Advanced Audio Aid for Visually Impaired using Raspberry Pi

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Abstract —This work focuses on the obstacle detection and face detection which helps for blind person in day-to-day activities. Raspberry pi is used for interface powered by MATLAB. It helps in recognizing usual objects around the person. Addition to that, it also helps in finding the known person approaching the user. Portable power supply keeps the hardware running throughout the day and the power bank can be recharged. Hence the power consumption is low.

Keywords : Raspberry pi, Viola-jones, LBP, Random-forest, SURF.

I. INTRODUCTION

Over 37 million people across the globe are visually impaired, among which one in three of them is an Indian, visually impaired people feel difficult to identify objects and reduces their activities in several fields like, while working in office difficult to identify things. The main aim of the project is to detect obstacles and recognize faces which would help them to do their daily work easier and smoother without any disturbances. The rest of the paper is organized as follows: Section II discusses the components used for face detection and obstacle detection. The Literature review is discussed in Section III. Section IV contains proposed system. Section V includes Testing, Results and future work.

II. SYSTEM DESCRIPTION

The advance guide cane for the visually impaired has two processes which work in parallel. The two processes are obstacle detection system and face detection. These systems are controlled by Raspberry Pi.

A. RASPBERRY PI

Raspberry Pi is a system on chip which is used as the processing unit. Raspberry Pi is a low cost, basic and small sized computer. The Raspberry Pi is a single circuit board in the size of a credit card. It helps in processing the events. low power consumption, small size and flexibility to work with different components. It can be easily programmed using MATLAB.

B. ULTRASONIC SENSOR

The ultrasonic sensor module used in this project is HCSR04. The ultrasonic sensor transmits a wave and the received echoes are decoded to sense the presence of physical objects. The specifications of HC-SR04 are:

1. *2cm 400cm (1 to 13 feet)*
2. *Working Voltage 5V*
3. *Working Current 15mA*
4. *Working Frequency 40KHz*
5. *Trigger input signal required 10s pulse (3V- 5VHIGH)*

HC-SR04 has been connected to the Raspberry Pi as shown in Figure 1. A voltage divider circuit is used to bring down the voltage from 5V to 3.3V as Raspberry Pis General Figure 1 HC-SR04 connection to Raspberry Pi Purpose Input Output pins (GPIOs) cannot tolerate a voltage above 3.3V.
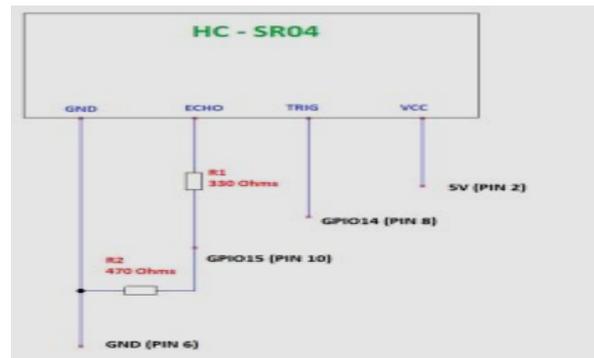
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Fig. 1.   HC-SR04 connection to Raspberry pi

C. **AUDIO FEEDBACK**

Both systems interact with the user through voice feedbacks. A light weight ear-piece will be connected to the 3.5mm jack of the Raspberry Pi, to be used by the user to get the voice-feedback.

D. POWER SUPPLY

A portable power supply which is used to power the hardware can be recharged contains micro USB to connect and runs for long hours.

III. LITERATURE REVIEW

As per the **Chaitali Kishore Lakde et.al**[1], A shoe based device guides the pedestrians for that uses RGB sensor and obstacle detection, sensor which senses the ground-level objects, based on the objects detected it checks the colour intensity levels and inform to the user through audio feedback module. Depending on the primary colour intensity levels processing unit decides the object. To run the process Arduino microcontroller used

As per the **Karthicknanmaran et.al**[2], zigbee based device for an specific indoor application, these zigbee module are known for locations, when a blind person comes to indoor activity ,zigbee begins its communication with the other fixed protocols which is already installed in the other indoor locations. Sonar is used for obstacle detection, four different sonars is used in the region to detect the road objects for blind person.

As per the **Kieran J. Callaghan et.al**[3] **,** Time of flight imaging technology uses image acquisition technique which converts into grayscale image and noise levels filtered and feedback as voice over output. The camera transfers both distance and light intensity data, it detects overall size of objects, since TOF camera gets affected by noise which is caused by low amount of light. The images are converted into histogram and stored in the database. Once the object comes, it detects and output is informed.

As per **Richard F. Joseph et.al**[4]**,** A system uses RFID tags to track the location and user has a device which will assist him/her, before that RFID tags must be deployed in a location and data transferred via Bluetooth to the device in an android OS an application developed for using the device. SQL database used to store the details of the environment and displayed in the PDA.
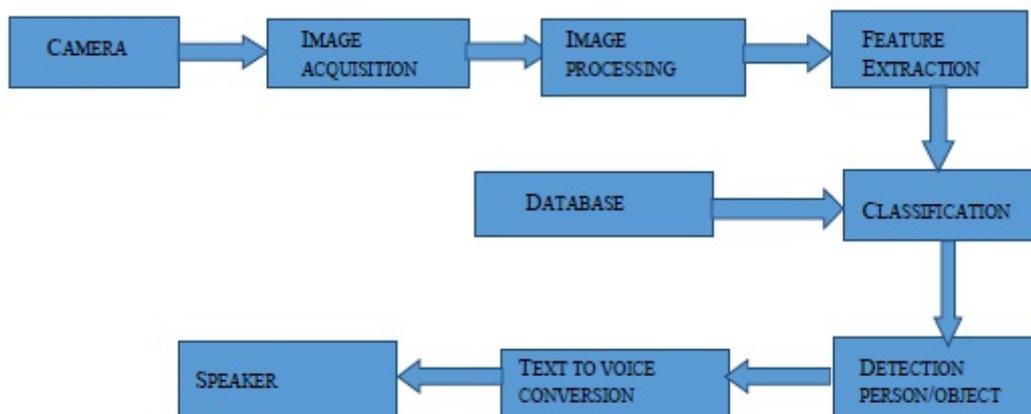
IV. PROPOSED SYSTEM

Fig 2 Block diagram

This proposed work (fig 2), device is made to handle easier and for image acquisition pi-camera is placed so that it can capture images from ground –level, Ultrasonic sensor senses the objects once the object is detected camera is turned ON and image is captured.

This proposed work consist of 2 process

1. FACE RECOGNITION
2. OBJECT DETECTION

Face recognition consist of 3 categories to detect, namely:-

> 1.*Viola-Jones face detection*
> 2.*Local Binary Patterns*
> 3. *Random- Forest classifier*

Viola-Jones used for face detection, this is done in 4 process,

> 1. *Haar Features*
> 2. *Integral image*
> 3. *Adaboost*
> 4. *Cascading technique*

Machines cannot detect faces like how humans detect, so it has programmed in such a way where it is able to detect faces, for which the above 4 process is used which is explained detail manner.

Haar Features (Fig 3)this concept is used so that segregates human faces into patterns so that processor remembers the patterns . Patterns (white and black) for example, between nose bridge and two eyes the patterns consider as white at the center and black for two eye
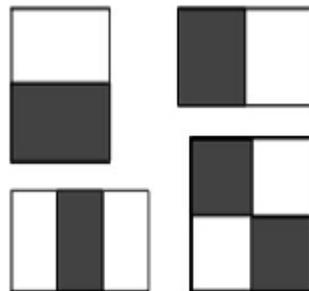

Fig 3 Haar feature pattern

Integral image, is summing the pixels above and to the left of an image so that pixels will not overlap and exact intensities will be recorded.

Adaboost and Cascading technique, machine learning, finds the best relevant features and eliminates the redundancy features, after identifying the features it forms a linear combination .These linear combination is known as weak classifiers, and adaboost constructs strong classifier from the linear combination.

Local Binary Patterns, The basic idea is local structure of an image by comparing each pixel with its neighborhood. Take a pixel as center and threshold its neighbors against. If the intensity of the neighbor pixel is greater-equal to the centre, then denote it with 1 or if neighbor pixel intensity is lesser then denotes it with 0.Finally end up with binary number which is converted to decimal number.

Random- Forest classifier, A Random –forest classifier takes the decision tree concept a step further by producing a large number of decision trees. These trees are based on random selection of data and random selection of variables and hence the name Random forest. Classifier using many decision tree models and starts by identifying set of features. It runs efficiently on large database and it can handle thousands of input variables without eliminating a single variable.

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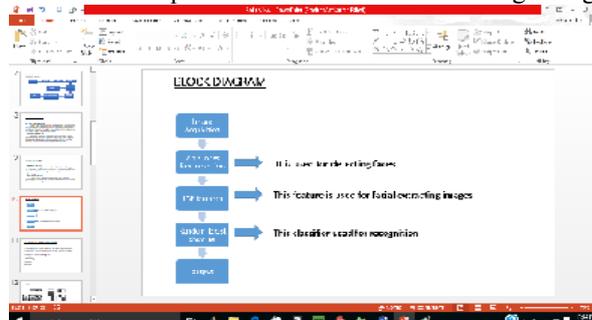
The next process is the **Object detection** for this it uses **Surf (SPEEDED UP ROBUST FEATURES)** features. SURF is used for tasks such as object detection and image classification. It can detect multiple no. of images faster, and it takes less time to execute the output .It works in three main stages:

1. EXTRACTION
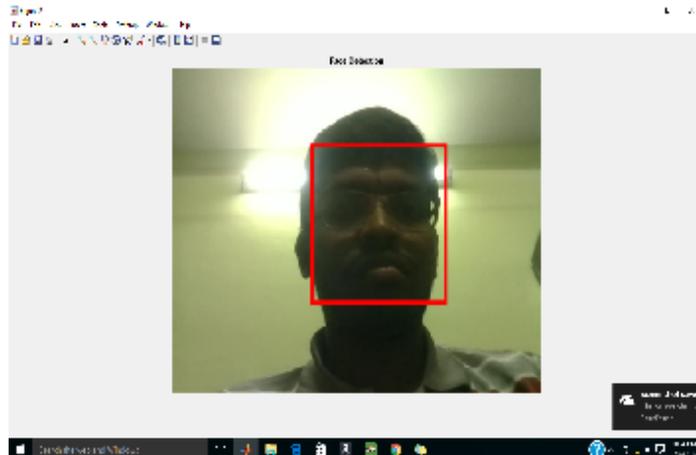2. DESCRIPTION
3. MATCHING

V. TESTING AND RESULTS

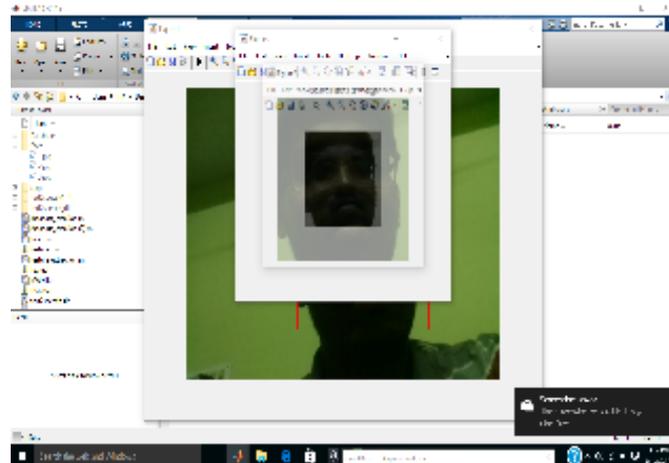*Fig 1 BEFORE DETECTION IMAGE IS CROPPED AND STORED*

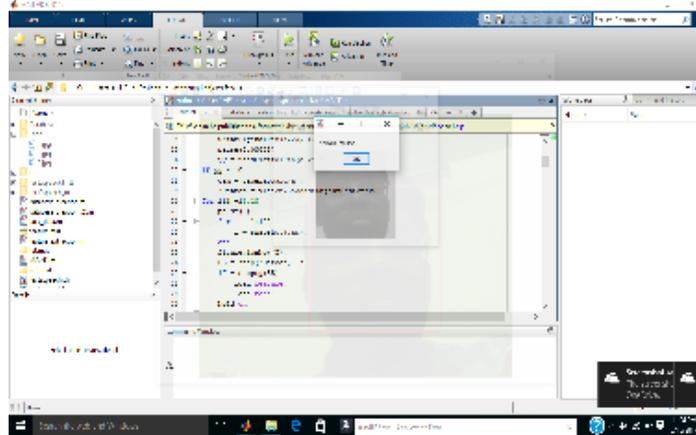*Fig 2 IMAGE OF AN OUTPUT FOR FACE DETECTION*

Fig 3 FINAL OUTPUT FOR FACE

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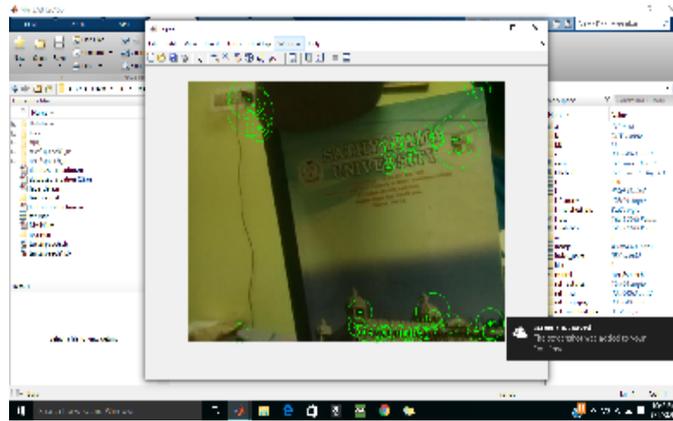
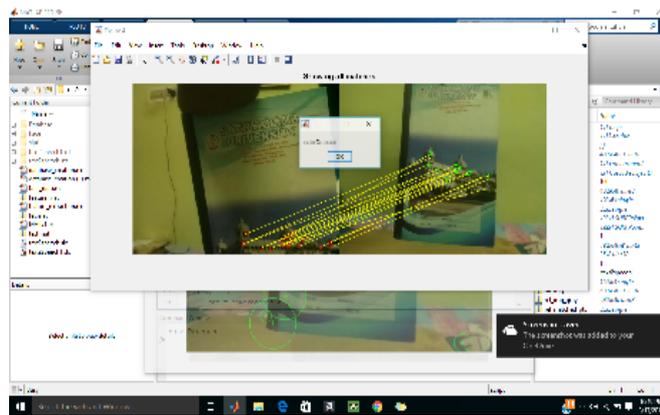*Fig 4 IMAGE IS CAPTURED FOR OBJECT DETECTION*

Fig 5 IMAGE OF AN OUTPUT FOR OJBECT DETECTION

DISCUSSIONS

FIGURE 1 shows that face is captured and stored in the database before recognition and FIGURE 2 shows that face is detected and FIGURE 3 shows that "known Person "FIGURE 4 shows that the object is stored before detection, FIGURE 5 shows that the "Note detected". As per the above results, all the data is Stored in the database for identification for comparison of trained images with the test images and output is delivered through audio feedback this is far better than the vibrations which is discussed in the existing system , time of execution and functioning is less for face recognition and object detection.

VI. CONCLUSION

Therefore this work is concluded by the electronic device which is created will help the blind person in a fast response time in daily activities. This proposed work will be use for visually impaired and blind person.

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