Multifunctional Device for Blind People

[1]A. Roselin Berna [2]R. Suganya [3]N. Surya [4]A. Suvetha [5]K. Manju Priya
[1,2,3,4]UG Scholar [5]Assistant Professor
[1,2,3,4,5]Department of Electronics and Communication Engineering
[1, 2,3,4,5]SVS College of Engineering, Arasampalayam,Myleripalayam (via.), Coimbatore- 642 109. India

Abstract

Blindness is a state of lacking the visual perception due to physiological or neurological factors. In the existing system only specific functions are available whereas in this proposed system more than three functions are integrated together. In this project, simple, cheap and user-friendly smart blind guidance system is designed and implemented to improve the mobility of blind and visually impaired people. The project includes wearable equipment comprising earphones. It is connected to raspberry-pi in order to perform the functions such as obstacle detection, face recognition, image to speech conversion and currency detection to help the visually impaired people to move anywhere without the help of others. In this project image processing with Haar classifier algorithm and ANN algorithm is used to perform the functions.

Keyword- Obstacle Detection, Face Recognition, Image Processing, HAAR Classifier Algorithm, ANN Algorithm

I. INTRODUCTION

Millions of people around the world are estimated to be visually impaired, about 90% of which live in low income settings. According to the survey made on 2012 June, 285 million people are visually impaired, 39 million are blind and 246 million have low vision. Performing daily routine activities such as moving around places, detecting obstacles and identifying various objects has always been a serious problem for them. Keeping such problems in consideration, a low cost, portable, wearable and reliable hardware along with the efficient software is designed.

It is an integration of Digital Image Processing and embedded Sensors and it will be in the form of a wearable jacket. This jacket will be easy to wear and it will have all the equipment mounted in it.

This wearable jacket helps visually impaired people in such a way that they can move easily from one place to another by avoiding any obstacle in their way, without the help from other. They will also be able to detect/recognize various objects commonly present around them. This will aid them in performing their daily chores easily, independently and more efficiently in an affordable manner.

II. LITERATURE REVIEW

1) Ayush Wattal, Ashutosh Ojha, Manoj Kumar-Obstacle detection for visually impaired using raspberry pi and ultrasonic sensors- National conference on Product /Design (NCPD 2016), July 2016. Ultrasonic sensor that uses sonar principle for distance measurement is used. It uses Arduino UNO and Python Programming to convert it into an audio signal. It has the merits such as low cost, power consumption and no initial training required.
2) Swathi.V, Steven Fernandes-Raspberry pi based human face detection-IJARCCE Vol 4, Issue 9, September 2015. Histogram Equalization and Haar classifier Algorithm is used for face detection. The merit is face detection even from poor quality images. The drawback is that it produces less accuracy for crowd.
3) K. Lakshmi T. Chandra Sekhar Rao-Design and implementation of text to speech- International journal of innovative technology and research Volume No.4, Issue No.6, October–November 2016, 4564-4567. 2320. Kirsch algorithm, Object Character Recognition and Tesseract is used. The merits are cost effective and user friendly.
4) Snehal Saraf, Vrushali Sindhikar, Shamali Thakare-Currency recognition system for visually Impaired-IJARIIE-ISSN (O)-2395-4396. Vol-3 Issue-2 2017. Scanner based system and Camera based system are explained by SIFO Algorithm. It overcomes the coin detection and economically compatible.
5) Shrutika V. Deshmukh, Prof Dr. U.A. Kshirsagar-Face detection and face recognition using Raspberri pi. IJARCCE ISO 3297:2007 Vol. 6. Issue 4, April 2017. Image processing is used to detect and recognise the faces.
6) Narayan T. Deshpande, Dr. S. Ravishankar-Face Detection and Recognition using Viola-Jones algorithm and Fusion of PCA and ANN-Advances in Computational Sciences and Technology ISSN 0973-6107 Volume 10, Number 5 (2017) pp. 1173-1189. Viola-Jones algorithm and Fusion of PCA and ANN algorithm is used.

7) Vandna Singh, Dr.Vinod Shokeen, Bhupendra Singh-Face detection by haar cascade classifier with simple and complex backgrounds images using opencv implementation-IJATES-Volume No. 01, Issue No. 12, December 2013 ISSN: 2348–7550. Face detection is performed by using Haar Classifier algorithm.

III. PROPOSED METHODOLOGY

Fig.1 shows the block diagram of the proposed system. This device will consist of multiple functions which include:

A. Obstacle detection using Ultrasonic HCSR04 Sensor

In this part an Ultrasonic sensor is mounted on the front side of the jacket. When the blind person is walking, the sensors will detect any obstacle coming in their way. The output of this sensor goes to the Atmel89C52 controller. The output of the controller then gives to Raspberry Pi kit which gives the output to the user in the form of audio signal as object sensed through the earphones/speakers.

B. Face Recognition using Image processing

When the user enters some place e.g. a room, he/she will press a specified button on the keypad mounted on the jacket. This will call a function in which Haar classifier and ANN algorithm is performed for face detection and recognition of the image captured. The web cam is placed at the front side of the jacket. The output in the form of audio signal tells the name of the person to the user.

C. Image to Speech Output using Image processing

The blind person can place the image (in which some text is written) in front of the mounted web cam and press a specified button on the keypad. This will call a function in which image processing is performed to convert it into text. This text will be sent too Raspberry pi to convert into audio signal. The output sent to the user via earphones. In this way blind people will be able to hear the written content rather than read.

D. Currency Detection using image processing

The user can place paper currency in front of the mounted web cam and press a specified button. This will call a function and python coding will be performed to detect the amount of that currency. This will output to the user via earphones.

1) Hardware Required

- Raspberry- Pi 3 Model B
- Raspberry pi camera module
- ATMEL 89C52 microcontroller
- HC-SR04 Ultrasonic Sensor
- Web cam
- Keypad
- Power bank
- Ear phone
- LCD display
- Accessories

2) Software Required

- Raspbian
- Open CV

3) Programming Language

- Python

E. Block Diagram

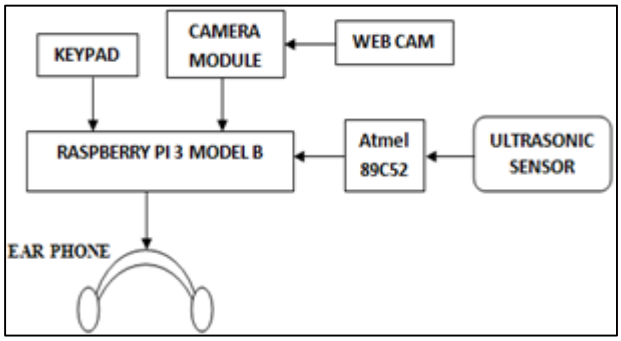

Fig. 1: Block Diagram of proposed system

IV. OBSTACLE DETECTION

The Ultrasonic HC-SR04 sensor detects objects by emitting a short ultrasonic burst and then "listening" for the echo. Principle of the Ultrasonic sensor is shown in the fig.2. Under control of a host microcontroller (trigger pulse), the sensor emits a short 40 kHz (ultrasonic) burst. This burst travels through the air at about 1130 feet per second, hits an object and then bounces back to the sensor. The ultrasonic sensor provides an output pulse to the host that will terminate when the echo is detected and hence the width of this pulse corresponds to the distance to the target. This output is fed to the Raspberry pi which converts this signal into audio signal [1]. Then this audio signal reaches the user through earphones/speakers.

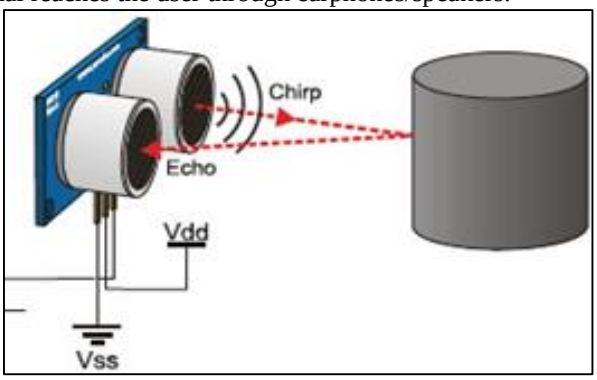

Fig. 2: Working principle of Ultrasonic Sensor

Transmission of signal
Sensor Elevation: 40 in. (101.6 cm)
Target: 3.5 in. (8.9 cm) diameter cylinder, 4 ft. (121.9 cm) tall – vertical orientation

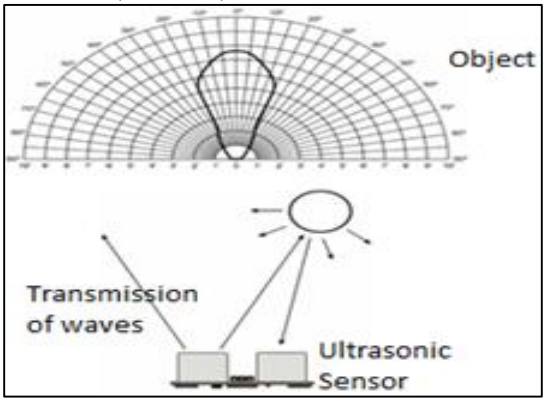

Fig. 3: Transmission of wave from Ultrasonic Sensor

Reception of echo
Sensor Elevation: 40 in. (101.6 cm)
Target: 12 in. x 12 in. (30.5 cm x 30.5 cm) cardboard, mounted on 1 in. (2.5 cm) pole
Target positioned parallel to backplane of sensor.

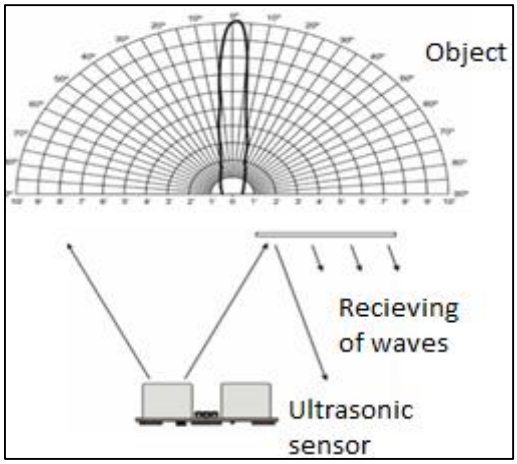

Fig. 4: Reception of echo by Ultrasonic Sensor

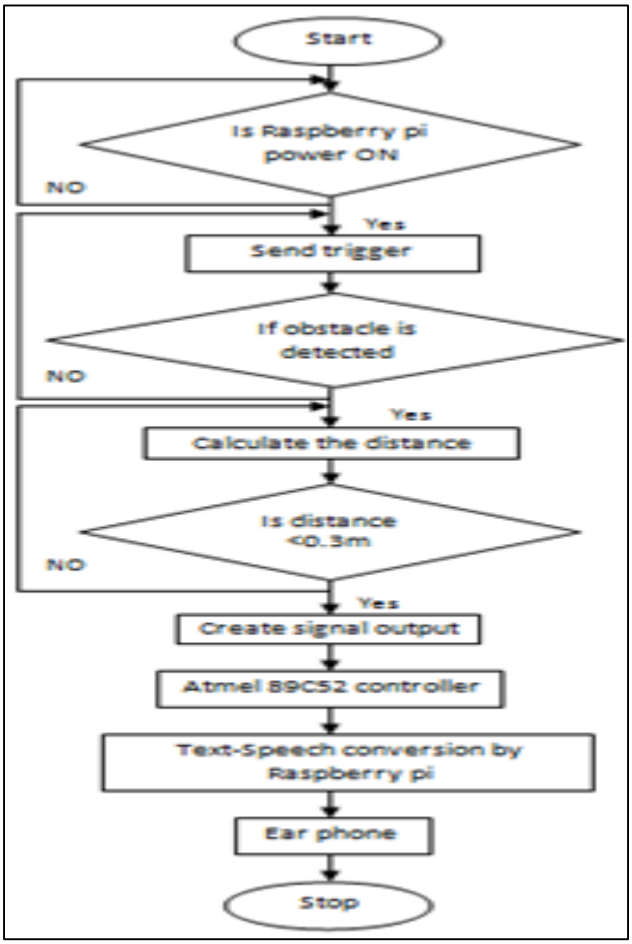

Fig. 5: Flow chart for obstacle detection

V. FACE RECOGNITION

When the blind person goes somewhere, he/she will press a specified button on the keypad. If any person crosses the webcam placed at the front side of the jacket, the face of the person will be detected by the camera. The detected faces re transmitted to the Raspberry-Pi[2]. In Raspberry-Pi Haar Classifier algorithm and ANN algorithm is performed to extract the features and compare it with the existing database. If the detected face matches with the database, the output is the name of the person in the form of audio signal to the user via earphones.

A. Haar Classifier Algorithm

It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. Then need to extract features from it. Haar features are shown in the fig.6. They are just like convolutional kernel. Each feature is single value obtained by subtracting sum of pixels under white rectangle from sum of pixels under black rectangle.

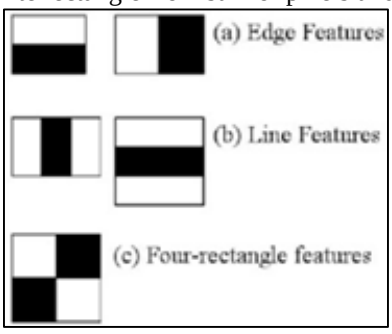

Fig. 6: Haar features

Among all these features calculated, most of them are irrelevant [3]. This can be reduced by using Ada boost classifier. Ada boost reduces the redundant features. Here instead of summing up all the pixels the integral image is used as shown in fig.7.

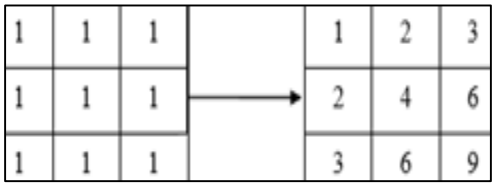

Fig. 7: Integral Image

To get a new pixel value the top pixels and left pixels are added then all the values around the patch are added to obtain the sum of all pixel value. Ada boost determines relevant features and irrelevant features. After identifying relevant features and irrelevant features the Ada boost assigns a weight to all of them [4].

B. ANN Method

In this stage the data taken from the images are simulated using a previously trained ANN. The input will be a vector array from the previous stage. The networks are trained with face descriptors as input. The number of network will be equal to the number of persons in the database.

As the function of natural neural network system of brain, the computer created artificial network has inputs for inserting the data, outputs for providing the network output and hidden layer for processing the data and training of the network as shown in Fig.8.

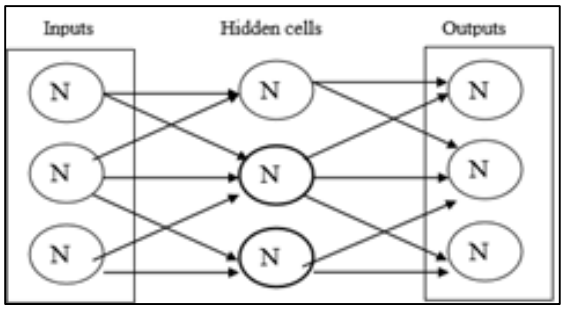

Fig. 8: Artificial Neural Network

The number of neurons in the input layer is equal to number of Eigen faces, number of neurons in the hidden layer is 10 and the type is Feed forward back propagation network.

C. Simulation of Neural Networks

Face descriptors of the test image calculated from the Eigen faces are applied as input to all the networks and they are simulated. Simulated results are compared and a maximum output greater than a predefined threshold level confirms that the test image belongs to the recognized person with the maximum output [5].

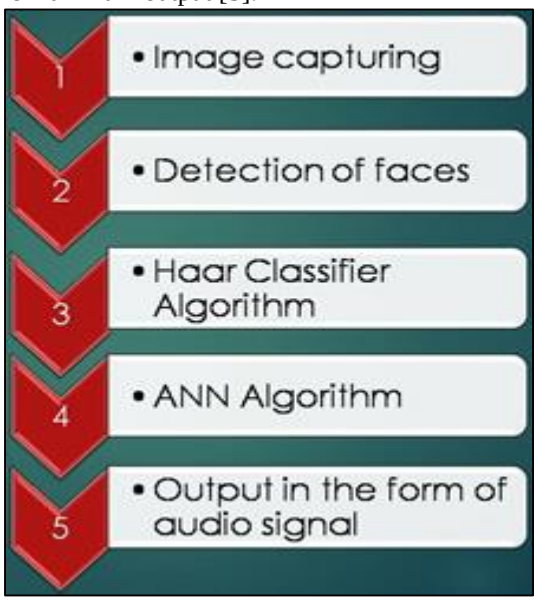

Fig. 9: Flow Chart

VI. IMAGE TO SPEECH CONVERSION

The blind person places the image (in which some text is written) in front of the camera and will press a specified button on the keypad. The text written in the image is captured by the webcam. The image processing is performed to convert it into text. This text is converted into audio signal by eSpeak algorithm and gives the output to the user via earphones [6]. The working flow is shown in the fig-10.

A. eSpeak Algorithm

eSpeak is a compact open source software speech synthesizer for English and other languages. eSpeak produces good quality English speech. It uses a different synthesis method from other open source TTS engines, and sounds quite different.

It can run as a command line program to speak text from a file or from standard input. It includes different voices, whose characteristics can be altered. It can speak text, or produce speech output as a WAV file. SSML (Speech Synthesis Markup Language) is supported (not complete), and also HTML. The program and its data, including several languages, total about 1 Mbyte. It can translate text to phoneme codes. It can be used as a front end for Mbrola voices and perhaps other speech synthesis engines. It can be written in C++.

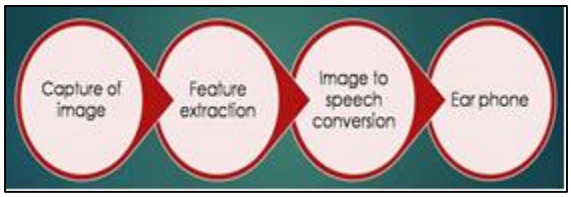

Fig. 10: Flow chart for image to speech conversion

VII. CURRENCY DETECTION

The user places a paper currency in front of the mounted camera and presses a specified button. The image captured by the webcam. The detected image can be compared with the reference images which was already included in the Raspberry pi. The difference between the images will be calculated [8]. The corresponding currency has the minimum difference value. Then the output will be converted into audio signal by Raspberry pi. It will send to the user through ear phones.

VIII. RESULTS

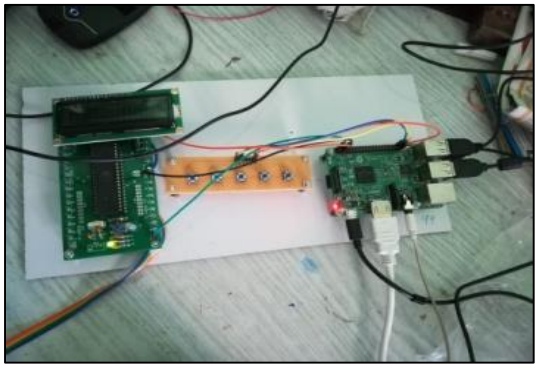

Fig.11 Hardware Module

Fig.12 Capturing of face by webcam

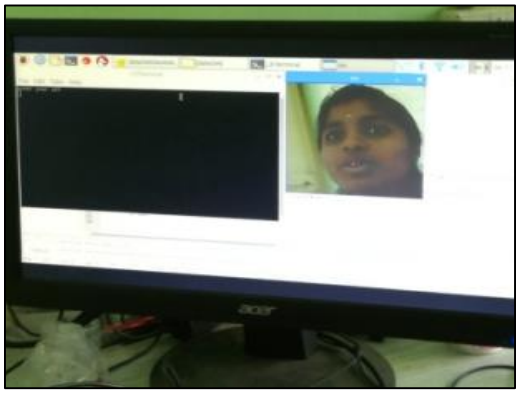

Fig. 13 Detected image

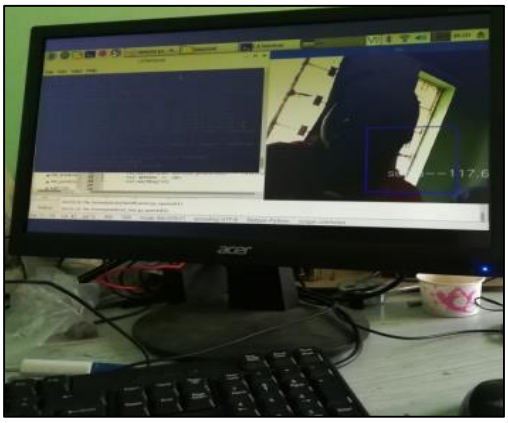

Fig.14 Output Image

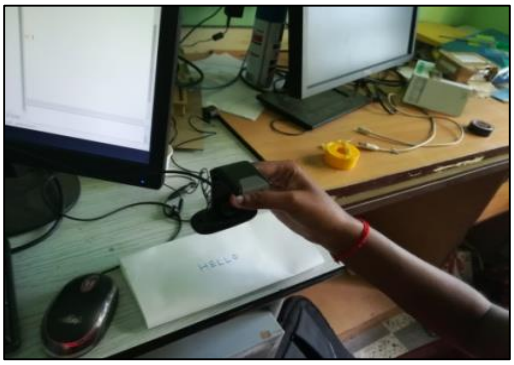

Fig.15 capturing the text image

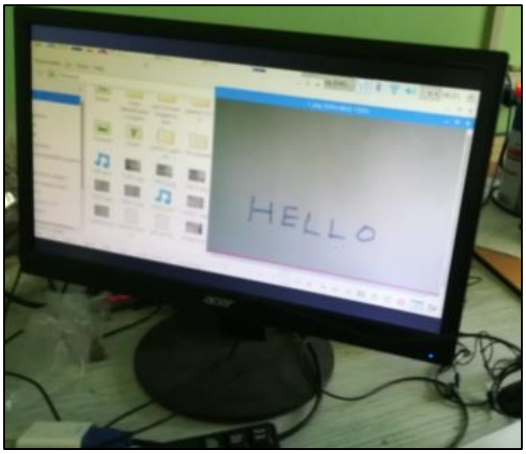

Fig.16 Detected image

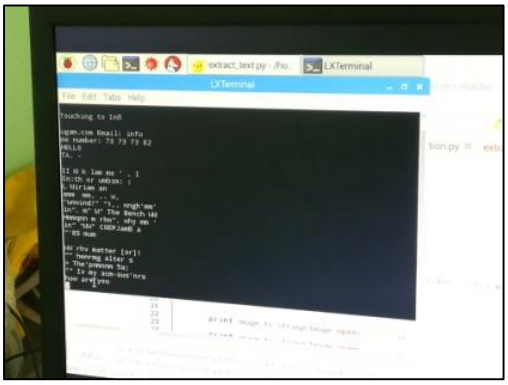

Fig.17 Display of text

Fig.18 Capturing of currency

Fig.19 Voice output through ear phones

IX. CONCLUSION & FUTURE WORK

The existing methods have one or two specific function. But the proposed system is integrated with multiple functions and this will aid them in performing their daily chores easily, independently and more efficiently in affordable manner.
Our further work is to include door/windows identification, integration of barcode reader and health sensors integration in this device.

REFERENCES

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