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Intelligent Assistive System for Visually Disabled Persons

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Abstract: ***There is increasin demand for smart widgets which make people more comfortable. Though many research works have done on current existing devices/systems for visually impaired people are not providing facilities them enough. The imperceptible people read Braille scripted books only, so here developing a new device that will assist the visually impaired people and also providing desired language reading facility. This smart assistive device will help visually impaired people gain increased independence and freedom in society. This device has an obstacle detection sensor to intimate the obstacles to the visually impaired person and a camera connected to Raspberry pi to convert image to text using Optical Character Recognition (OCR). The read data is converted to speech using text to speech synthesizer. This will useful for visually impaired people for surviving in outdoor environment as well as reading books which are in normal script. The read data can be stored in database for further reading and it can be retrieve by giving a command.***

Keywords : Widget, Imperceptible, Braille, Optical Character Recognition, speech synthesizer.

I. INTRODUCTION

Many people do not lose the eye and some people have been blind since childhood. According to a World Health Organization survey in 2015, some 246 million individuals worldwide are outwardly disabled and 39 million are blind. Many types of investigations have been carried out to solve these problems. Previously, Louis Braille was a French educator and inventor of Braille. This is a hepatic script and users must learn it before they understand it. Today, several technologies are being developed based on the latest technology for the blind. Moderators will be introduced, based on OCR, blind obstruction and much more. However, these are not enough techniques to overcome all problems of the blind.People with visual disability cannot survive in their daily life without any assistance. In many previous developments and designs I have noticed drawbacks like using application, blind stick, hand wearable device etc. they are not effective. That's why we introduce a new technology based on the previous technology which is more efficient and low cost project. With this electronic widget will provide excellent assistance for the impaired people in outdoor environment also. The main motivation to this paper is am very interested in solving problems in different domains this will open on to do this project. I have read news about blind who had hit by a train and children stating that “can’t read, so use new tech to let books speak” in Deccan Chronicle news paper. This statement will provoke me to find a new technology. I searched many IEEE papers and websites for present technologies and I found that there are several technologies with minimum equipment. Existing projects are having drawbacks. They can handle by people if they know present technology like smart phones.The main goal of this paper is the plan and execution of smart devices for the blind. This project encourages outwardly impeded individuals to feel comfortable in this world. Here I am presenting the systems for the prevention of obstacles and the readers of textbooks, posters and other readers of texts. With a camera, you can capture an image, convert it to text, and convert it to audio using OCR or TTS. Another goal is to add memory to this converted file so that you can preview or retrieve those files in the future.

II. LITERATURE SURVEY

Many researchers say that providing effective devices for impaired people is a challenging task for the engineers around the world. A search is being processed on this domain from four years.Text to Speech Conversion Using Raspberry Pi for Embedded System presented in [1] released in 2012. This paper proposed a text to speech conversion from input string of text into corresponding speech. A Raspberry pi B+ model is used for the processing. The text to speech synthesizer is used in this paper follows the simple File Accessing Protocol (FP). Reading assistance for visually disabled people in [2] released on 10 April 2015. This paper involves a camera for capturing images of text and this will be converted to speech using a synthesizer. This author used a new technology of image processing and speech synthesis. Vision Based Text Recognition by Raspberry Pi presented in [3] released in 2015. This paper proposed an image to speech converter using a Tesseract OCR engine. Smart Assistive Device forVisuallyImpairedpeople presented in [4].This paper uses a conversion technique to convert an image to text and then it will be converted to speech using a synthesizer. Intelligent Translate System for Visually Challenged People presented [5] released in 2016. In this paper the used MATLAB coding to convert an image to text. They had mentioned about conversion of image to text only. Character Detection and Recognition System for blind people explained in [6].

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In this paper author presented a computer vision technology to extract text from scene images and electronic aid is used to convert text to speech.

Design and Development of Smart Assistive Device for Visually Impaired People presented in [7] released on May 20-21, 2016. In this paper the author introduced a smart stick with an RFID technology and IR sensors to give direction and to detect obstacles respectively. Image Text to Speech Conversion in the Desired Language By Translating With Raspberry Pi [8]. In this paper the author introduced a new technology to convert the text into desired language. Voice-Controlled Smart Assistive Device for Visually Impaired Individuals presented in [9]. In this paper author introduced a microcontroller based smart assistive device. They used ultrasonic sensors to measure distance of obstacle and a smart phone to give voice commands this will be failed if the blind people haven't any idea about smart phone. Smart Guiding Glasses for Visually Impaired People in Indoor Environment presented in [10].OCR Based Facilitator for the Visually Challenged, 2017 presented in [11]. The model comprising of a couple of showcase glasses and a few minimal effort sensors is created, and its effectiveness and exactness were tried by various clients. The exploratory outcomes demonstrate that the brilliant directing glasses can viably improve the client's voyaging knowledge in muddled indoor condition.Image to speech conversion for visually impaired people June 2017 presented in [12]. This author implemented the system with a software used for the conversion of text to speech. The converted image to text is the input to the device that input will be converted to speech using text to speech synthesizer.All of the above papers are released for conversion techniques only; there should be a new device to avoid obstacle, intimate the distance to the blind as well as reading the text in desired language and storing the converted image to text file for future retrieving.

III. DESIGN AND IMPLEMENTATION

A. The Hardware model

The proposed model has a raspberry pi 3B+ surrounded by Ultrasonic sensor, PIR sensor, GPS module and a camera. In a pair of glasses we fixed the camera in middle of the glass. This camera can capture the images or live video, according to the command given by the user. PIR sensor will detect the motion around the person and ultrasonic sensor will give the distance of the object from the user. Headphones were used here to intimate to the user through the speaker. The proposed system block diagram is shown in the figure1. The initial prototype of this model is shown in the figure 2 & 3.

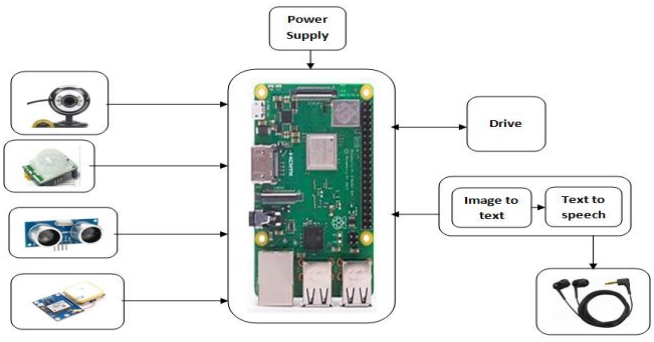

Fig.1 Hardware model of the proposed system

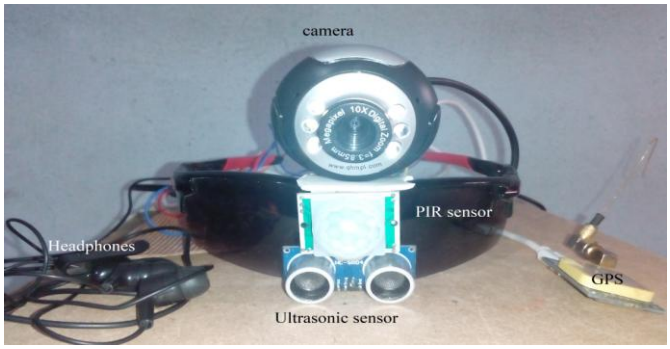

Fig.2 Prototype of proposed model

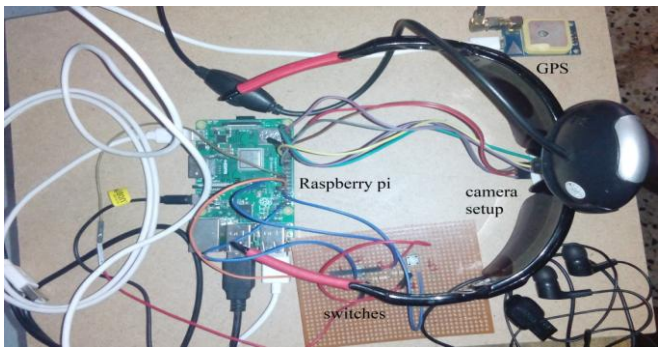

Fig.3 Top view

1) Finding the distance using Ultrasonic

The Ultrasonic sensor is used for finding the distance of an obstacle which is in front of the blind people. The ultrasonic sensor mounted to the glasses beneath the PIR sensor. The sensor basically has Vcc, GND, TRIG and ECHO. Echo will generate the signal at 40 Khz samples, Trig will receive those samples continuously. Whenever we give 5V supply to the ultrasonic sensor the Txr will send the samples in the form of ultra sound which can't hear by human being. If any obstacle is present in front of the sound signal it will be reflected back, with the help of time lapsed and speed of the signal the distance will be measured.

The distance = (Time lapsed * Speed) / 2

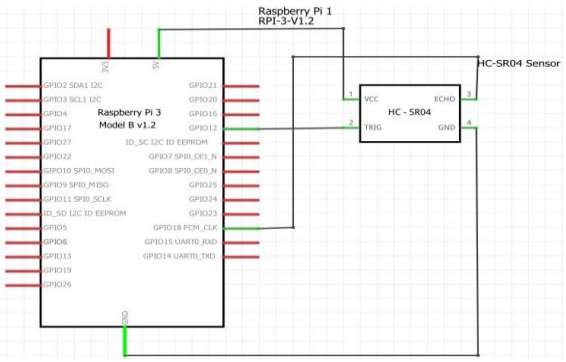

Fig.4 Ultrasonic connection with Raspberry pi

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2) PIR sensing

The PIR sensor will give the logic high when it detects a warm body in its surroundings. PIR sensor has a data pin, Vcc and GND. The data pin will give the data to the raspberry pi, raspberry pi will process the related action. In our project on detection of movement by PIR sensor that will be intimated to the user through the speaker.

3) Location Updating

We connected a Neo-6M GPS module to this prototype for location updating. If the person wants to know where he/she is then it will tell the location of that place in the earphones. Here we provided a button for location when we press the button the Raspberry pi will update the location to the earphones, hence they(blind people) know the location.

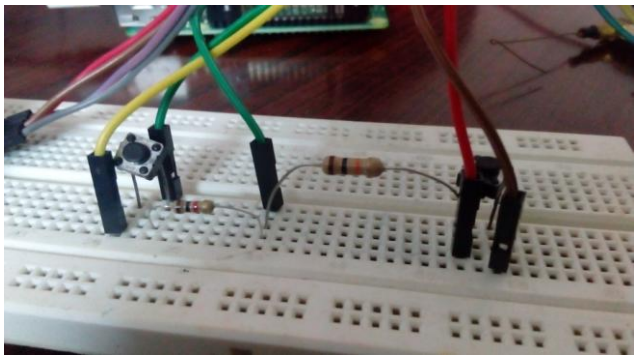

Fig.6 the switches used for location and image capturing

4) Camera

A high resolution camera is used for capturing the images as well as for live OCR streaming. In market there are so many cameras are available, but we have used a less cost and high resolution camera. With this camera we can capture images and we will see the live video in ant time.

B. Software

5) Live Stream OCR

We have used a Live stream OCR technique to read the text books, posters, newspaper etc. When the user pressed the button provided, the camera will automatically go to live stream to capture the images and save them in to Jpeg format in memory card in the Raspberry pi. An image to text converter (a Tensorflow is used) is used for the conversion of image to text. The text will be saved to the memory for further reading. Before dealing with the image processing we need to install OpenCv in the Raspberry pi. It has around 2 hours for me to install the OpenCv library. A screenshot of OpenCv installation and OCR output is provided below. The Numpy(Number Python) will take all the samples in the image and store them as a matrix after that this will be converted to related characters using Tensorflow library.

Fig.5 OpenCv installation screenshot

6) Image Detection

The live image detection is also providing in this project. With this the blind people can know the objects clearly up to 90%. OpenCv and Tensorflow together used for the image detection in the Raspberry pi Python language. We have implemented the device with these facilities to help blind people to survive in their daily life without any help. The identified object will notified in the earphones.

7) Flowchart

The flow of the code and operation as explained in the flowchart in figure 6.

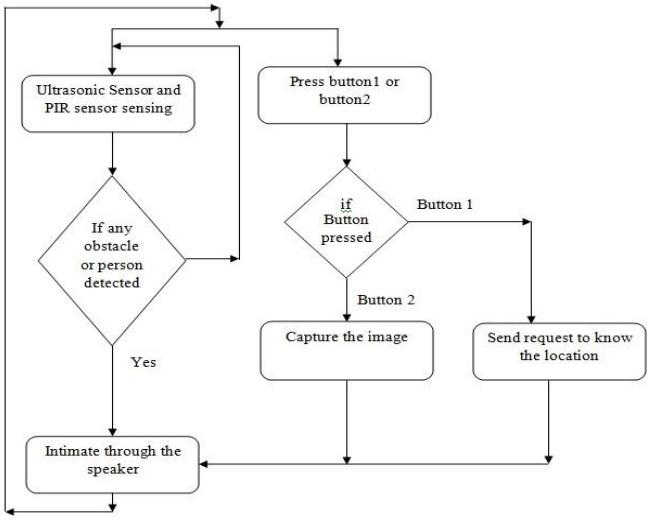

Fig.6 proposed system workflow

As shown in the flowchart, the obstacle detection and person sensing is started with the powering the device. When the button pressed by the user the related action will be done.

IV. EXPERIMENTAL RESULTS

The experimental results of the prototype tabulated according to the performance of the device. The obstacle detection of the device as shown below.

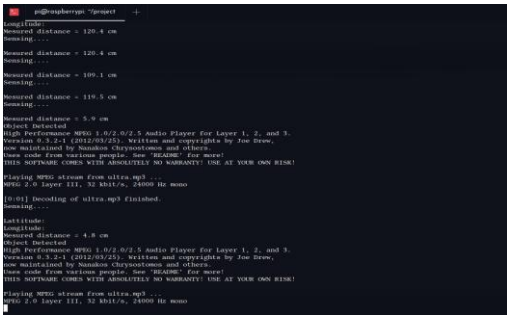

Fig. 7 Screenshot of obstacle detection result

TABLE 1
Testing the ultrasonic sensor accuracy

Condition	Instruction	Accuracy
Obstacle detected	Attention, obstacle detected at 45cm	9
Obstacle detected	Attention, obstacle detected at 25cm	10
Obstacle detected	Attention, obstacle detected at 15cm	10
No obstacle	-	10

As well as the PIR sensor is also detecting the movement, a screenshot of result is provided below during the test. The live OCR streaming is the big task in this prototype. Even though it is live streaming we need to translate the image into text and to the speech. So for that we set the loop of live OCR to one time only, when the person pressed the button then only the OCR live will takes place. At the same time the converted text will be read through the speaker. The converted text will be saved to memory. This can be retrieved thereafter. The image detection is also a part of our prototype. The detected image will be intimated on speaker. The process is shown in the below images.

Fig.8 Image captured by camera

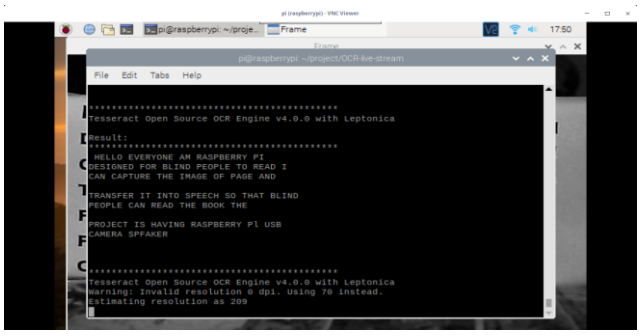

Fig.9 Output of the above image (image to text)

The image capturing, converting it into text and object detection are experimented many times to get the accurate results. We tabulated the no. of tests and accuracy of the device for image detection process as below.

TABLE 2
Testing the object detection and accuracy

Test case	No. of times	Result
Cell phone	10	85-95%
Book	7	60-75%
Cat	4	70-80%
Toothbrush	3	80-95%
Laptop	5	76-87%
Person	10	75-91%
Pen	8	73-85%

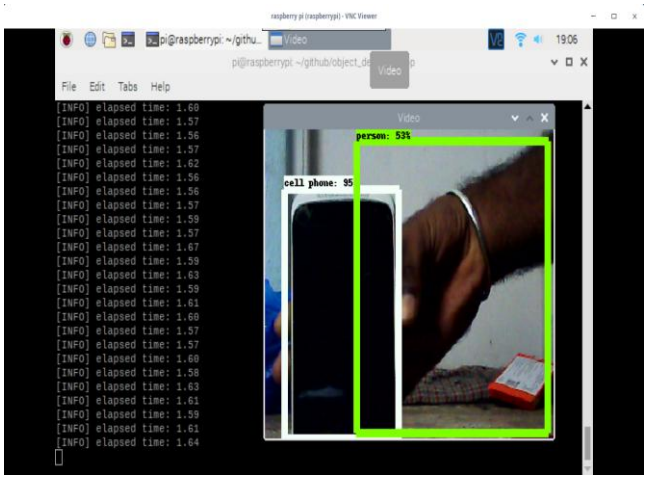

Fig.9 Image showing live objet detection

According to the designer's perspective we designed a very well device. Based on our testing the device performance is very well it should be giving 90-93% accurate output. While user's perspective it is little hard to place the reading text book in front of the camera. To overcome this problem we can exchange the more high resolution camera instead.

V. CONCLUSION & FUTURE WORK

By providing this technology many of people in the world who were unable to see will have their daily life in a normal way and they may enjoy as same as normal persons. If we give a small training about this device to the disabled people, they can use this device efficiently. This device is low cost device, hence each and every people can buy this device. This device is updated and extended to a new form by updating software for comparing the each and every photo in the surroundings. This prototype can be designed in a single goggle so that wearing of this device is very comfortable. This idea will tend to a new technology that involves neuron based visual system which can give information directly to damaged neurons in mind in disabled people.

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