implementing image capturing technique in an embedded system based on Raspberry Pi board. 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). Optical character recognition (OCR) is the identification of printed characters using photoelectric devices and computer software. Itcoverts images of typed or printed text into machine encoded text from scanned document or from subtitle text superimposed on an image. In this research these images are converted into audio output. OCR is used in machine process such as cognitive computing, machine translation, text to speech, key data and text mining. The recognition process is done using OCR the character code in text files is processed using Raspberry Pi device on which it recognizes character using tesseract algorithm and python programming and audio output is listened.

The drawbacks of the existing system are as follows:

The idea of "Smart Glasses" is to create wearable computer glasses for a different purpose. These uses determine type of glasses that are needed to be created. The "Smart Glasses" were simple. In the existing system it Contains many

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elements which might be difficult for the blind to handle. It does not detect how far the obstacle is from the person. Processing time is more.

The objectives of the project are as follows:

To develop a smart reading device that helps blind person to learn independently and work efficiently. For blind or visually impaired persons and the increasing availability of cost efficiency, high performance and portable digital imaging devices has created a tremendous opportunity for supplementing traditional scanning for document image acquisition. To propose a camera based assistive text reading to help visually impaired person in reading the text present on the captured image. To recognize the products in real world by extracting the text on image and converting it into speech. To assist normal people to read a huge document in a short span of time. To make visually impaired people life easier and they will be able to live a normal life.

The scope of the project are as follows:

Speech and text are the main medium for human communication. A person needs vision to access the information in a text. However, those who have poor vision can gather information from voice. This system proposes a camera based assistive text reading to help visually impaired person in reading the text present on the captured image. It converts captured text image into audio to help visually impaired people. The main purpose of this project is to present a progressive work for developing an assistive aid for visually impaired. It will help them in object identification, face recognition and obstacle detection as well as reading newspapers and books. In this approach the object identification, face recognition, text extractor block, obstacle detection module is integrated in a single device. Use of finger for reading the text is overcomes by the camera module

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## III. PROPOSED ALGORITHM

A. OCR Mechanism

OCR is an abbreviation of optical character recognition method, it is used to convert typed, printed or handwritten text into machine-encoded text. There are some OCR software engines which try to recognize any text in images such as Tesseract and ABBYY FineReader. In this project Tesseract version 4 is used because it is the best open-source OCR engines.

B. SPEECH SYNTHESIZER (E-SPEAK)

E-Speak is a compact open-source software speech synthesizer for English and other languages, for Linux and Windows which uses a "formant synthesis" method. This allows many languages to be provided in a small size. The main advantage of using e-Speak is that the speech is clear, and can be used at high speeds. E-Speak is available as a command line program (Linux and Windows) to speak text from a file or from stdin and shared library version for use by other programs. (On Windows this is a DLL). Raspbian OS follows the Advanced Linux Sound Architecture (ALSA) for managing audio devices.

### 1. Ultrasonic Sensor


**Fig. Ultra-Sonic Sensor**

The purpose of ultrasonic sensors is to measure the distance using ultrasonic waves. Ultrasonic sensors emit the ultrasonic waves and receive back the reflected. So, by this time the ultrasonic sensor will measure the distance to the object. It can sense from 2-400 cm.

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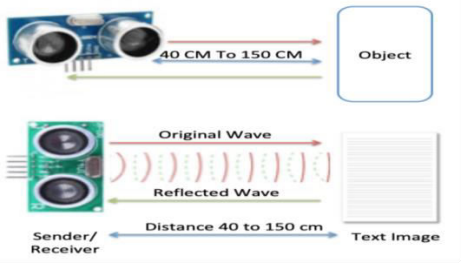


**Fig. Measuring the destination of Ultrasonic Sensor**

The project makes use of the Ultrasonic sensor is used to measure the distance between the camera and an object to detect the text from the text image. The distance should be from 40 cm to 150 cm and that is because this is the required range to capture a clear image.

**Distance L = 1/2 x T x C**

L: The distance

T: Time between the emission and reception

C: Sonic speed

*The value is multiplied by 1/2 because T is the time for the go-and-return distance.

**2. RASPBERRY Pi CAMERA**

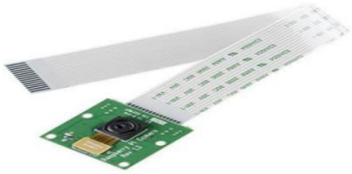

**Fig. Raspberry Pi camera**

The Standard version of the Raspberry Pi camera - Raspberry Pi camera Module 2, is designed to take pictures in normal light. The Raspberry Pi Camera Module 2 replaced the original Camera Module in April 2016. The v2 Camera Module has a Sony IMX219 8-megapixel sensor. The Camera Module 2 can be used to take high-definition video, as well as stills photographs. It's easy to use for beginners, but has plenty to offer advanced users if you're looking to expand your knowledge. The camera works with all models of Raspberry Pi 1, 2, 3 and 4. It can be accessed through the MMAL and V4L APIs, and there are numerous third-party libraries built for it, including the Pi-camera Python library.

**3. Raspberry pi model b+**

Raspberry Pi is a credit card-sized computer. It needs to be connected with a keyboard, mouse, display, power supply, SD card and installed operating system. Raspberry Pi is a low-cost embedded system that can do a lot of significant tasks.

**Fig. Raspberry pi model b+**

It can be run as no-frills PC, a pocketable coding computer, a hub for homemade hardware and more. It includes GPOI (general purpose input/output) pins to control electronics components. It is also a great machine to

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attract children to learn more about how computers work and motivate them to improve their programming skills which help to create the next generation of developers.

Raspberry Pi 3 is the main component of the project. It used as a low-cost embedded system to control and connect all of the components together. It uses the Raspbian or NOOBs as the operating system which can accomplish many important tasks However, for the project the team decided to work on Raspbian as the operating system.

**4.Raspberry pi pinout**

Raspberry Pi 4 GPIO Pins helps you to do things on your Raspberry Pi 4 easily. There are 40 pins in this model and among them 26 are GPIO pins.The Raspberry Pi model includes two 5V pins, two 3.3V pins, eight ground pins and two reserved pins.

**5V pins:** The 5V pins are used to output the 5V power supply provided from the Type-C port. The pins are numbered 2 and 4 on Raspberry Pi 4 device.

**3.3V pins**: The 3.3V pins are used to provide a 3.3V power supply to the external components which are numbered 1 and 17.

**Ground pins:** The ground pins are used to close the electric circuits. The ground pins help you to protect your board from burning and play an important part in a circuit. The ground pins are numbered 6,9,14,20,25,30,34 and 39.

**Reserved Pins:** These pins are used to perform communication between I2C and EEPROM. If you are new to Raspberry Pi, you are advised not to connect anything with these pins which are 27 and 28 number pins.

**GPIO Pins**: These are the pins on your Raspberry Pi that perform various functions and each pin is assigned a different task. Some pins are used as inputs, while others are used as outputs. Input voltages ranging from 1.8V to 3V are considered high voltage, while voltages less than 1.8V are considered low voltage. You need to keep the voltage of the power supply below 3V in order to protect your Raspberry Pi from burning.

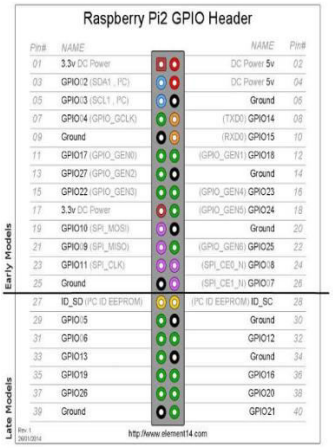


**Fig. Raspberry pi pinout**

## IV. IMPLEMENTATION

OCR process consists of multiple modules:

**1. Pre-processing**

The main goal of this step is to reduce the noise that resulted from scanning the document where the characters might be broken or smeared and causes poor rates of recognition. Pre-processing is done by smoothing the digitized characters through filling and thinning. Another aim of this step is to normalize the data to get characters of uniform size, rotation, and slant. Moreover, compression in the amount of information to be kept through thresholding and thinning techniques.

**2. Segmentation**

In this process, the characters or words will be isolated. The words will be segmented into isolated characters that are recognized separately. Most of OCR algorithms segment words into isolated characters which are recognized individually. Usually, segmentation is done by isolating every connected component.

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**3. Feature Extraction**

This process will capture the significant features of symbols and it has two types of algorithms which are pattern recognition and feature extraction/detection.

**4. Classification**

OCR systems use the techniques of pattern recognition that assigns an unknown sample into a predefined class. One of the ways to help in character classifying is using English dictionary.

**5. Post-processing**

This process includes grouping and error detection & correction. In grouping, the symbols relate to strings. The result of plain symbol recognition in the text is a group of individual symbols.

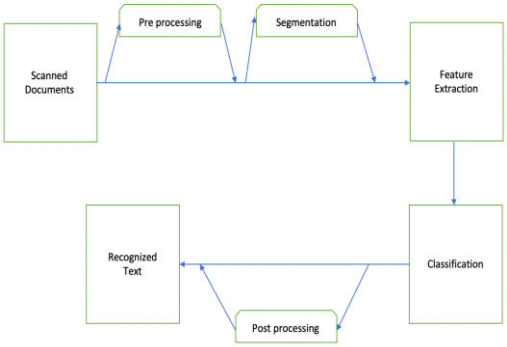


**Fig. Modules of OCR Mechanism**

## V. CONCLUSION AND FUTURE WORK

Three different modules: Camera module, Optical Character Recognition Module and Text-To-Speech Modulewe are developing text reader-based text reading system for visually impaired persons. The proposed system ensures to read text present in the image for assisting blind people. Pre-processing part ensures efficient background separation with an improved algorithm. The main purpose of this project is to present a progressive work for developing an assistive aid for visually impaired. The future work: developing an efficient product that converts the text in the image to speech with high accuracy, that is invisible

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