Electronic Travel Aid for visually Impaired People using Sensor Nodes and Computer Vision in Raspberry Pi

DISSERTATION II

Submitted

By

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IN

EMBEDDED SYSTEMS

Under the Esteemed Guidance of

MR. CH. RAVI SANKAR

TOPIC APPROVAL PERFORMA

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PROPOSED TOPIC : Electronic Travel Aid for visually Impaired People using Sensor Nodes and Computer Vision in Raspberry pi

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Sr.No.	**Parameter**	**Rating (out of 10)**
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2	Project Feasibility: Project can be timely carried out in-house with low-cost and available resources in the University by the students.	7.00
3	Project Academic Inputs: Project topic is relevant and makes extensive use of academic inputs in UG program and serves as a culminating effort for core study area of the degree program.	8.00
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Final Topic Approved by PAC: **Electronic Travel Aid for visually Impaired People using Sensor Nodes and Computer Vision in Raspberry pi**

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CERTIFICATE

This is to certify that the Dissertation-II titled "Electronic Travel Aid for visually Impaired People using Sensor Nodes and Computer Vision in Raspberry pi" that is being submitted by "Ram Tirlangi" is in partial fulfillment of the requirements for the award of MASTER OF TECHNOLOGY DEGREE, is a record of bonafide work done under my guidance. The contents of this Dissertation-II, in full or in parts, have neither been taken from any other source nor have been submitted to any other Institute or University for award of any degree or diploma and the same is certified.

CH. Ravi Sankar
(Assistant Professor)
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CANDIDATE’S DECLARATION

I hereby certify that the work which is being presented in the synopsis entitled “Electronic Travel Aid for visually Impaired People using Sensor Nodes and Computer Vision in Raspberry Pi” by “RAM TIRLANGI” in partial fulfillment of requirements for the award of degree of M.Tech. (ECE) submitted in the Department of (ECE) at Lovely Professional University, Phagwara, is an authentic record of my own work under the supervision of Mr. CH. RAVI SANKAR The matter presented in this synopsis has not been submitted by me in any other University for the award of M.Tech Degree.

Signature of the Student

(RAM TIRLANGI)

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I would like to place on record my deep sense of gratitude to Mr. CH. RAVI SANKAR, Department of Electronics and Communication Engineering, Lovely Professional University, for his generous guidance, help and useful suggestions without which this work would not have been possible.

RAM TIRLANGI

ABSTRACT

Objectives: To make robust, reliable and affordable Electronic Travel Aid (ETA) which is composed of ultrasonic sensor nodes, smart cane stick and object detection device used in synergy used by blind and visually impaired persons for navigation and object recognition in indoor and outdoor environments.

Methods: For the navigation in indoor environment, four ultrasonic sensor nodes which measure proximity of surrounding obstacles and if any object is too close then vibration feedback is given to the user. Smart cane stick will detect wet floor and stairs and if detected then vibration feedback is given at cane handle. In object recognition device, we have used Raspberry pi 3 and camera which will detect defined objects in front of the blind user and describe it using audio feedback via headphones in which we have used computer vision techniques from Opencv libraries like SURF extraction and haar cascades used with neural networks for cognitive machine learning which makes object detection and recognition robust. And we have used image captioning technique to for the image description of what is there in front of him.

Findings: Using ultrasonic sensor nodes at ankles, wrist, and waist, yielded better navigation in indoor environment because the ultrasonic sensors are more accurate, fast and distortion less as compared to the other sensors. A simple cane stick gives less information about the environment while smart cane stick gives information about stairs, wet floor and unevenness of floor to the blind user to avoid collision and also better range of detection as compared to simple cane stick. For object recognition, SURF feature extraction and haar cascades are used which is best suited for object detection and recognition of defined objects. And using machine learning increases the accuracy of the object recognition for unknown objects so like this the blind user can understand what kind of object is there in front of him, which was not possible using distance sensors alone. Using the three devices in synergy the blind person can navigate and recognize the objects in indoor and outdoor environments more easily and makes our ETA more accurate, efficient and affordable.

Application: For visualization of the surroundings for blind and visually impaired people.

INDEX

LIST OF ABBREVATIONS

- ETA ELECTRONIC TRAVEL AID
- OPENCV OPEN COMPUTER VISION
- SURF SPEED UP ROBUST FEATURES
- WHO WORLD HEALTH ORGANIZATION
- RAM RANDOM ACCESS MEMORY

LIST OF FIGURES :

CHAPTER - 1

INTRODUCTION

As indicated by a review by WHO information [1] 285 million individuals are blind or visually impaired and most of them living in the developing nations. And to assist blind people ETA were build and developed since past five decades, but there was no robust and affordable device which can save blind user to avoid hitting obstacle. And also give more information the blind user which was not possible simply using simple Cane stick alone. There were many types of ETA in the market, like In Fig.1.1 is ultrasonic sensor based ETA, which uses ultrasonic sensors to measure distance and give tactile feedback to the user if the obstacle is too close.

Fig.1.1 A Typical Electronic Travel Aid

1.1 Sensor based Obstacle Avoidance Electronic Travel Aid

The Sensor based ETA measure the proximity of the distance between the user and the surrounding objects and the feedback input from the surroundings is sent to the user through vibration feedback or sound feedback by changing intensity of vibration feedback or the intensity of the sound. For distance measurement we use light sensors, ultrasonic sensors in which sound sensors are the best for distance measuring. So, most of the obstacle avoidance systems all over the world use ultrasonic sensors in ETA.

So how this ultrasonic sensor work is they use ultra sound which has frequency of above 20kHz, which is not audible to the humans, and in that sensor, they have transmitter which sends ultrasound and upon reflection of sound from the obstacle they receive the sound, and by calculating the transmission time we can conclude the distance.

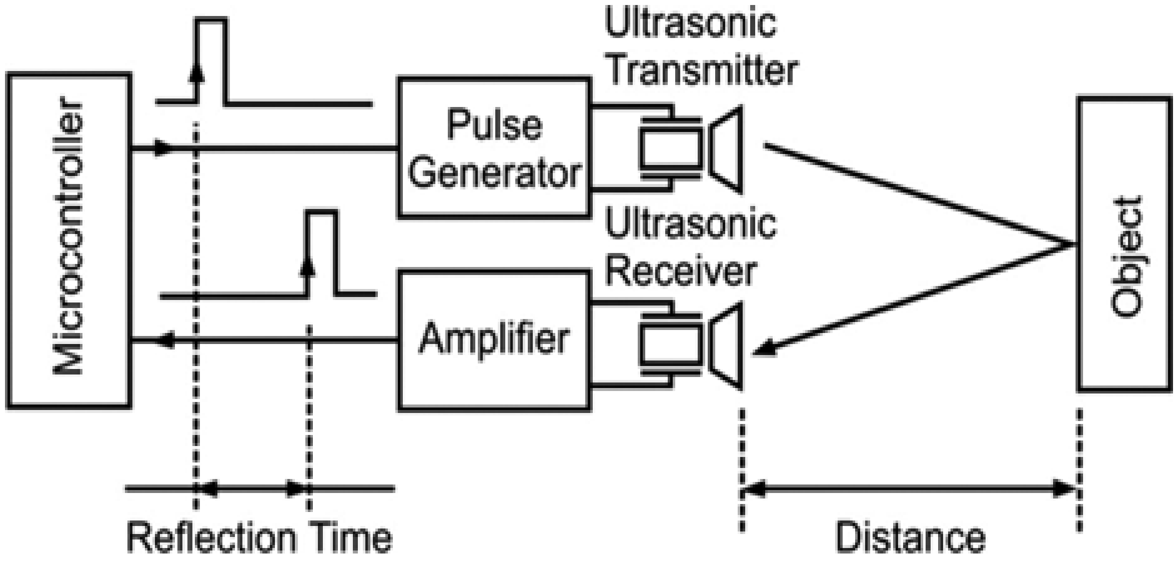

Fig. 1.2. Ultrasonic Sensor Principle

1.2 Computer Vision Based Electronic Travel Aid

As we already have obstacle avoidance based devices, and by using these devices the blind or visually impaired user can navigate across indoor and outdoor but what about other features about the surrounding like how it looks like, or what is there infornt of the user, so here computer vision comes into play. Computer vision is a vast field which we have object detection, recognition etc, which uses image processing and machine learning features to do these operations.

So, for computer vision we use OpenCv which is a largest open source library for computer vision applications which was created by intel technologies.

In computer vision, there are many algorithms many algorithms through which we can recognise the objects but these algorithms are extensively used for the object recognition.

- SURF (Speed UP Robust Detection)
- Haar Cascades

- Hog Classifiers

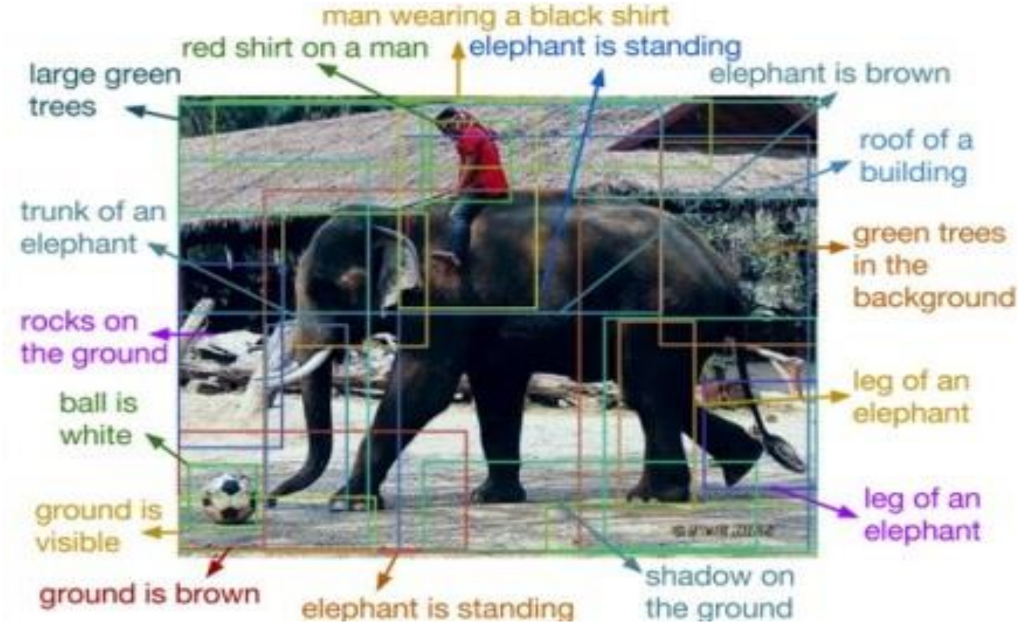

Fig.1.3 Object Recognition and Description

So, using these algorithms we can detect and recognise the objects. And upon recognition we can tell the blind user that object has been detected via auditory output. By this the blind user can understand what is there infornt of him.

1.3 Conveying Information Through Sound and Touch

The Blind Persons Vision sense but they have other senses which are much more powerful that are touch and sound and smell, although we can't use smell sense much widely for conveying information to the blind user, but we can use them in some occasion like in emergency situations. But we can use other senses like touch (tactile) for giving message to the user, like in ultrasonic sensor nodes, which give vibration feedback to the blind user if an obstacle is detected.

But the one of the best to convey information will be sound i.e., auditory input to the user by headphones or speakers. We always describe things via speech, what if we make a device which converts images into speech which will be heard by the blind user so that he can better understand the environment, without depending on others.

CHAPTER – 2

REVIEW OF LITERATURE

The results of literature review are presented here. In this we have used IEEE and the other reputed journal to learn what has been learned and tested, and what are other things to be improve. In this we have learned about different aspects of ETA and how to use the better parts of the system and make our system more accurate.

In [2] Yabiao Gao et al, they have used multiple ultrasonic sensor nodes to measure the distance between the user and the object, and if the distance between the user and the obstacle is less then tactile intensity controlled feedback is given to the user.

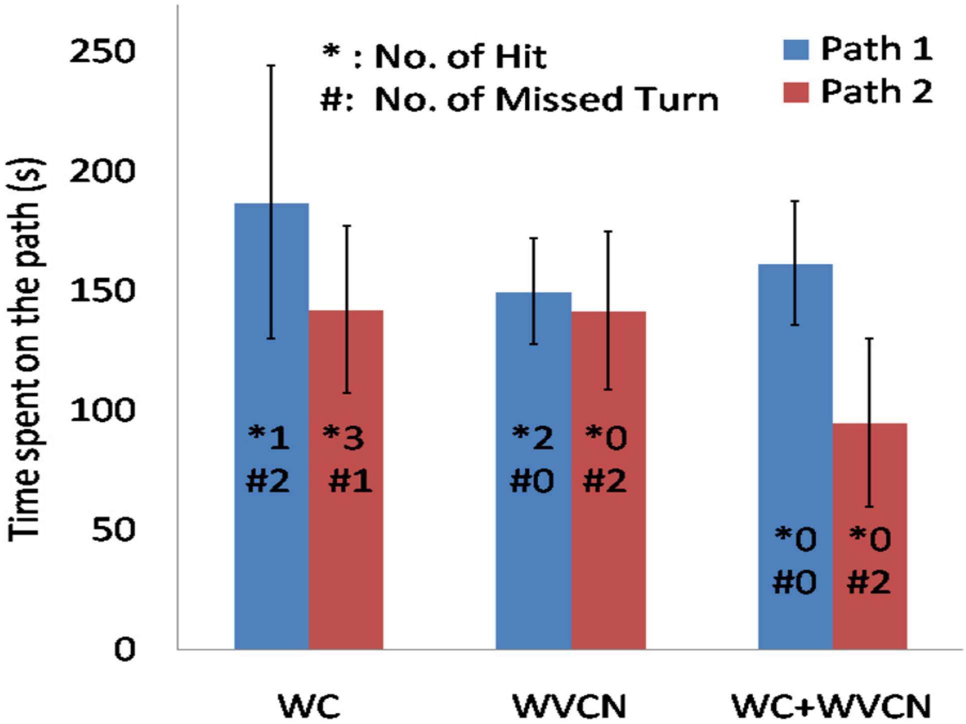

Fig.2.1 Testing of subject with and without ultrasonic sensor nodes

In Fig.2.1 they have sent 5 subjects to the unknown indoors then checked their how much accurately they traversed without colliding with this obstacle using these Sensor nodes, results were very good.

In [3] shirpad bharatwandal et al, here they have given a nice method to build up a smart stick to distinguish the surrounding's and give output as per it to the user. In Fig.2.2 This keen stick is not the same as ordinary stick since the more advanced stick simply give bolster and less scope of location of the user since they are difficult to use. But busing this smart mobility stick then user can fine wet floors and stairs and avoid collision with obstacles. The figure they have given graph for performance the result was best.

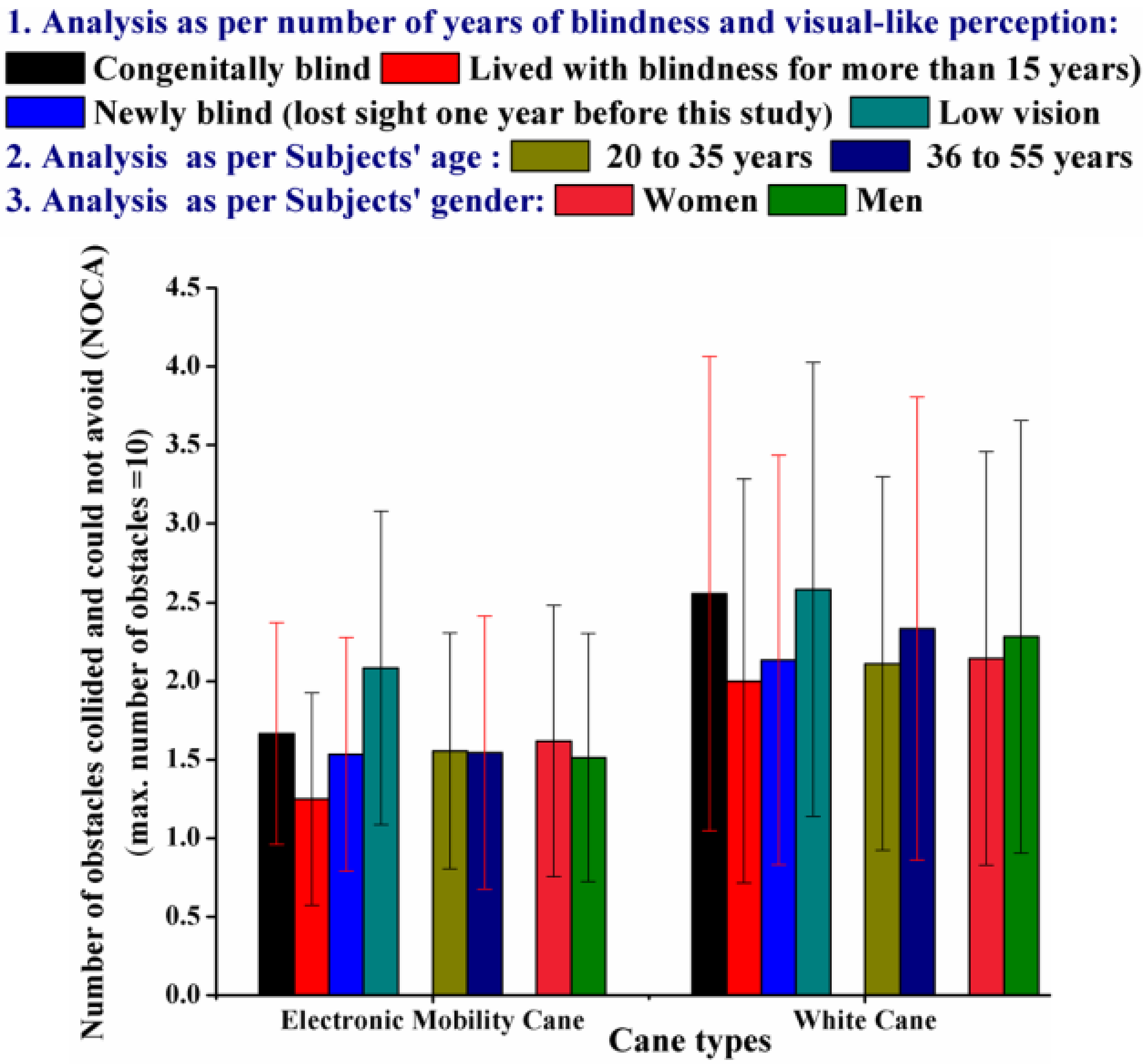

Fig.2.2 study of the graph and result of the electronic mobility cane

In [4] Yanqi Lu et al, they have given a better way to sense the environment with using the filters which collect the data from the multiple sensors and give feedback per our configuration in Fig.2.3. they have done this. In this paper they have implemented multisensory nodes which work in tandem for the more accurate results which the user need to avoid collision with the obstacles, as you can so in the figure there they been many sensors attached to the body that person , so that she can move freely in indoors in to avoid collision , the accuracy of these sensors depends on what algorithm you are using to take an average for the getting mean value so that if that is given to the blind user in tactile feedback. So, this is one of the most accurate system but using this many sensors is tedious.

Fig. 2.3 An Electronic Travel Aid Based on Multi-Sensor Fusion Using Extended Kalman Filter

In [5] Shrugal Vardel et al. in this paper, they used an FPGA based obstacle detection device, in which they used fpga what are one of the fasted as compared to the microprocessors and microcontrollers. And upon detection they give vibration feedback to the user to avoid collision to the obstacles.

In Fig.2.4 in this they have given FPGA based ETA which has ultrasonic sensor for distance measurement and also, they have fpga which very fast since it contains sram, which is a fast memory. In this project, the best will be the it since it will near to Realtime output since we are using fast memory here.

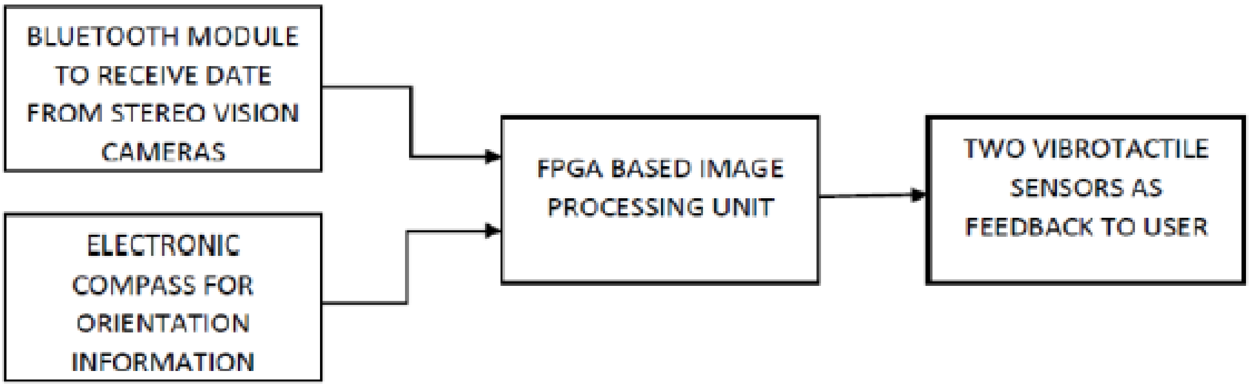

Fig.2.4. Block Diagram of the system

In [7] Sandra Mau et al, here this they have used a mobile for the processing part and used tags which detect and give output to the user when the user comes too closes top the tag and these tags are built by RFID using this the user can freely travel in the house without minor issues, for instance, in Fig 2.5 in the building there were equipped with these sensors, so when the blind suspect comes too much close RFID will be activated the and the user know where are the obstacle. actualizing their structures with RFID labels.

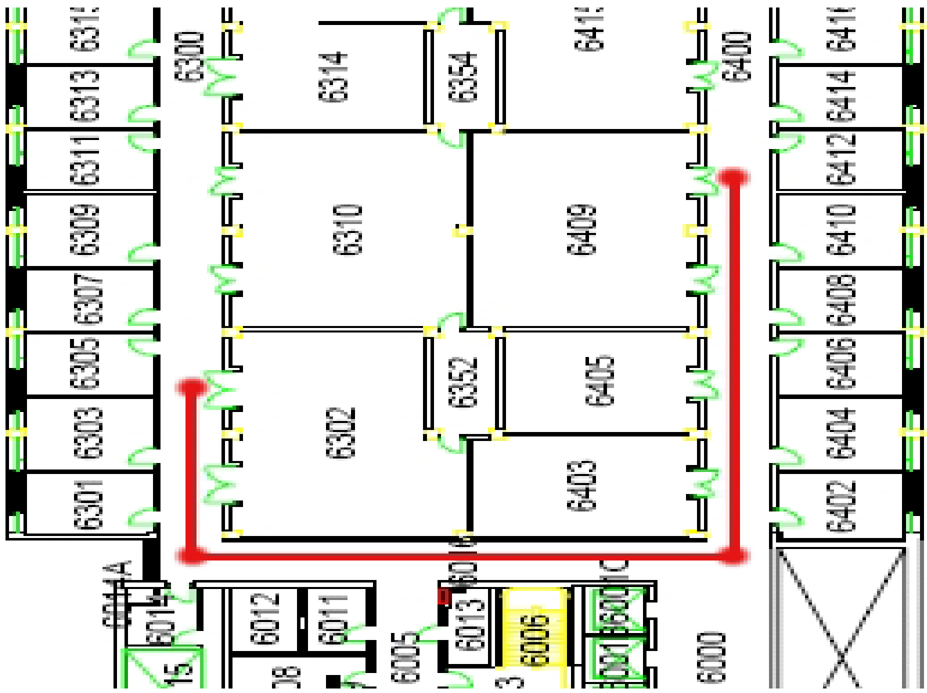

Fig.2.5. Path used by the user using RFID

In [8] Yeongmi Kim et al, in this paper they used tactor feedback material for better to the blind persons in the fingers so that he can avoid the collision with the other obstacles. In Fig.2.6 as per the

Reach there has been immense reach in this field so that blind use can learn based on his hand. That is vibration sensor is given using tactile sensors which give data to the used when obstacle is too close.

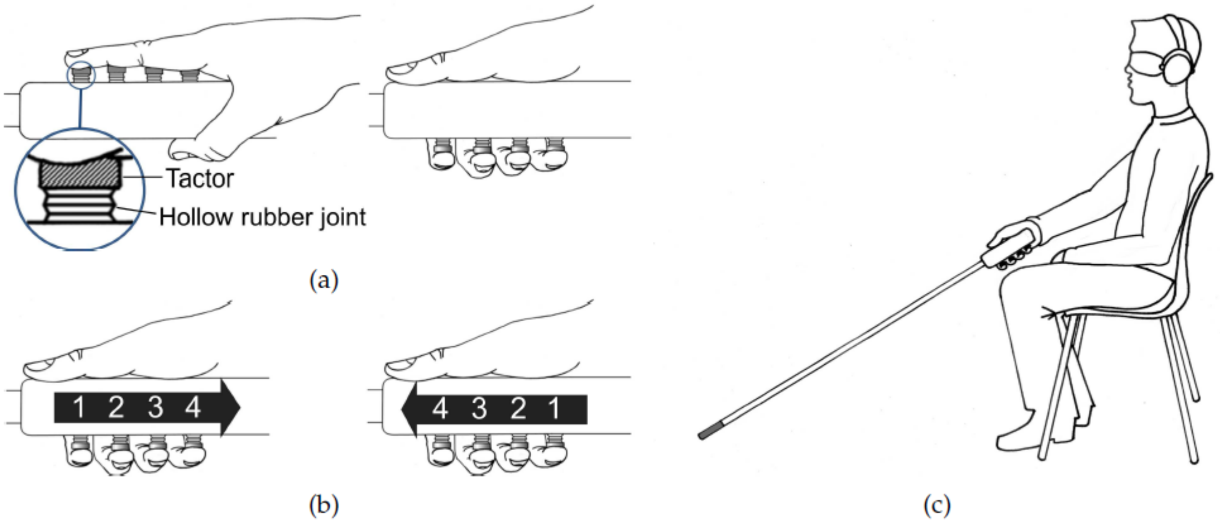

Fig.2.6. Tactor arrangement with different finger arrangements in a,b and c.

In [9] Dimitrios Dakopoulos et al. In this study, they have the essential contention that human hearing framework is very equipped with the best sound sensors which will listen to the sound and send to all over in front of the user so that user Can hear binaural sounds like a bat in this project they have used binaural system see like a bat vision but it many inaccuracies and sometimes it may fail so user caution I more important here. In Fig.2.7 The camera catches pictures and the PC utilizes a drake's pictures of surrounds and give feedback based on the depth on the surroundings so like this project works.

Fig. 2.7 voice— "Seeing with sound" system

In [10] Hangrong Pan et al, in this they have used image processing to detect buses and bus numbers so that users and know which bus is coming, so they have haar cascades to know that and track the bus, after a photo is taken and in that image bus number is searched and after receiving the bus number then it will be conveyed to the blind user and they can climb the bus. In Fig 2.8. their framework is that detect bus, and after that number and if relevant then inform the blind user.

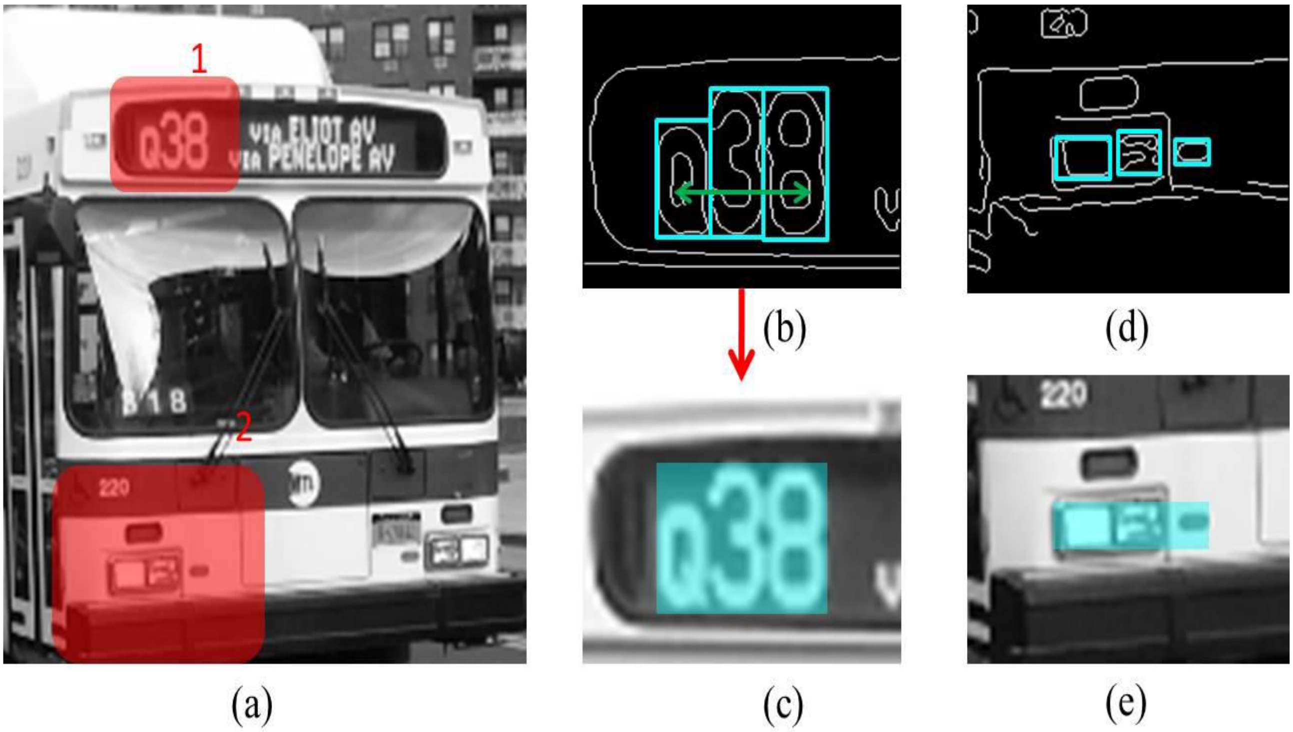

Fig. 2.8. The character grouping. (a) Original image of bus (b, d) candidate character boundaries in edge map. (c, e) An adjacent group in the candid.

In [11] Ricardo Chincha, they proposed an object recognition method to help blind this function, we are going to use Speed Up Robust Features Detection function which extracts features form the image and next these features are given to classifier like naïvebayes classifier and then we also give target name, and like Fig.2.9 this it will train itself, so if we test in the Realtime video, then it will check that features in that video, if the features are matched then it will give object is detected and if the object is detected then audio output is given to the user.

In [12] Ruxandra Tapu et al. in this paper they have given rare and navel technique to study the surroundings based upon the features i.e., based upon the edges, here we have used edge detection to find the edges and if the edges are too close then user is infuriated to stop and change course to avoid the collision and like this using computer vision the user was able navigate in the cities which informed about the dangerous to move especially for a blind person.in Fig.2.10. shows the thing which here are detected based on their features so theta to detect them and convey user about the cars, road and tress and any other obstacle he may get on his to the places when he visits.

Fig. 2.9. Matching between reference and test images in the presence of cluttered background under various conditions, keys, cell phone, sunglasses, sneaker, and wallet.

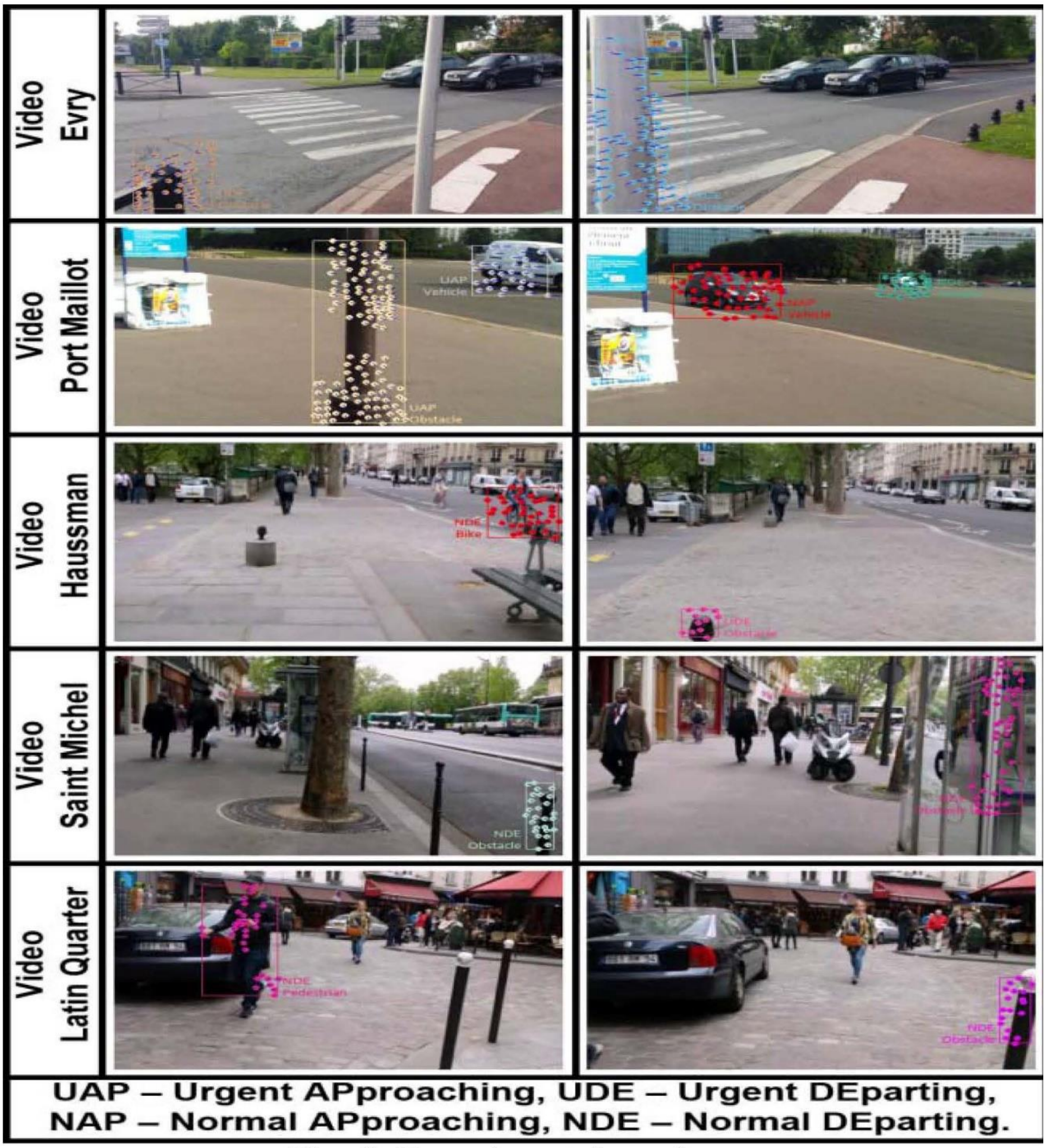

Fig 2.10 Experimental result of Hog descriptor for feature extraction for detecting objects.

In [13] Aurang Zaib et al, in this paper they have used marker notes on each side of the corridors, so we have detectors which will then be used to detect the marked object since it is difficult for the blind people to search for the lost things, so now the user can use this mark to mark where ever he wants to see and if that thighs came once again then it will inform the user about that thing by sensory output. In Fig.2.11 gives the flowchart for this system, so in this they first mark things and next check things and inform the user. This system is cheap and easy to build but it now possible to marl all over the world so we need better alternative for this type of things.

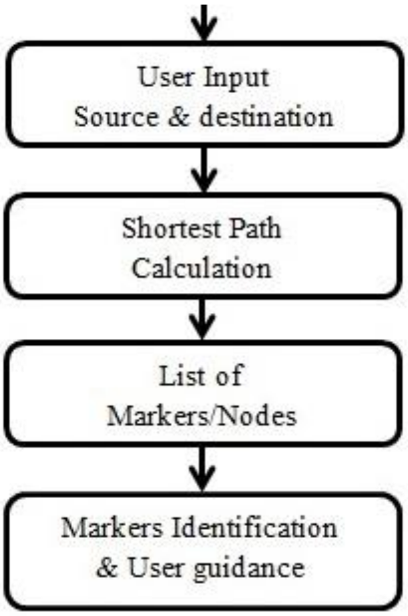

Fig. 2.11 Steps For marker detection and guidance in indoor environment.

In [14] Deep Visual-Semantic Alignments for Generating Image Descriptions, In this paper they have presented a model that generates natural language descriptions of images and their regions, they train by huge data sets which are already classified, and then they are sent to the recurrent neural networks by which the system learns how to identify objects, like in Fig. 2.12 they have classified things and image captioned them so by using this technique we can implement object recognition device for description of the surrounding for the blind user.

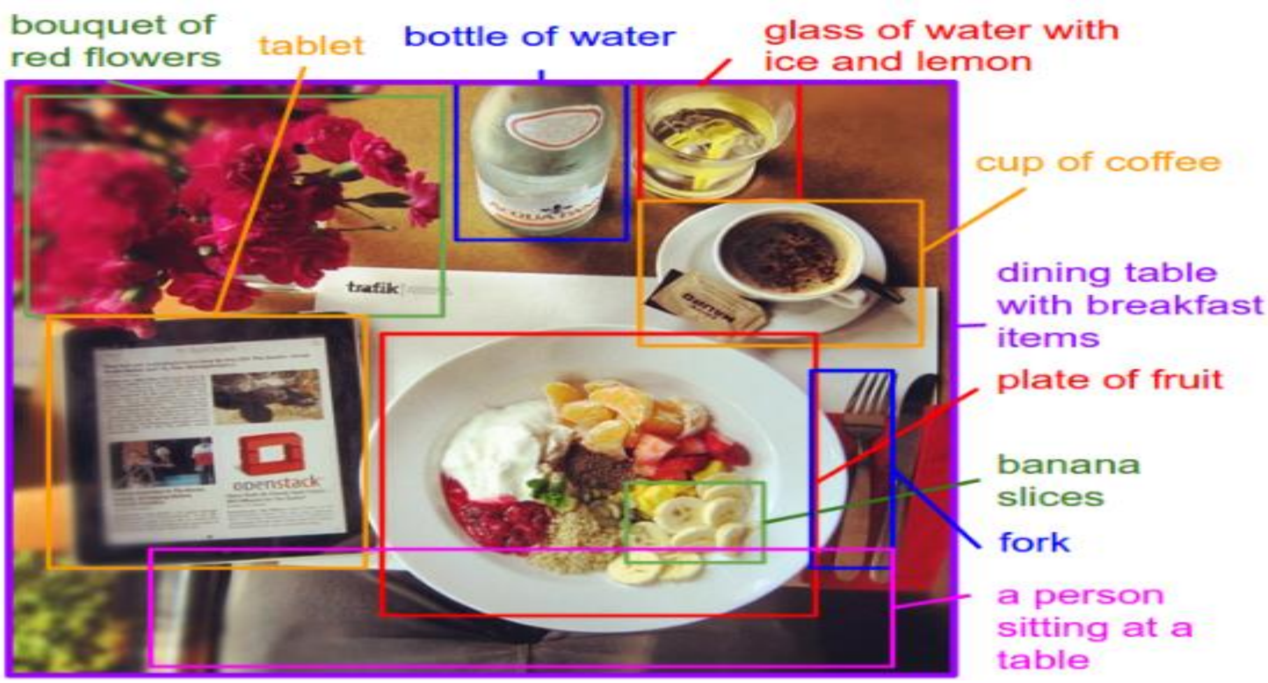

Fig. 2.12. image captioning using recurrent neural networks.

CHAPTER – 3

RATIONALE AND SCOPE OF THE STUDY

3.1 RATIONALE

There are many problems with currently available devices and they are

First, the blind users find ultrasonic ETA difficult to operate and less accurate, and not that much reliable and robust.

Secondly, blind persons get the vibration or sound feedback mostly confusing, since they have to adapt for it, so it will sure take more time and sometime users may that information conveyed is just too much.

Thirdly, most blind persons don't like to use these electronic products, since they need to be charged and are little bulkier. And may get damaged easily, so they have taken special care of such products.

Fourth, with computer vision there is some changes of error, or miss conception, so we need a more robust algorithm which are accurate

Fifth, as we keep on increasing our needs there is will more need powerful hardware, and we can't afford that as we are making a less cost device.

Sixth, there is serious need to utilize the computer vision concepts in the products, but are a little difficult. Since it is new concept to many of the users also, it takes time for the users, to learn this technology.

Seventh, there is serious need for affordable devices in the developing countries.

Eight, as output from our computer vision device is in English, so there are language barriers.

3.2 SCOPE OF THE STUDY

Our main scope of this study is, to make a most affordable and reliable, obstacle and computer vision device for better navigation of the blind persons, take maximum information from the surroundings and convey it to the blind user through sound and tactile feedback. And in the market, there mostly just simple obstacle avoidance devices which are mostly costly and convey less information so that’s why we have added computer vision ability to the device. This make give blind user another friend who will assist him, for his needs.

CHAPTER – 4

OBJECTIVE OF THE STUDY

Objectives of the Study are:

a) To make a robust, reliable, ETA.

b) ETA should be easy to use.

c) Give maximum information of the surroundings to the blind user.

d) To fully utilize computer vision technology which is hardly used for this purpose.

e) The device should be affordable, to threshold cost up to 5000k rupees, so that every blind user can afford it.

f) To make device more error free, so we have almost all algorithms, used best accurate algorithms.

g) For the betterment of the blind persons in our society.

h) To make the blind persons more independent, make them less dependent on others for getting more information from others.

CHAPTER – 5

MATERIALS AND RESEARCH METHODLOGY

5.1 MATERIALS

A) Raspberry Pi: It slim pocket Size Motherboard which can run OS. And its features are given in the Fig.5.1. And one question arises why we used raspberry pi, because it is the cheapest motherboard currently available in the market, and also powerful and best online support by developers.

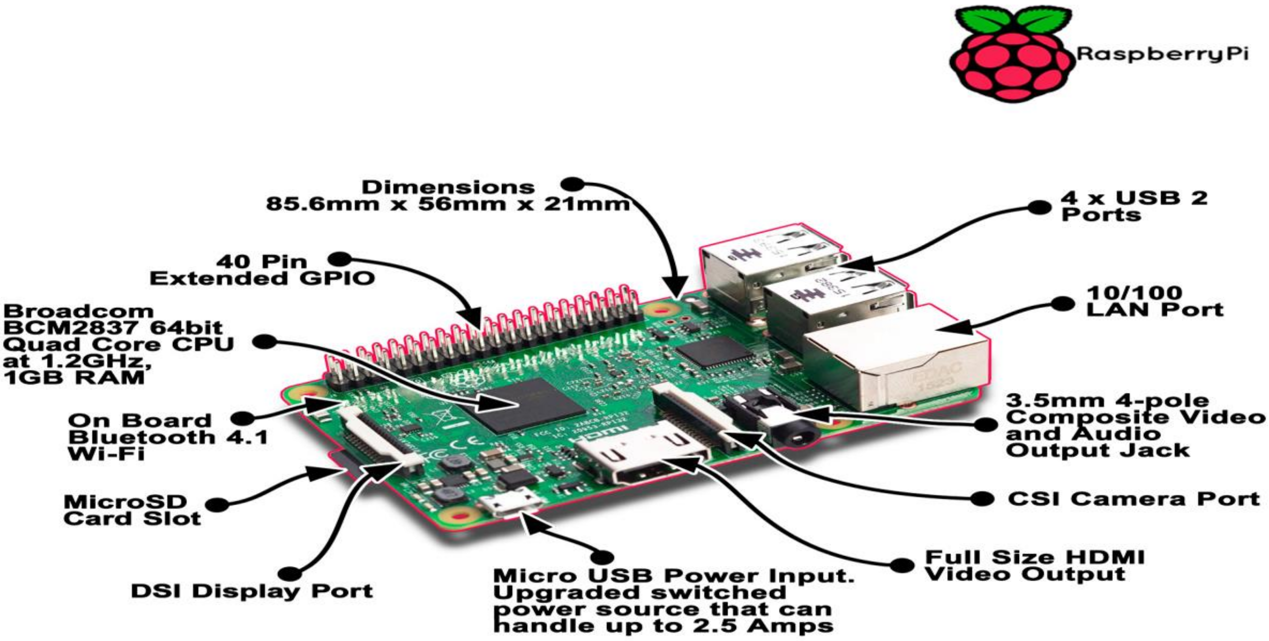

Fig.5.1. Raspberry Pi

B) Logitech C270 USB Webcam : we have this webcam because it gives high quality images and also our OpenCv programs run better with this camera. We can see Fig.5.2 it has 3MP clarity.

Fig. 5.2. Logitech C270 USB webcam

C) Ultrasonic Sensors: they have four terminal that is supply, trigger, echo, and ground, and this sensor is used for distance measurement. In Fig.5.3

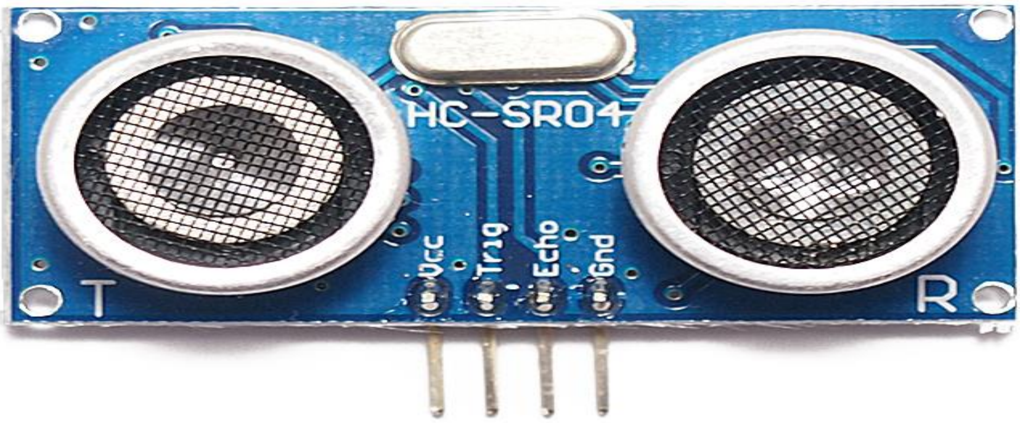

Fig. 5.3 . Ultrasonic Sensor

D) Earphones : these will help blind user to hear name of the object. We can also use Bluetooth headset for the comfort of the blind person, as wires just mixup.

Fig. 5.4. wired and Wireless Earphones.

E) Power Bank : it will be used to power the Pi so that it will be mobile, the slimmer would be better but the, there will less power use 10000 maH power bank for power supply upto 10 hrs.

Fig. 5.5 Powerbank for Powersupply to Pi

F) Push Buttons : these are used for the controlling the functions in Pi. All these functions will be can be opened and closed by the user by pushing it.

Fig.5.6 Push Buttons

5.1.1. **COST OF MATERIALS**: as we add up the cost of the materials, they all add up to less than Rs.5000 INR, they are affordable, since in market only ultrasonic sensor based ETA cost about 3 to 10 k, but this device, works as obstacle avoidance device and

5.2 METHODLOGY

Here we have three devices where the first two are ultrasonic obstacle detector based on which proximity of the distance between the user and the surrounding objects is measured and feedback is sent to the user through sound feedback or vibration feedback i.e., by changing intensity of vibration with respect to the distance measured between sensor and obstacles. In the third device, we have used object recognition module which will detect and recognize the surrounding objects and give the audio output to the user if the defined objects are detected. And also, it will work as image captioning device upon a single click of button. So, these three devices work in tandem so that the blind user will get maximum information from the surroundings without any other persons help.

5.2.1 ULTRASONIC SENSOR NODES FOR OBSTACLE AVOIDANCE

We have excessively used Ultrasonic sonic sensor because for distance measurement they are one of the best, since it is distortion free as compared to light, in the Fig.4.1 is flowchart for the working of the ultrasonic sensor node, here an ultrasonic sensor is used to send and receive the ultrasound, and by the delay time we measure the distance although the maximum range of distance detection is up to 4 meters, and now we are going to implement decision loop for checking condition, i.e., if distance is below 1 meter the user will get vibration feedback. And If detected distance is between 1 to 2 meters then using PWM the blind user will get tactile feedback for 50% of duty cycle, and if above 3 meters then the user will not get any tactile feedback.

We have also used multi sensor nodes which will convey info to different parts like legs, arms, and waist, but it becomes cumbersome for using this many sensors.
But using this sensor alone for the obstacle avoidance will not be enough for the user, so we have used computer vision device for object detection and recognition, so that the blind user can know what is there in front of him.

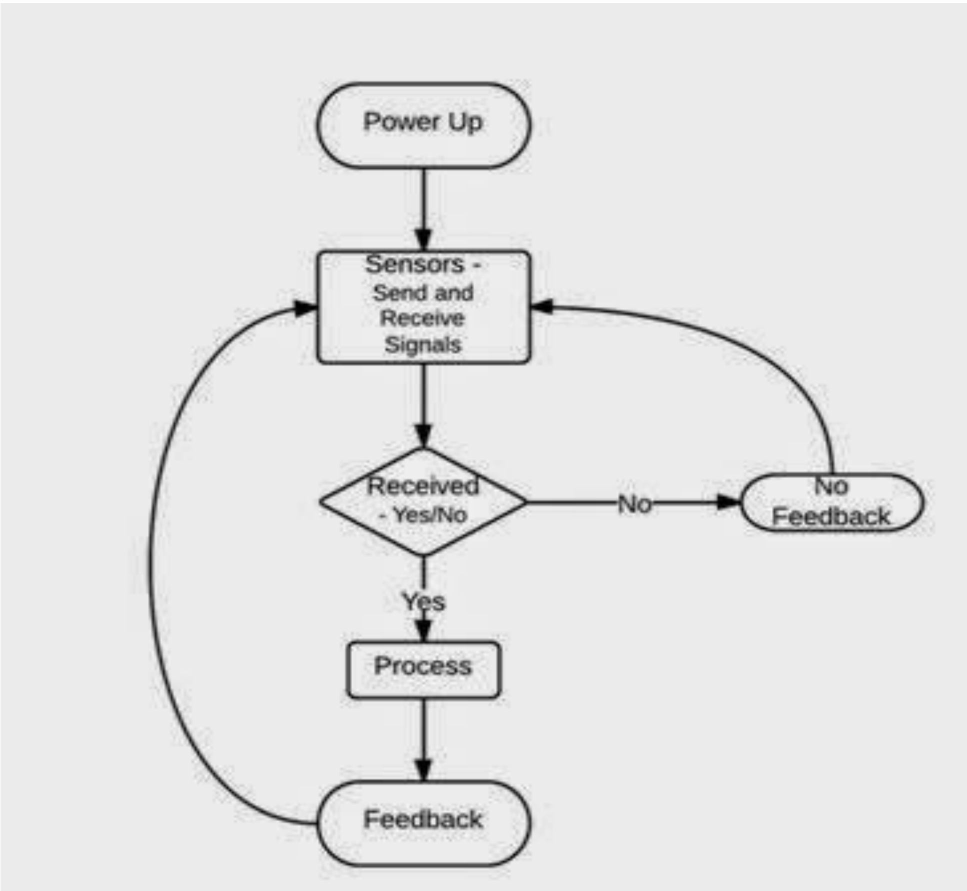

Fig 5.7 a) Flowchart for working of Ultrasonic Sensor Node.

5.2.2 COMPUTER VISION DEVICE

5.2.2.1 Working Principle

In this device, we are going to use many feature of computer vision for the betterment of the blind user. So now the working principle of the computer vision device is it has three units and they are.

a) Input from the camera
b) Image Processing by Raspberry Pi
c) Sound feedback given to the blind user via headphones or Bluetooth headset for comfort.

So, these are the main components in our computer vision device, first we are take input i.e., photo and video from the camera and that input is processed by the raspberry Pi and after object detection and recognition, the name of that detected object is given as sound via headphone jack or Bluetooth headset.

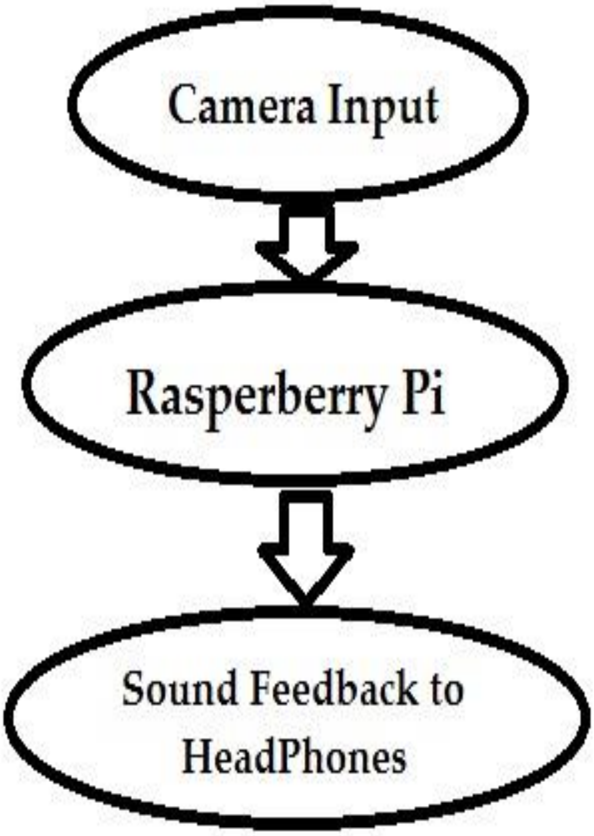

Fig.5.8 Flow Chart of Computer Vision Device

5.2.2.2 Hardware Part:

To build this device we need:

a) Raspberry Pi
b) Logitech C270 Camera.
c) Earphones or Bluetooth Headset.
d) Power bank
e) USB Cable
f) Push Buttons

So, our Assembled final hardware looks like this,

Fig.5.9 Assembled Computer vision and Obstacle avoidance device with Bluetooth Headset

5.3.3.3 Software Part:

After installing Rasbian Jesse OS, we need to install these dependencies and computer vision libraries.
So, the commands will be:

sudo apt-get install build-essential
sudo apt-get install python-dev
sudo apt-get install gfortran
#sudo apt-get install python-opencv
#sudo apt-get install python-matplotlib
#sudo apt-get install python-numpy

After installing all these dependencies and computer vison libraries. There is need for TTS i.e, text to speech conversion, we need to install

#sudo pip install festival

And we use that library like this

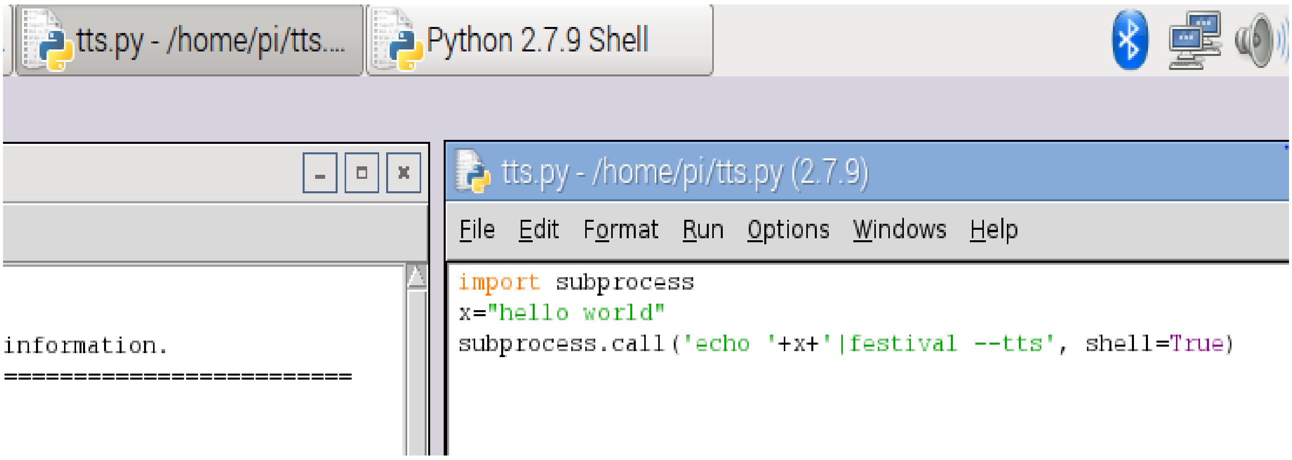

Fig.5.10 festival text to speech conversion library

We have three buttons via which we can control our pi, and use the function which we need. So, in this function the first function is

A) SURF based object recognition function (Activated by pressing button one):

In this function, we are going to use Speed Up Robust Features Detection function which extracts features form the image and next these features are given to classifier like naïvebayes classifier and then we also give target name, and like this it will train itself, so if we test in the Realtime video, then it will check that features in that video, if the features are matched then it will give object is detected , and if the object is detected then audio output is given to the user.

For this First we need to create Training Data, where we save object image which we want to recognise. So, we will use sift extractor. For extracting the image. And use other functions to load video camera and other features.

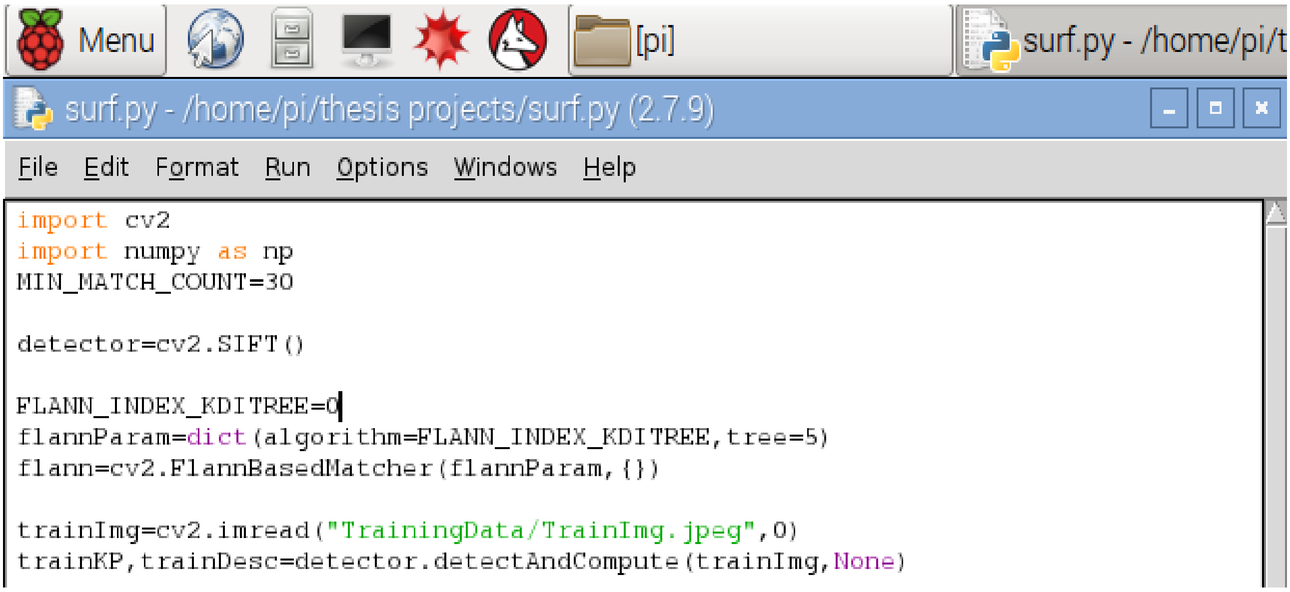

Fig.5.11 surf Feature extraction and Flan based KNN matcher

And now if the more than of equal than 30 features are then it will recognise object.

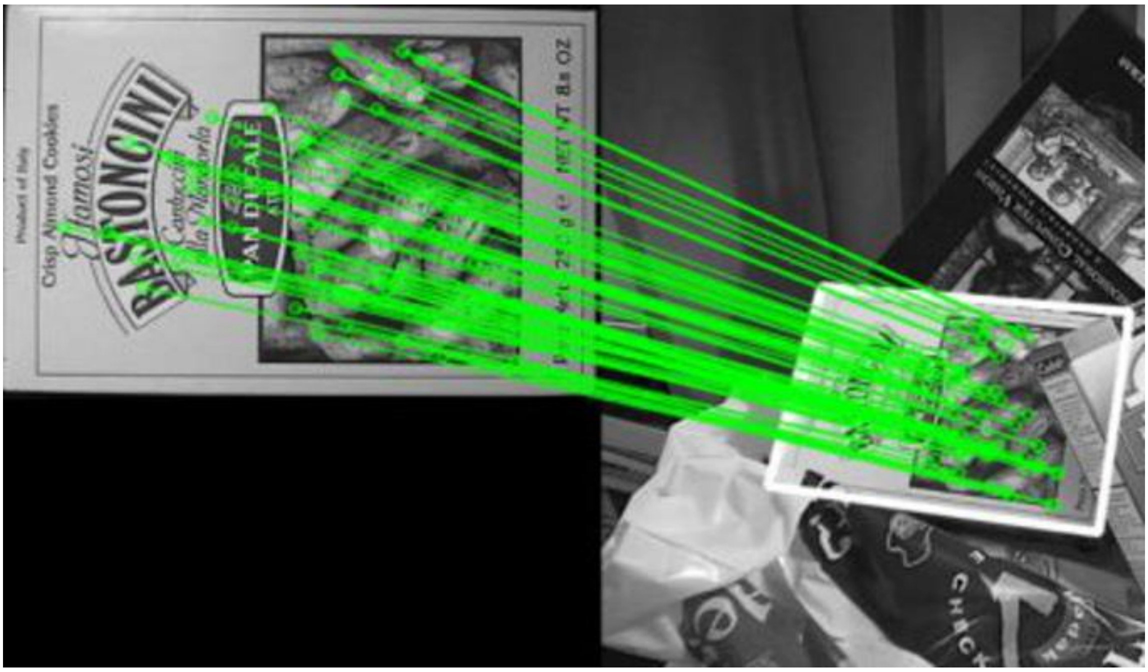

Fig.5.12 feature mapping using surf

The Disadvantages of SURF based object detector is it has more false positives so, we may get an error So, we need more robust object recognition technique and that is using Haar Cascade.

B) Haar Cascade based Object Recognition Activated by pressing button two.

Haar Cascade is a classifier used to detect objects, it is developed by viola and jones, in this we have XML files which are trained using positive samples in the negative samples. Haar cascade is more robust and fast than SURF based classifier since it is a machine learning based algorithm, in this the process of training an algorithm will be like this.

Steps to build a Haar Cascade:

a) First download a set of positive (the images of the object which you want to recognise) samples from the imagenet (standford repository of images)
b) Then download a set of negative (the images other than the object you want to recognise) samples from the imagenet and other sources.
c) Now train the Haar Cascade classifier by placing every positive image onto the negative smaples
d) Like this a xml file is created which can be used to detect objects in real time.

By using this haar cascade xml file we can detect the required object. Now this feature is used by the bind people as, they always may have kept somethings in somewhere in the room, now to recognise the user defined objects and then check for them in real time video, if that object is detected then a audio output is given to the user via headphone jack using festival text to speech library.

In this computer vision device, if we press button two, then haar cascade classifier is turned on and from the camera input, pre-defined objects are searched, if detected then length of the output is given out, if it is greater than one, then we give audio sound to the blind user.

To button functionality we have pulldown resister switches, and if button logic one then output is detected. Here series of if loop is added so that to detect number of objects but we keep on adding the objects then PI ability to detect images fastly will be delayed even further.

As Pi as some limitation of RAM i.e., 1 GB and its clock speed is 1.2 GHz which if fairly not enough to run like to detect 100 objects simultaneously, definitely pi will be hanged, and so we are restricted, So when what if we run all those processing in high speed servers and just give input to the server and take output from it, then we can detect lakhs of objects.

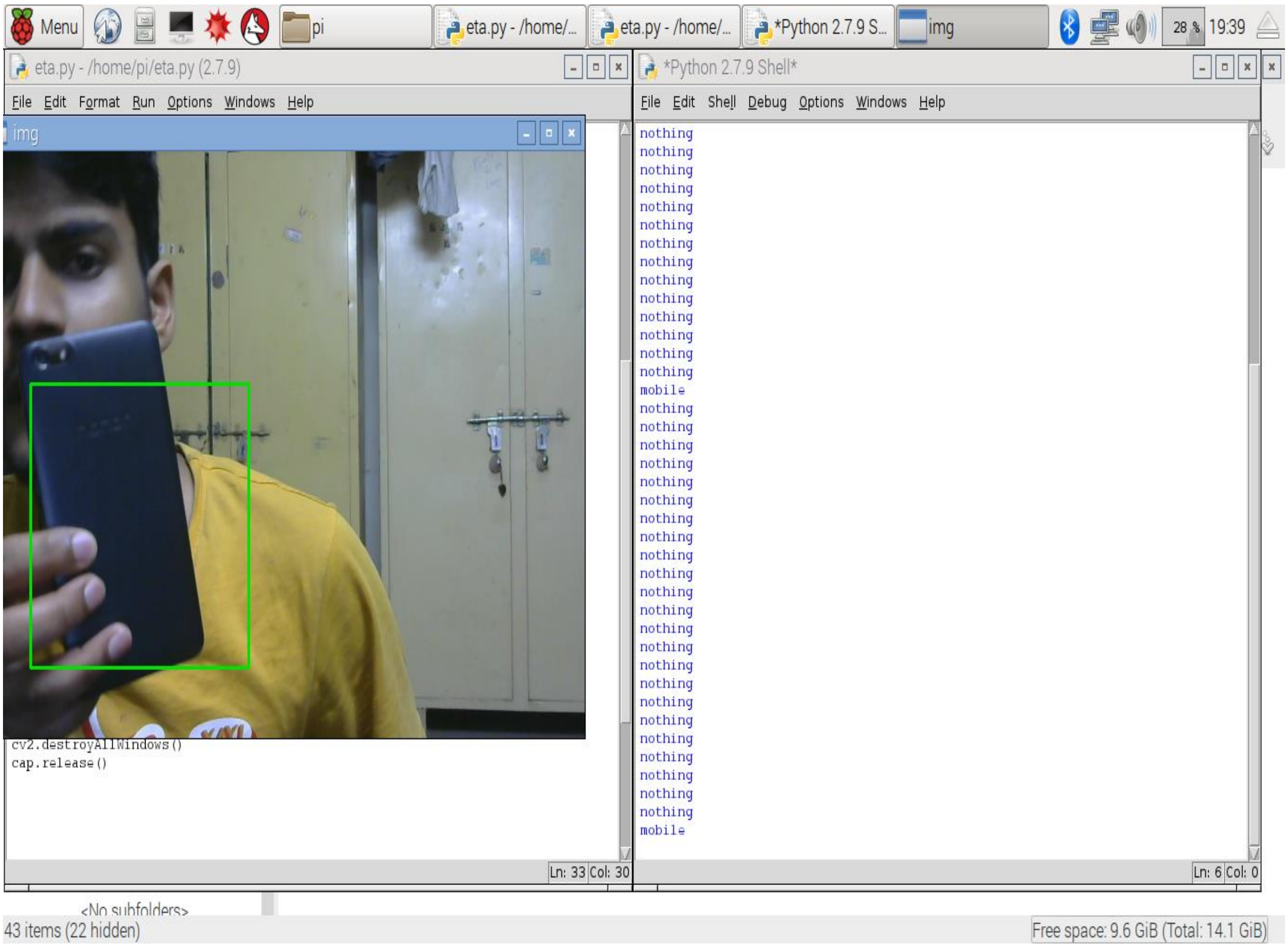

Fig.5.13 pre-defined objects detection using Haar cascade

In this Fig. I have used haar cascade of certain number of objects, and placed a mobile before it to detect, and as I have haar cascade of mobile xml file, it gave logic signal that mobile is detected in the audio format to the blind user, so like this the blind user was able to detect his personal objects. This function we use for the offline purpose.

C) Image Captioning based Computer Vision Device Activated by third button.

In Digital Image processing and machine learning this is the buzzing technology which has been developed for 20 years and on, and we in near future when machine will think like us see like us. And since then there has been a huge research in this field of image captioning, and this image captioning means describing images based on what is there in the image based on front and backend of the image. Then I felt why not we use this computer vision for the assistance of the blind people, so I thought, if a blind user clicks a photo of what is there in front of him, then that image can be processed and then after image captioning it, we will get a sentence which describes the image, that what is in it, what it doing, and that sentence is converted to auditory output to the blind user via headphones or Bluetooth headset. Like this a blind user can understand what is there is inform of him by audio, without asking anyone help. So, this the core idea behind the third and most important function of the computer vision device.

Working of this model is , in this we have recurrent neural networks which work as back propagation network, here computer detects all the components in the image and gives a probability to predict the sentence, here unsupervised machine learning is used in which all the important components are come together and using the English grammar a meaningful sentence is constructed, which is then given as the output, but this process huge number calculations, so doing this in PC is a hectic task , that why we used servers to process this huge amount of data, and the image descriptions is used by us to read out to the blind persons to, so that they can understand what is there infornt of him, but provided the user should be connected to the internet.

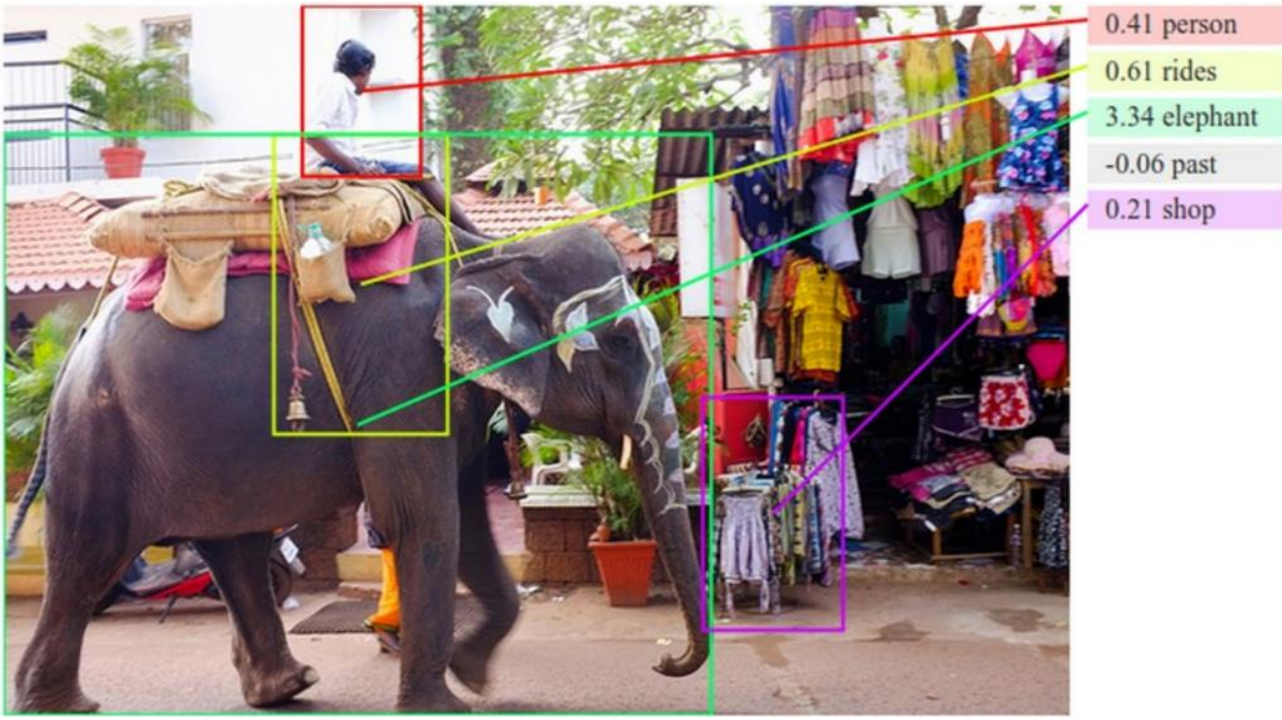

Fig.5.14 Working of Image Captioning or Description

Now we have used this function in our project as a third button function, that means the user can use this service as many times as he wants.

In this Fig. is the example on how we have implanted this in raspberry pi, as pi cant to all this model , pi waits for button on , then clicks photo , that photo is sent to the servers via API which process that image and give image descriptions now that image description is given as sound output to the blind user.

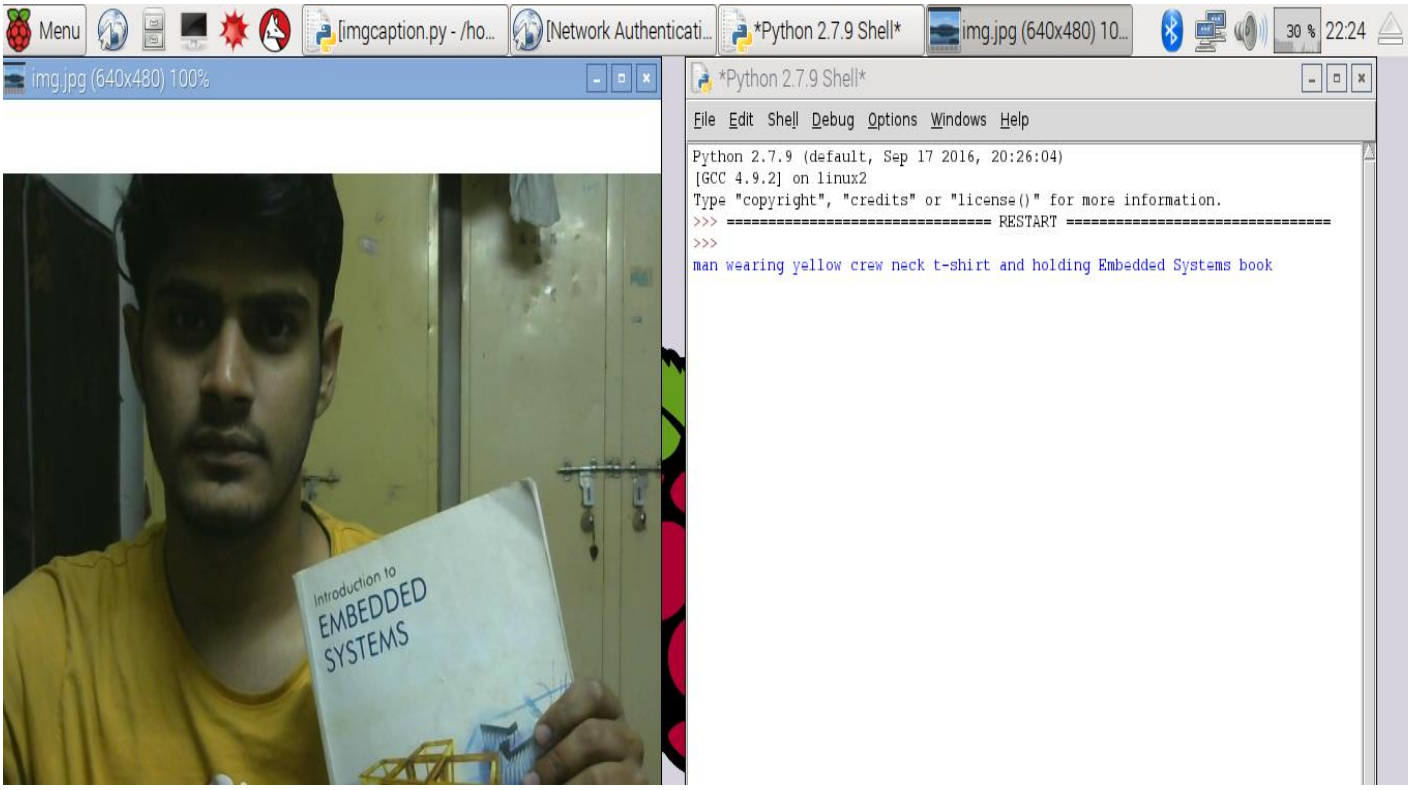

Fig.5.15 Image description upon click of push button

So here, disadvantages will it dependent on internet speed for how much fast you will get the image description output. But it is much more accurate than before other techniques, so this is one of the best way a blind person can understand the world infornt of him.

CHAPTER – 6

RESULTS AND DISCUSSION

My objective is to, make an affordable, reliable and robust ETA, which is more accurate and gives maximum information of the surroundings for visualization of the environment for the blind persons. First, we created an obstacle avoidance system, which is Ultrasonic sensor nodes which gave tactile feedback if we are less than 1 meter close to the obstacle. But in certain cases, it was not that useful in outdoors, so it was more accurate it indoors. For computer vision device, we are having three options buttons 1 and 2 for the detection of the objects and button three for image description. So, for Button SURF based object detection technique was accurate for trained object only, not for the same object with different color or shape, next button two used Harr Cascades which were more robust and accurate, depending on how many samples they were trained, for best output we used 6000 positive samples to train each object. But the problem here was how many haar cascade do we going to make, pi was not bake to handle more than 5 haar cascade simultaneously, and pi was little slow for this purpose but it is most affordable computer. Next, we used third button that is image description through audio which gave 90% accurate results, but with a certain delay.

And delay has been most critical part, we faced in our results and there was 2 to 3 seconds delay in the output in the computer vision device, so to reduce this we used optimization the code, by removing visual data to be displayed. And like this delay was reduced significantly. So overall there were more than 90 % percent accurate results and we achieved our objective.

EXPERIMENTAL WORK

To do field testing of our device we have performed indoor and outdoor testing, in indoors it was very accurate and we were in convenience to walk around, although take s time for the first-time users to learn how to use this device. Next was the outdoor, we face most difficulties here as range of our ultrasonic sensors was 4m we didn’t have much info of the surrounding, but using the computer vision device we were able to know the place without seeing them. So, it was quite helpful. This means using obstacle avoidance and computer vision device together gave us more information of the surroundings in outdoor and navigation was successful.

CHAPTER – 7

CONCLUSION AND FUTURE SCOPE

Since many years, there were only obstacle avoidance based ETA were available, but it was not enough for getting maximum information of the surroundings to the users. So, we have computer vision device, to convey maximum information, through oratory feedback to the blind user. In which SURF based object detection was easy to train but was not robust, hence next Haar, cascade which were difficult to train but were robust, but how to train all the objects in the world, and it now possible in the raspberry Pi to do for all. So, implemented I servers, used API and internet for sending input and receiving output. So, using all these together yielded better results, as were able to avoid collision with obstacles and know what is there in front of us. The device was affordable as it came under 5k, and also user friendly, since user has to press three buttons only for his need.

The Future scope will be:

a) Use OCR feature in our computer vision device, so that blind users can listen what is listen in pages.
b) Use language translation system, since in our computer vision device the output was in English. There was a language barrier for many people.
c) Use more powerful more board like Tkinter by asus but they are costly, but performance will be significantly increased.
d) To Open Source this technology so that All persons can Do It Yourself.

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