RASPBERRY PI BASED SMART GLASSES USING OPENCV AND ML FOR VISUALLY IMPAIRED

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Introduction:

People with visual impairment face various problems in their daily life as the modern assistive devices are often not meeting the consumer requirements in term of price and level of assistance. The number of visually impaired people is growing over the past decades. On an approximation 285 million people are visually impaired across the globe, among which 39 million are blind and 246 have low vision according to WHO statistics. About 90% of the world's visually impaired live in low-income settings whereas 82% of people living with blindness are aged 50 and above. India is now home to the world's largest number of blinds. Out of the 37 million blind people worldwide, over 15 million are from India. The worst thing is that 75% of these are cases of avoidable blindness. India has an acute shortage of optometrists and donated eyes for the treatment of corneal blindness. Blind people are usually dependent on assistance from others. The assistance can be from human beings, dogs or some special electronic devices.

Among all assistive devices, wearable devices are found to be the most useful because they are hand free or require minimum use of hands. This paper presents a new design of smart glasses that can provide assistance in multiple tasks while maintaining at a low building cost. The design uses the Raspberry pi single board computer, a camera, an Ultrasonic sensor and an earpiece to convey information to the user.

Visually impaired people use braille system for witting and reading purposes. The visually impaired person feels the arrangement of the raised dots which conveys the information and are very difficult so keeping these things in mind we have designed our system in such a way that reading any book for blind people become easier. The glasses use many technologies to perform its tasks which are OCR, Text to Speech Conversion (gTTS), Object recognition. The detection of text in the image is done using the Open Cv and Optical Character Recognition. The Ultrasonic Sensor is used for obstacle detection.

OBJECTIVES:

As reading is of prime importance in the daily routine (text being present everywhere from newspapers, commercial products, sign-boards, digital screens etc.) of mankind, visually impaired people face a lot of difficulties. The objective is to assist in multiple daily tasks using the advantage of wearable design format. These “Smart Glasses” are designed to help the blind people to read the typed text which is written in the English language. These kinds of inventions consider a solution to motivate blind students to complete their education despite all their difficulties. Its main objective is to develop a new way of reading texts for blind people and facilitate their communication. Our device is designed for people with mild or moderate visual impairment by providing the capability to listen to the text. It can also act as a learning aid for people suffering from dyslexia or other learning disabilities that involve difficulty in reading or interpreting words and letters. It provides object recognition which helps in identifying the object present in front of the person.

Methodology:

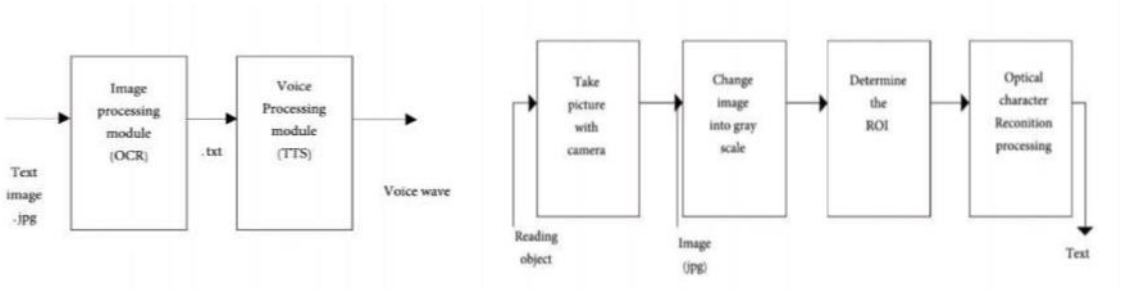
Image acquisition: In this step, the inbuilt camera captures the images of the text. The quality of the image captured depends on the camera used. We are using the Raspberry Pi’s camera which 5MP camera with a resolution of 2592×1944.

Pre-processing: This step consists of colour to gray scale conversion, edge detection, noise removal, warping and cropping and thresholding. The image is converted to gray scale as many OpenCV functions require the input parameter as a gray scale image. Noise removal is done using bilateral filter. Canny edge detection is performed on the gray scale image for better detection of the contours. The warping and cropping of the image are performed according to the contours. This enables us to detect and extract only that region which contains text and removes the unwanted background. In the end, Thresholding is done so that the image looks like a scanned document. This is done to allow the OCR to efficiently convert the image to text.

Image to text conversion: The below diagram shows the flow of Text-To-Speech. The first block is the image pre-processing modules and the OCR. It converts the pre-processed image, which is in .png form, to a .txt file. We are using the Tesseract OCR.

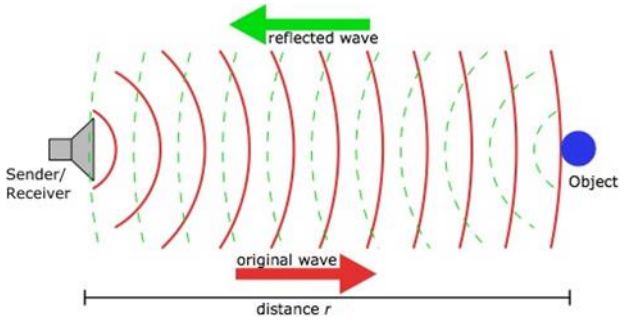
Text to speech conversion: The second block is the voice processing module. It converts the .txt file to an audio output. Here, the text is converted to speech using a speech synthesizer called gTTS.

Design Methodology:

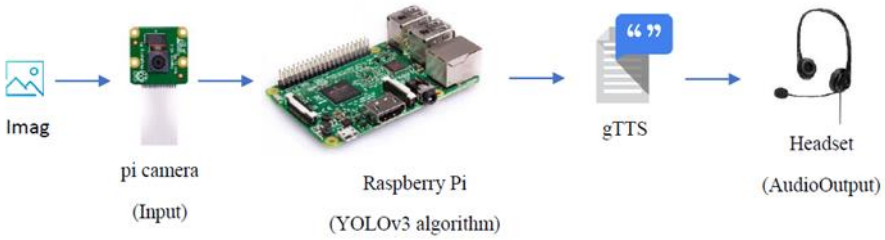


Obstacle detection using Ultrasonic sensor:

The ultrasonic sensor transmits sound waves and receives sound reflected from an object. When ultrasonic waves are incident on an object, diffused reflection of the energy takes place over a wide solid angle which might be as high as 180 degrees. Thus some fraction of the incident energy is reflected back to the transducer in the form of echoes. If the object is very close to the sensor, the sound waves returns quickly, but if the object is far away from the sensor, the sound waves takes longer to return. But if objects are too far away from the sensor, the signal takes so long to come back (or is very weak when it comes back) that the receiver cannot detect it.



Real Time Object Detection:



We will use YOLOv3 real-time Object Detection algorithm trained to identify the object present before the person. Then the label of the object is identified and then converted into audio by using Google Text to Speech (gTTS), which will be the expected output.

Face Recognition:

The device is a wearable Face Recognition device which allows blind and low vision people to recognise faces in front of them. Using face recognition and OpenCV technology, the device will identify classmates, relatives and colleagues by giving a message on an earphone to notify the user and has a facility to tag image by giving some identity or name for new people. If the same person appears in front of the user then the name of a person is given as a message on an earphone.

Results and Conclusion:

The user will wear the Smart glasses and press a button for reading text present in front of them. After pressing a button the glasses will take a picture of the image using a camera module installed in the glasses. Then, using OCR the text will be identified. Finally, using gTTS the text will be converted to a voice that the user is going to hear through a headphone. The accuracy of the model is 87%. The objects are detected using yolov3 algorithm. The Ultrasonic sensor installed in the smart glasses helps to detect the obstacles when they are near or approaching the user by prompting the distance of obstacle through audio. From which the user can avoid any obstacle on the way. Thus the device helps in readability which is one of the most important part to gather information in our day to day life. The price is quite affordable for blind people with low economic condition. The design of the device makes it suitable to be used comfortably by the blind person over the blind stick which he needs to carry each and every time he moves out of his house.

Scope For Future Work:

There can be number of future advancements that can be associated with this project work .The system can be made to translate a text into various languages. The system can be further expanded for the alphabets, numbers in gesture control. The input can be also taken in the form of videos and they are divided into frames and then it is converted into text. We can also add grammatical structure for sign language. We can produce a product for blind people that converts the information in any hand-written notes more efficiently.