Department of Electrical and Computer Engineering
North South University

Senior Design Project

Smart stick for visually impaired people

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Declaration

This is to declare that no part of this report or the project has been previously submitted elsewhere for the fulfillment of any other degree or program. Proper acknowledgement has been provided for any material that has been taken from previously published sources in the bibliography section of this report.

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Approval

The Senior Design Project entitled "**smart stick for visually impaired people**" by Galib Ahmed Turjo (ID#1510697042), Ahsanul Kabir (ID#1520660042) and Md.FATIN ISHRAK (ID#1612787043) has been accepted as satisfactory and approved for partial fulfillment of the requirement of BS in CSE & EEE degree program on December,2019.

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Abstract

Life of a blind people is always challenging and more difficult than normal people's life. So in this project our main idea is to make their life little bit easier. So our goal is to design a stick for them that will help them to walk or go anywhere fearlessly especially when they are crossing roads. We all can see every now and then that on the street that there is always a blind or impaired people needs help to cross road and most of people around him/her ignores and refuse to help them. So our stick will help these types of blind people to cross roads without needing anyone's help. Basically our stick's main features will be to detect the traffic light signals and alert the user whether to cross the road or not also it will detect any obstacle when user is walking with that stick by using ultrasonic sensor. To detect the traffic light we will use camera to capture the image of traffic light's state and match it our stored traffic light pictures in database and alert the user accordingly. Besides this our stick can also detect stairs whether it is an upward or downward stair. Also there will be an android based application that will have all the data and it will be connected to microcontroller via Bluetooth. Another feature it will have that is it can tell the user location so that his/her relatives will know where the user is and if there is any kind of emergency user can send alert to emergency contacts by pressing the emergency panic button.

Table of Content

List of Figures

CHAPTER 1

INTRODUCTION

1.1 Introduction

A smart stick can be valuable asset for a blind people in these days. Our project goal is help to blind people who are most oppression in the society. The stick will help them while they are crossing or walking on the road, detecting the obstacle and road surface conditions. It will also help the blind people to inform his family where he is or incase if he falls in danger it will help his family to rescue him by location tracking system in our stick and other part of this project is image processing with raspberry pi where the pi-camera will detect the traffic light signal and with voice command it will tell the blind person to cross the road. This stick also help the blind people to avoid wet surface in his way or if there is water on the road our stick will detect that and alert the user.

1.2 Motivation

The principal motivation of this project is to develop a simple stick into smart sensor based stick that will help blind people. There are lot of work happened on this stick before but all are sensor based but this stick has its own characteristic. We are aiming on detecting the signals of traffic light and tell the user the state of it. So that he/she can cross the road fearlessly. This approach or feature will create new dimension in this project. We also have seen the blind peoples who live in undeveloped country and most of them are unable to buy this stick. So, we are trying to give them this stick into as less amount of price as possible. We want to do something really helpful for blind people and that is why we are encouraged to do this project.

1.3 Objective & Contribution

The main idea was to build a stick that will help the blind people to cross road and also give an alert of obstacle's position also with this we are adding some more features that will help blind people not for only road crossing but also in their daily life movement.

The main aims and objectives are:

- It will detect obstacle around the user and will send notifications to user to alert him/her.
- It can sense water on the road to avoid slipping or drenching or falling down.
- We will use camera to capture the traffic light and by image processing that captured image will be compared with stored traffic light images in database and user will get the information about traffic light.
- It can trace the location of the blind person and sends the data to their relatives to avoid any misfortunes from befalling them.
- It can be easily located if misplaced.
- It is also having a panic button, blind persons can immediately inform their relatives in case of an emergency.
- Also it will detect stairs and also tell the user if it's an upward or downward stair.
-A Bluetooth module is used to achieve communication between the microcontroller and the Smartphone through serial port communication. Code for handling different hardware is hardcoded in the flash memory of the microcontroller. After pairing the mobile phone with the Bluetooth, data can be exchanged between the two.

1.4 Summary

In this chapter we have talked about the efficiency and importance of the stick. How it can change a life of blind person. In chapter one we discuss about our aim of this project why we are interested to do this project is explained in chapter. In Chapter two we gathered knowledge by reading out research papers, In three & four we have shown our experimental setup and technical section.

CHAPTER 2

Literature Review

2.1 Chapter Focus

In this section we are going to discuss about previous work that had been done and implemented and after that we are going to compare with our work and how our stick is efficient

In this paper *Ultrasonic blind walking stick* [1] the main focus was to detect object around blind people using ultra sonic sensor. also another feature it has that is to detect moisture on the road by using water sensor and these two sensor is connected to a micro controller that gets the data from those sensors and alert the user by the help of a buzzer.

In this research paper *Advanced cane for visually impaired* [2] they build a cane that helps the user not only obstacle but also helps the user to navigate around the city or user's desired location with the help of GPS navigation system, meaning user can give their desired location they want to go and this cane will help them to reach their destination. to build this they used raspberry pi to store all sensor and GPS navigation program and the user gets the feedback through voice command.

In this paper *Smart Ultrasonic stick for blind* [3] a study was made to help the blind people by using the pulse eco technique that will provide a warning sound whenever it detects any kind of object and the calculation is done by finding the difference between signals transmitted and received. This system can detect up to 3 meters and detection and angle is 0 to 45 degree but the main problem with this system is that it consumes a lot of power because of the transmitted and received circuits. Ultra-sonic sensor is being used for detection

In this paper *Ultrasonic Electronic system for Blind people Navigation* [4] presents a new electronic system using an ATmega328P microcontroller, two ultrasonic sensors and two vibrating motors as a new helping solution for blind people navigation. The block diagram,

specific requirements and implementations are described in the paper. Specific design problems and experimental adjustments are mentioned. Future optimizations and developing trends are also considered.this project is fully build using sensors and microcontroller.

In this paper *Traffic Light detection for Color blind individual* [11] they used an algorithm which is combination of color and the algorithm that they proposed which image is processing technique combined with LAB VIEW toolbox. To help color blind people can easily identifying the color of traffic lights. They use mobile camera for better view and the camera capture the image and comparing the actual image of traffic light with the templates that represents 22 different shapes of traffic light. The algorithm extract the color in Red and Green and helped the color blind person to understand the actual color.

By reading this paper *Implementation of Image Processing in Real Time Traffic Light Control* [12], they focus on the real time traffic light detection on the basis of traffic density on road. Usually there is timer for each phase to control the traffic light also there is an electrical sensor to detect the vehicles gaggle on the road and on that basis traffic light cycle is created but in this paper a camera will set up with traffic light and it will take image of road. With the edge detection and the capture image will sequentially match with the existing image and it will show a result and help to change traffic light automatically with the help of image processing. In this paper they are using Intelligent Transportation System (ITS) which is important part of traffic monitoring and surveillance for road usage.

In this paper *Traffic light detection during day and night conditions by a camera* [13] the focus is about prevent accident at the traffic interception in day and night. So, they determine the traffic light detection in three parts. To detect the light, image processing system is used for vehicle diver assistance system. This system has three parts which includes CCD camera, RGB colour space the algorithm extracts green, red, blue then compare with existing image and identify the object.

2.2 Comparison between our suggested work and previous work that already have implemented:

Our main focus is helping the blind people to cross road and there are many research and work done related to this but they all are sensor based, so we have approached with image processing in raspberry pi.In previous work, to detect the traffic lights others used various kinds of sensors to detect the color of traffic light but in our project we are using pi camera to detect the color of the lights. In other works done before most of them used color sensor to detect the color of light but the problem with this sensor is that no matter what, the color sensor will sense any red/green/yellow color around the blind people which is not even a traffic light, some other red/green/yellow objects the sensor will detect that also and give the user a misinformation. Because of this problem we come up with the real time object detection idea that will first detect the object then it will detect its color meaning when our system detects any object first it will detect what kind of that object is then if the object is traffic light then it will detect the signal of that traffic light and after it detects the signal it will send the user with appropriate information with voice command. Besides this we are also adding some more features that a single stick didn't have all together in previous like in our smart stick we will also have obstacle detection with buzzer, water sensor to check if the road is wet or not, real time tracking system so that the user's relatives can know his/her location, also there will be a panic button or SOS button for emergency and when the button is pressed it will send a text message or notification to emergency contacts with having user's location.

CHAPTER 3

Technical Section

3.1 Introduction :

In this section we will talk about the components and equipment and other software things that we have used to build our smart stick and its details.

To do this project we need some sensor based equipment like

- Arduino Uno
- HCSR04(ultra-sonic sensor) for obstacle detection
- Moisture sensor for wet road detection
- GPS & GSM module for real time location tracking
- Raspberry PI and PI Camera for image processing.
- Power bank
- Switch

3.2ArduinoUno

Arduino Uno is a device or a open source plant from where electronic things and different types of projects are built upon. With this thing people do their projects and create things that helps the society or makes people's life easier. It is a portable cpu than can easily be carried and it uses simplified language of C++ and there is a software that runs on pc or laptop and from there it is very easy to upload codes in Arduino Uno and do work with it.

3.2.1 Arduino Uno Technical Specification [7]

Power

Pin Name: Vin, 5V, 3.3V

Operating Voltage at 5v

Input Voltage range: 6v-20V

PIN

Analog Pin: 6 (A0-A5)

Digital i/o Pin: 14

Frequency Clock Speed: 16 MHz

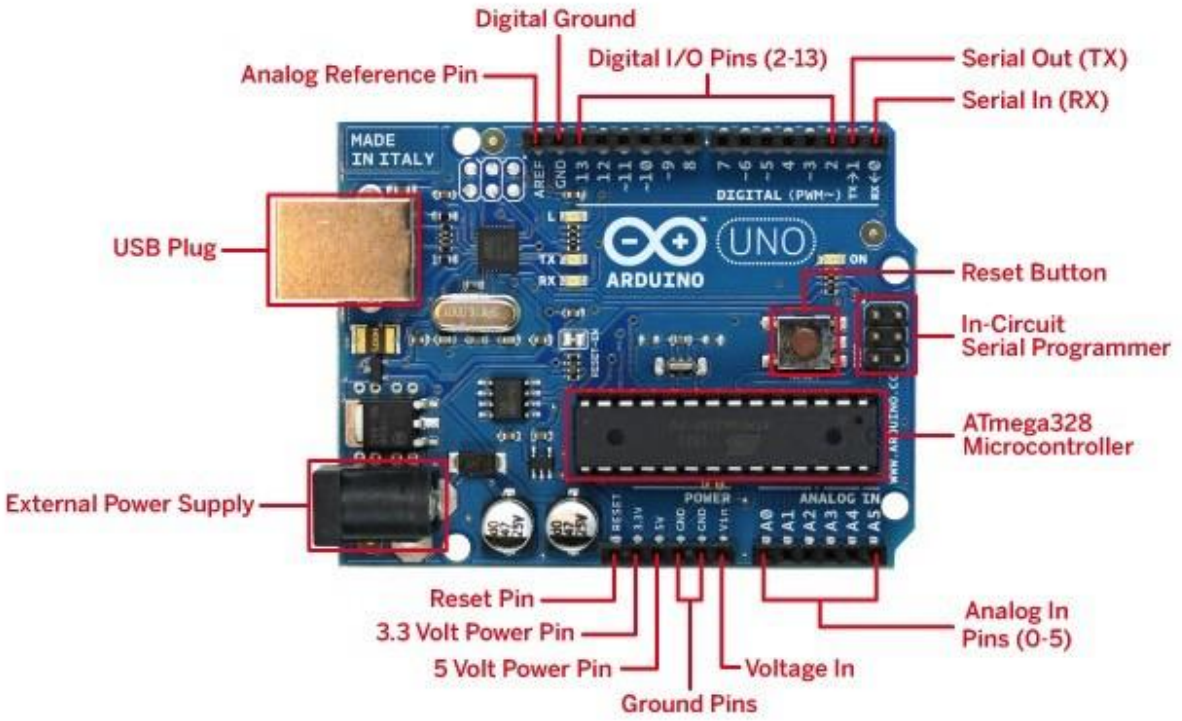

Figure 3.2 Arduino Uno and its pin diagram details

3.3 HC-SR04 (ultra-sonic sensor)

HC-SR04 is an ultra-sonic ranging module that provide 2cm-400cm Non-contact measurement function .The effectual angel <15◦. [8]

3.3.1 HC-SR04 Technical Specification

Working voltage: 5v

Max Range: 4m

Min Range: 2cm

Working Current: 15mA

Measuring Angel: 30◦.

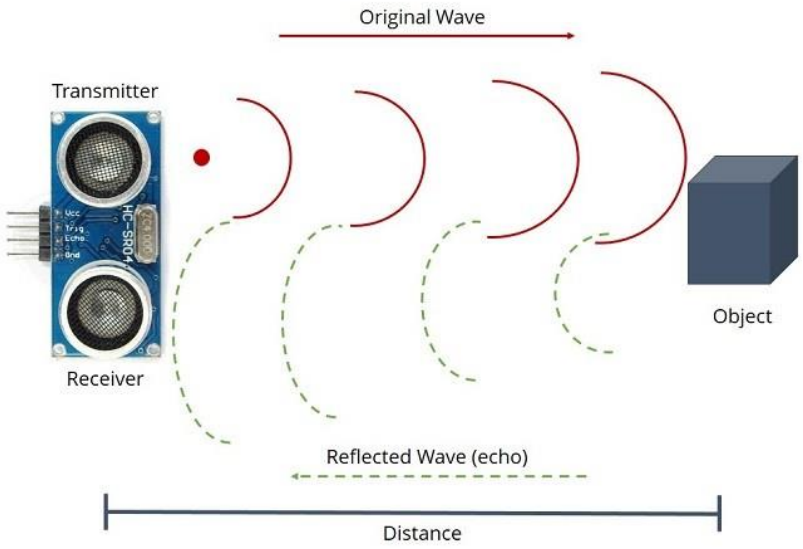

Figure 3.3 Ultra-sonic sensor and object detection

3.4 Moisture & Water Sensor

The sensor has two probes that are used to measure the volumetric content of water .This sensor can be connected with analog or digital pin.

3.4.1 Specification of this sensor

Input Voltage: 3.3V-5v

Output Voltage: 0-4.2v

Input Current: 35mA

Output signal: Both Analog &Digital

A0: Analog Output

D0: Digital Output

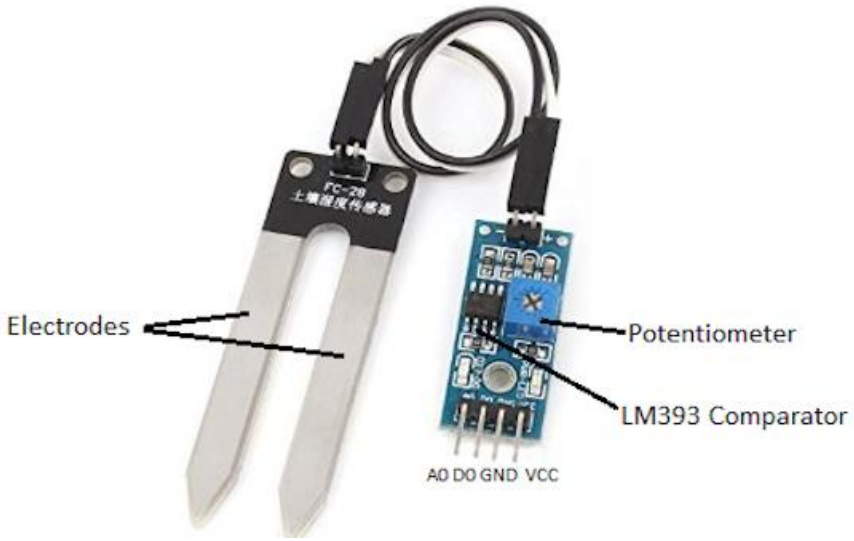

Figure 3.4 Moisture Sensor and its pin diagram details

3.5 GPS & GSM

The full form of GPS is global positioning system and the full from of GSM is global system for mobile communication. Both device is used to detect the location of anything. Nowadays it has been used everywhere. For example in vehicle tracking system, mobile phones, person tracking etc. it detects the location with UTC time. GPS gets the coordinates from the satellite with having date and time also.so in this project we have used these two modules to track the user of our smart stick. GPS module gets the data from satellite and sends it's information to GSM module and from there GSM module sends the information to emergency contacts with latitude and longitude of user's location. There is a sim card in GSM module that helps to send information to contacts.[9]

3.5.1 Technical Specification:

Voltage Input: 5V

For GPS input voltage is 3.3v

2G/3G sim required for strong Network

Open space required for GPS to get signal for its Antena.

Figure 3.5(a) GSM (Global System for Mobile) module

Figure 3.5(b) GPS (Global Positioning System) module

3.6 Traffic light detection with image processing:

3.6.1 Python language:

General tasks like in image processing include basic manipulations like cropping, displaying images, Image Segmentation, flipping, rotating, Classification and feature extractions, Image recognition and Image restoration. Python becomes an important choice for Image processing tasks. This is due to a scientific programming language and its growing popularity and free availability.

Python is very high level language and the usage of this language is huge. Nowadays in every area python is used and because of its simplicity and easy to understand method people are using his language in their every work and project. Python is very easy to learn and any coder can read and understand python language even if they are not expert in it. Python's libraries and frameworks are used everywhere and it's much easier to implement these framework compared to other programming language.

3.6.2 Libraries of python:

Python has many of libraries and frameworks that are used in image processing, so far we have used –

OpenCV − Opencv is mainly used for recognizing facial and gesture of human in real time with computer vision application. It can detect things in 2D and 3D.its framework are now used everywhere and results are very efficient compared to other.

Scipy libraries and Numpy − it is used For image processing and manipulation.

Sckikit – it has lots of algorithms regarding image processing.

Python Imaging Library (PIL) –with the help of this library it can create thumbnails, resize, do rotation, also can format in different files.

3.7 OPEN CV

We have used opencv to do our image processing. With the help of image processing we have detected the color of traffic light. Opencv is used for mainly computer vision that is created and developed by intel then supported by willow. Opencv also has deep leaning frameworks that helps to recognize the facial and gesture of human or other living things. opencv has algorithms that is more than 2500 and these algorithms are well optimized and efficient and it was built for computer vision and also for machine learning. Many things can be done by opencv for example tracking the moving object, detect 2D 3D models ,recognize faces ,converting file formats, producing 3D high resolution images and also detecting the objects on image, finding similarity between images or in databases and also in augmented reality.

3.7.1 Modules of OpenCV

The main modules that opencv provides are filtering images, traformation of geometric image, transformation of miscellaneous image, functions of drawings, conversions of color space, tracking of object, motion analysis. We have used the color detection by using opencv to detect the color of traffic light. If the color is red/green/yellow with the help of opencv module and libraries it detects that color sends user the information.

3.8 TENSOR FLOW

To build the model of traffic light we use tensor flow. Because previously we detect color of traffic but the problem was it can detect any kind of color. So we have to build object orientation traffic light system so that the module can only detect the traffic light and detect the three state of traffic color. So, we use Tensor flow to build the model of traffic light .So, that our pi-camera easily build the traffic light.

So we have trained our linux machine with the help of tensorflow framework, python and some C++ libraries, for capturing images we have used our laptop's camera to capture real time object and camera detects any object it in real time. We have put all code in file named "object_detector" and by simply running in command prompt "python3 object_detector.py" , our machine's camera starts and captures images continuously and detects any object in that image and tells that object's name.

3.9 Raspberry Pi 3 - Model B

For our image processing and detecting the traffic light we have used raspberry pi model B and the details about raspberry pi is given below,

- Broadcom BCM2387 chipset
- 1.2GHz Quad-Core ARM Cortex-A53
- 802.11 bgn Wireless LAN and Bluetooth 4.1 (Bluetooth Classic and LE)
- 1GB RAM
- 64 Bit CPU
- 4 x USB ports
- 4 pole Stereo output and Composite video port
- Full-size HDMI
- 10/100 BaseT Ethernet socket by
- CSI camera port for connecting the Raspberry Pi camera
- DSI display port for connecting the Raspberry Pi touch screen display
- Micro SD port for loading your operating system and storing data
- Micro USB power source

Figure 3.9 Image of Raspberry Pi Model 3B

3.9.1 Raspberry Pi 3 - Model B Features

- Now 10x Faster - Broadcom BCM2387 ARM Cortex-A53 Quad Core Processor powered Single Board Computer running at 1.2GHz!
- 1GB RAM so you can now run bigger and more powerful applications
- Fully HAT compatible
- 40pin extended GPIO to enhance your “real world” projects.
- Connect a Raspberry Pi camera and touch screen display (each sold separately)
- Stream and watch Hi-definition video output at 1080
- Micro SD slot for storing information and loading your operating systems.
- 10/100 Base Ethernet socket to quickly connect the Raspberry Pi to the Internet

3.10 PI CAMERA (Capture Image)

The camera we have used is pi camera. The camera is version 1 and its 5 megapixel and can record 1080p video and it is enough for use to detect the light condition of traffic light. The pi camera is easy to use and the installment is very easy to do. With this camera there are we can use it for time lapse, slow motion video etc. besides this there are effects that we can apply to make any image more vivid and more realistic.

The camera can be used in any raspberry pi model and we can use it by MMAL and V4L APIs and also with the help of other libraries and modules for example python camera library this camera can be more functional. The main reason we have selected the pi camera is because we are using raspberry pi model B to detect the traffic light and pi camera is very much compatible to use with it and the commands are very simple and understandable.

Figure 3.10 Pi camera (version 1)

Material cost of our whole project:

In this table we have given all the equipment we have used for our project with cost

MATERIAL COST			
Component	Unit	Price	Price (Taka)
Raspberry Pi 3 Model B	1	3450	3450
Memory Card (32 gb)	1	650	650
Raspberry Pi Camera Module	1	800	800
GPS (NEO6MV2) and GSM module	1	2050	2050
Arduino Uno	1	405	405
Moister sensor	1	80	80
Power Bank	1	650	650
Ultra-sonic sensor	1	90	90
		Total	8075/-

Here's is the cost list of our whole system and that is around 8000 taka.

CHAPTER 4

METHODOLOGY & EXPERIMENTAL SETUP

4.1 Chapter focus

In this section we are going to explain our whole project from start to bottom. We will elaborate our project like how it is made, what types of equipment we have used to build it and also a step by step guideline that will help readers to understand with details also how it works and what were the mistakes and their fixes everything, So that they can make better project and more efficient product in the future from this.

4.2 First Implementation: Object detection with Sonar Sensor (HC-SR04)

The first feature we have implemented in our project is object detection. We have used ultra-sonic sensor to detect the object and this features helps the user to walk freely and fearlessly and whenever user is close to an object a buzzer will buzz to alert the user.

4.2.1 HC-SR04

This is an ultra-sonic sensor and it has 4 pins and they are ground, VCC, trig and echo. The VCC pin needs minimum 3V and maximum 5V to work and the ground pin must be attached to ground otherwise it won't work and the remaining pins trig and echo are for digital input and output.

4.2.2 Specifications:

- Power supply: 5V DC
- Quiescent current: <15mA
- Effectual angle: <15°
- Ranging distance: 2cm – 350 cm
- Resolution: 0.3 cm
- Output cycle: 50ms

To measure distance formula is D= (speed of sound * taken time) / 2 [10]

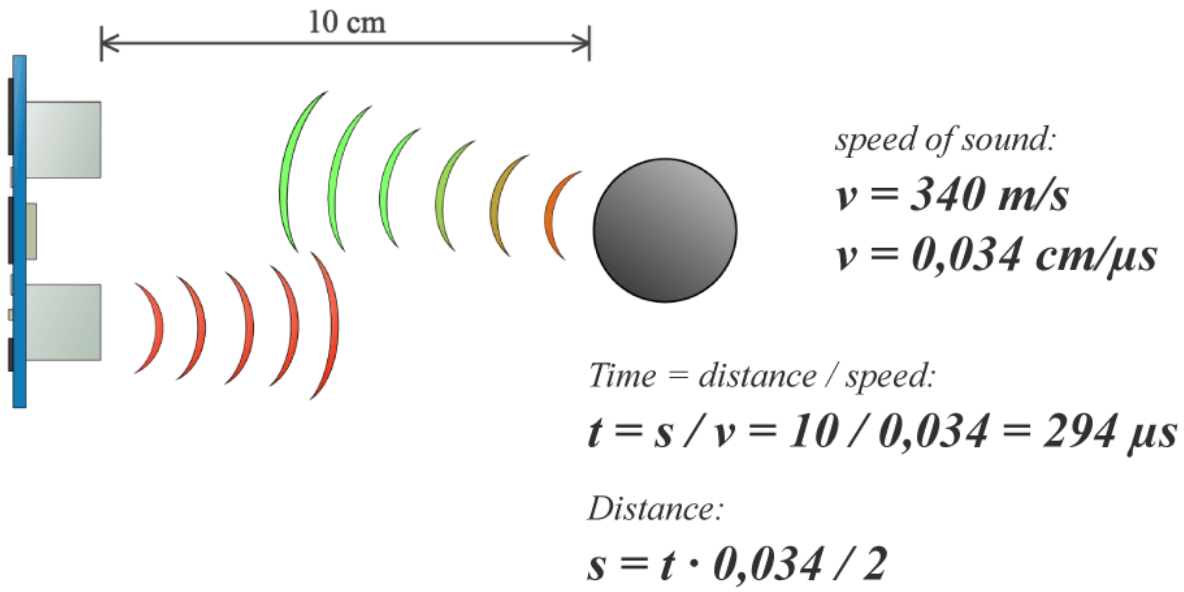

Figure 4.2 Measurement of distance to detect the object [11]

4.3 Location tracking by using GPS and GSM module [9]

This section we have implemented the location tracking in real time with the help of GPS and GSM module and later we will add it to our smart stick. So the basic idea is to get the users real time location whenever we need to know. A message with the location (latitude & longitude) will be sent to the emergency contact's mobile when he/she sent an SMS to track the stick.

4.3.1 Components Required:

- Arduino uno
- GSM Module
- GPS Module
- 16x2 LCD
- Power Supply
- Connecting Wires

4.3.2 How it works:

GPS and GSM are being used to get the location of the user in real time. We have used gps NEO6MV2 and GSM 900A SIM model in our stick. GPS collects the data from satellite and gets the latitude and longitude of the user and this information is send to GSM and GSM sends the information to emergency contacts with the help of a sim. We have faced a lot of problems during implementing this feature. GSM supports only 2G sim and at first we have used 3G sim then after replacing the sim it was ok but then there was problem with GPS. GPS needs to be outside area to work as it gets data from satellite but sometimes it gives wrong latitude longitude of user's location so we have to modify our code accordingly then as these two are different two modules so we had to merge the code of it. After merging the Arduino code it sent the location information correctly then in our code we had not only gave latitude and longitude of user's location but also provided the google maps location link so that emergency contacts can easily check the user location with just one click.

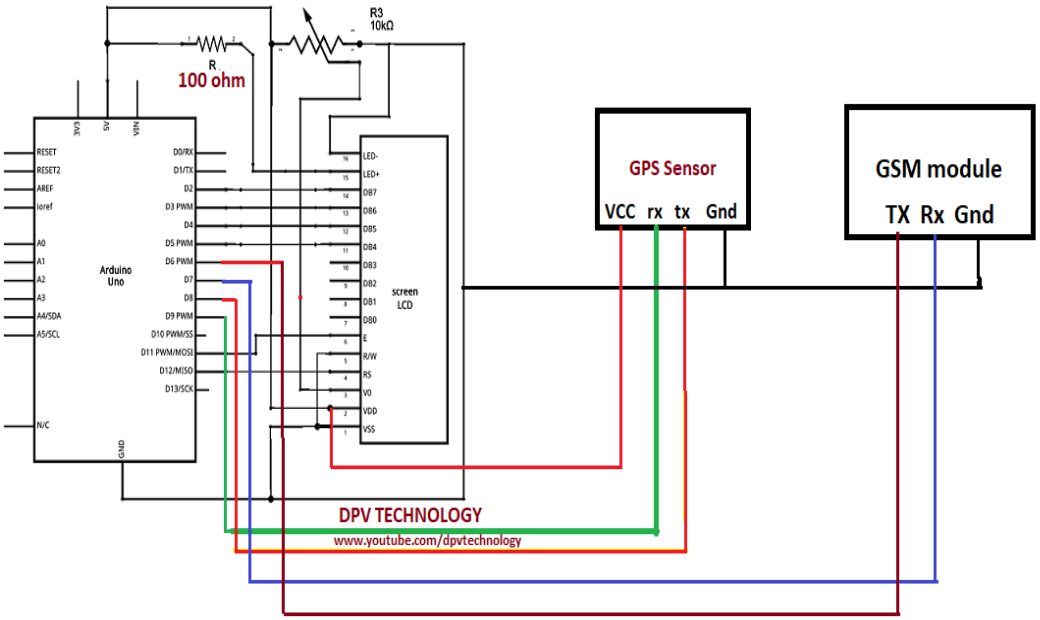

Figure 4.3 Connection diagram of GSM and GPS module with Arduino.

In this figure 4.3 we can see the block diagram of GPS and GSM and how its connected to Arduino Uno and also with pin numbers.

4.4 Location tracking implementation setup image:

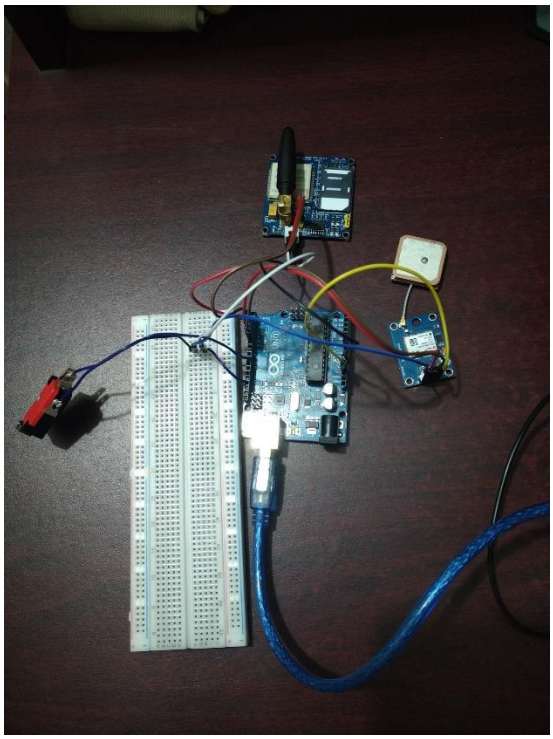

Figure 4.4 Implementation of GPS and GSM module in practical

In this picture we have implemented the GPS and GSM with Arduino and whenever we put the command the GPS and GSM module sends the location to emergency contact number.

4.5 Water detection using moisture sensor

Working procedure:

It is an important feature of a blind stick to detect water while crossing the road because there can be wet areas of soil or roads while a blind people wants to crossing. The Moisture sensor is used to measure the water level and wetness level of soil. This sensor reminds the user about water. The moisture sensor will be put in the forward of stick to show the degree of moisture of earth soil to prevent immersing in the mud. In addition, the stick must be used because all the sensors must read the values properly by making the stick in 90° angle on the earth. Soil moisture sensor that is

shown in figure measures the volumetric water content in soil. The sensor is used in our proposed system to read the water value on road. We have set the value of moister sensor to >300 and the reason to set the value for 300 is that below 300 value the water level is very much less which is not even dangerous to the user. So whenever the sensor gets the value above 300 it sends the alert to the buzzer and this means that there's probably water on road or the road is slippery. This alert will help the user to avoid these types of areas and they can walk on dry surface where there's no chance of slippery area or watery road.

Below the pin connection with Arduino is given,

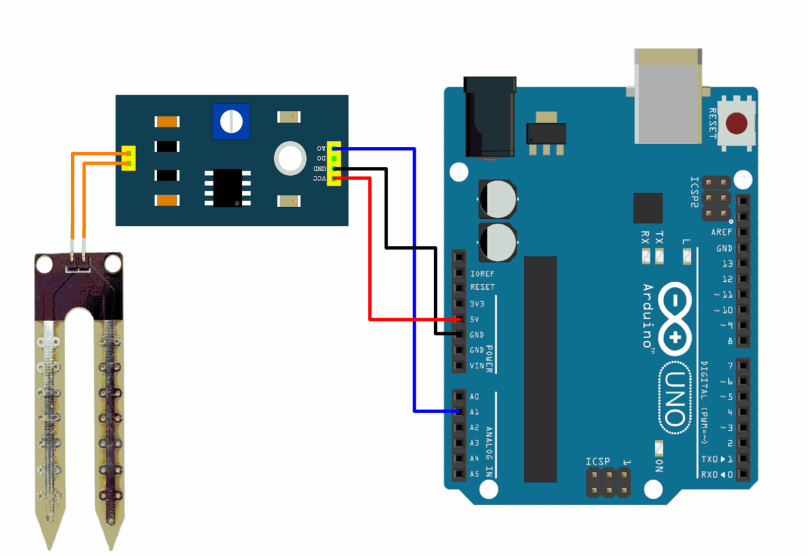

Figure 4.5 Connection and circuit diagram of moisture sensor with the Arduino.

Here in this pictures we can see the pin diagram and circuit diagram of moister sensor and also the connection with Arduino. Here ground of moister sensor connects with ground pin of Arduino and 5v from Arduino is given to the sensor in its VCC pin.

4.6 Traffic light detection with raspberry pi and pi camera:

TECHNICAL TOOL USED FOR TRAFFIC LIGHT DETECTION

*OPEN CV (Color Detection)

*TENSOR FLOW (Create Model & Object Detection)

*RASBERY PI MODEL B (Installation The Program)

*PI CAMERA (Capture Image)

4.6.1 How it works:

Opencv work method for color detection

Hough Circle Transform:

A circle is represented mathematically as $(x - x_{center})\ (x - x_{center}) + (y - y_{center})(y - y_{center}) = r^2$ where $x_{center\ and}\ y_{center}$ circle's center, radius is r.

There are 3 parameters and these 3 parameters mean that 3D accumulator for Hough transform but this is highly not effective. So openCV approaches with being trickier.

The gradient information of edges is used in Hough Gradient Method. The function that is being used is cv2.HoughCircles()**.**

4.6.2 TENSOR FLOW

There are total of three parts that tensor flow works on,

- Firstly it Preprocess the data
- Secondly model building
- After that it estimates and trains that model.

4.6.3 Changing Colour spaces:

Opencv has more than 160 color spaces functions and methods and to detect our traffic light signal we have used 2 methods and they are BGR ↔ Gray and BGR ↔ HSV.

For converting the color we have used a function and that is function `cv2.cvtColor(input_image, flag)` where `flag` tells the conversion type.

For BGR → Gray conversion, flags `cv2.COLOR_BGR2GRAY`. Similarly for BGR → HSV, and flag `cv2.COLOR_BGR2HSV` Is being used.

From this we did the color extraction of the object and it is very much easier to represent a color in HSV than RGB color-space.
We can use this to extract a colored object. In HSV, it is easier to represent a color than RGB color-space. In our application, we will try to extract a red and green objects. So here is the method.

- Take each frame of the real time image
- Convert from BGR to HSV color-space
- We threshold the HSV image for a range of red and green color
- Now extract the red and green object alone by marking it in a circle.

4.6.4 Camera calibration

There is tow type of calibration for pi camera .This calibration is important for pi camera to detect the real time object. This are –

* Geometric Calibration

*Color Calibration

Geometric Calibration

This calibration is create for only geometric shape things. So, that the camera take real time image and our code can detect the traffic light shape or other solid material if we trained the model. This Geometrical calibration is so important in our project for detecting the traffic light.

Color Calibration

Here the color class tells us the color as red, green, and yellow objects. This color class has a builder that creates an instance from many different colorful objects for example RGB, HSV,HLS. There is also another builder for these types of work that also allows us to user the system code in our modified code forcefully.

Color of instance can be build in any of the ways given below,

```
>> Color('#f000')
<Color "#ff000">
>>> Color('green')
```

<Color "#000800">
>>> Color(0, 0, 1)
<Color "#0000ff">
>>> Color(hue=0, saturation=1, value=0.4)
<Color "#7f000">
>>> Color(y=0.3, u=-0.04, v=0.515)
<Color "#fff04c">

4.7 Flow Chart of Color Detection

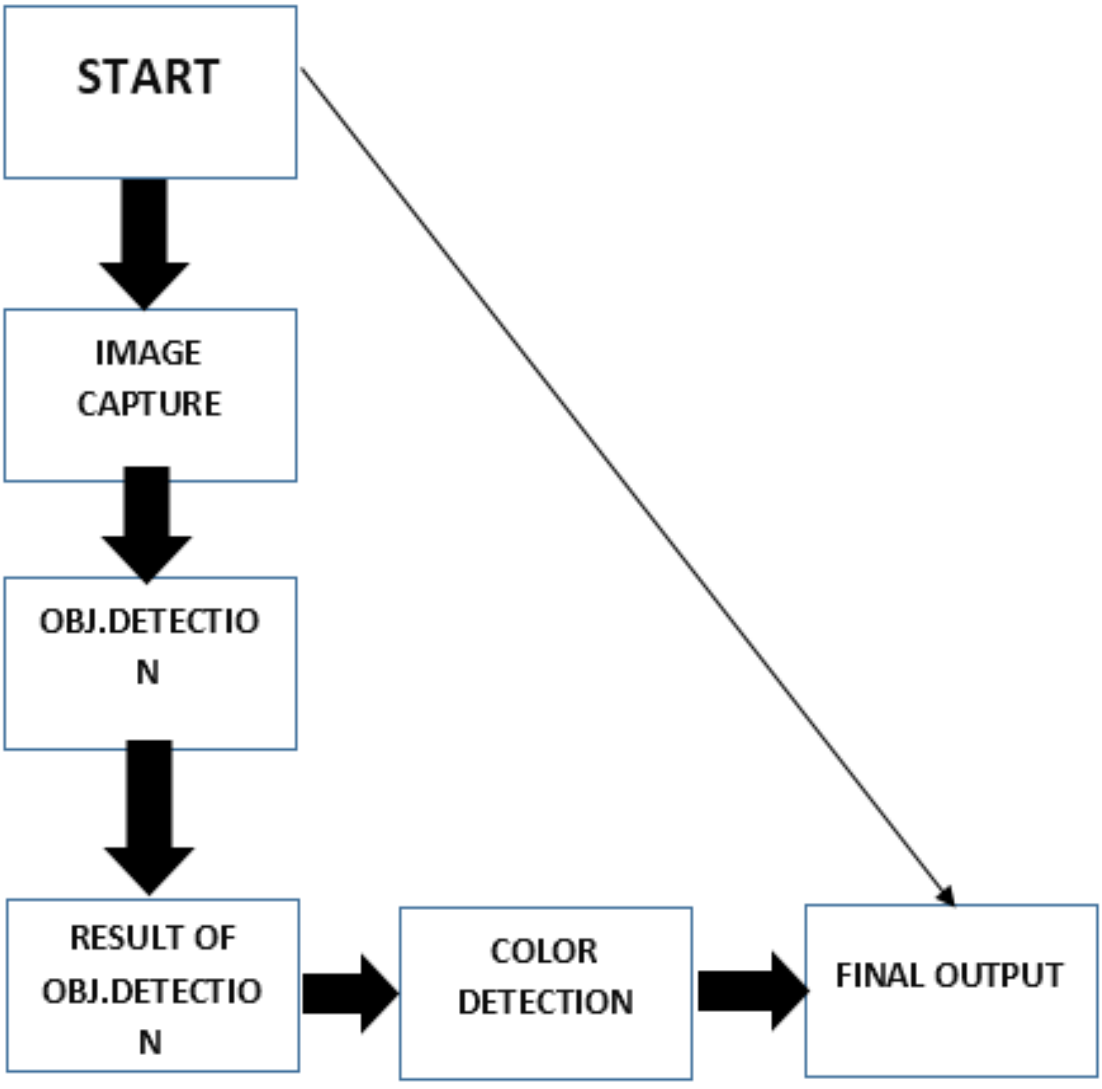

Figure 4.6 Flow Chart of Color Detection

In this diagram it shows the overall steps of how traffic light detection works and the whole process. Here we can see that after starting the system the camera captures the image in real time then first with the help of tensor flow the object detection starts and starts detecting the object and the result of that object detection goes to in color detection then after detecting the color user gets the final output but if the object is not a traffic light then the color detection won't start because in our codes we have given the command that if and only if the object is traffic light then it will go to color detection otherwise no need to do that as the main purpose of our system is to detect traffic light color only. In next flow chart we will show the in depth of how image processing working.

4.8 Flow Chart of Traffic Light Detection with Voice Command

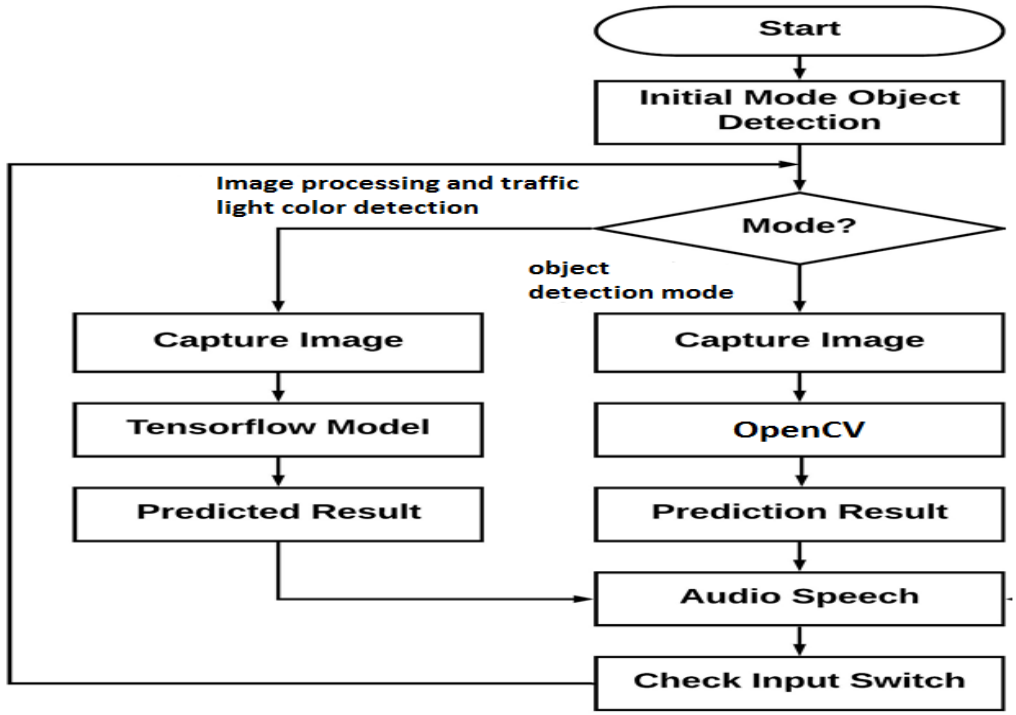

Figure 4.7 Flow Chart of Traffic Light Detection

This is the flow chart of in depth of image processing and how it works step by step. As we can see from this chart that first the camera starts and there are two modes that starts automatically in

raspberry pi. First our system detects the object and its type and if that type is traffic light then it starts to detect the color of it and after detecting the color it sends the user the information through voice command. An earphone will be connected to raspberry pi and other end will be put on user's ear. So whenever our system detects the traffic light as an object and then detects the color of it then the information will go to the user through earphone with voice command.

4.9 Whole idea of our smart stick:

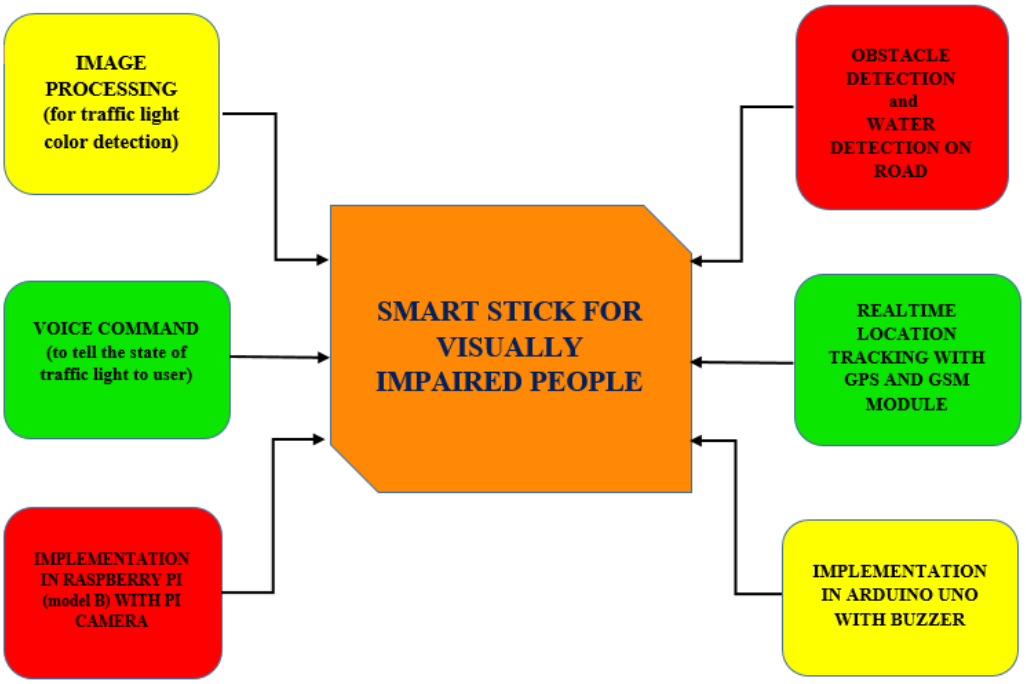

Figure 4.8 Flowchart of our whole system

The picture of our smart stick:

This is the whole picture of our smart stick with all the features we have implemented so far. Here we can see the pi camera at top and its connected with raspberry pi and in middle of the stick there is ultra-sonic sensor that is connected with Arduino Uno and in middle there is GPS and GSM module also connected with Arduino Uno and at the bottom of the stick we have attached water sensor to detect wet road.

Figure 4.9 Picture of our smart stick

CHAPTER 5

Result & Analysis

5.1 Introduction:

In this chapter we are going to discuss about our weekly progress to complete our project. In our weekly progress our first implementation was obstacle detection that was implemented by using ultrasonic sensor then our second implementation was water detection which was implemented by using moisture sensor and the our last implementation was tracking the blind person and if he faced any problem during crossing the road then he can send a message to his relative by using GPS module and GSM module.

5.2 Results:

5.2.1 Obstacle detection:

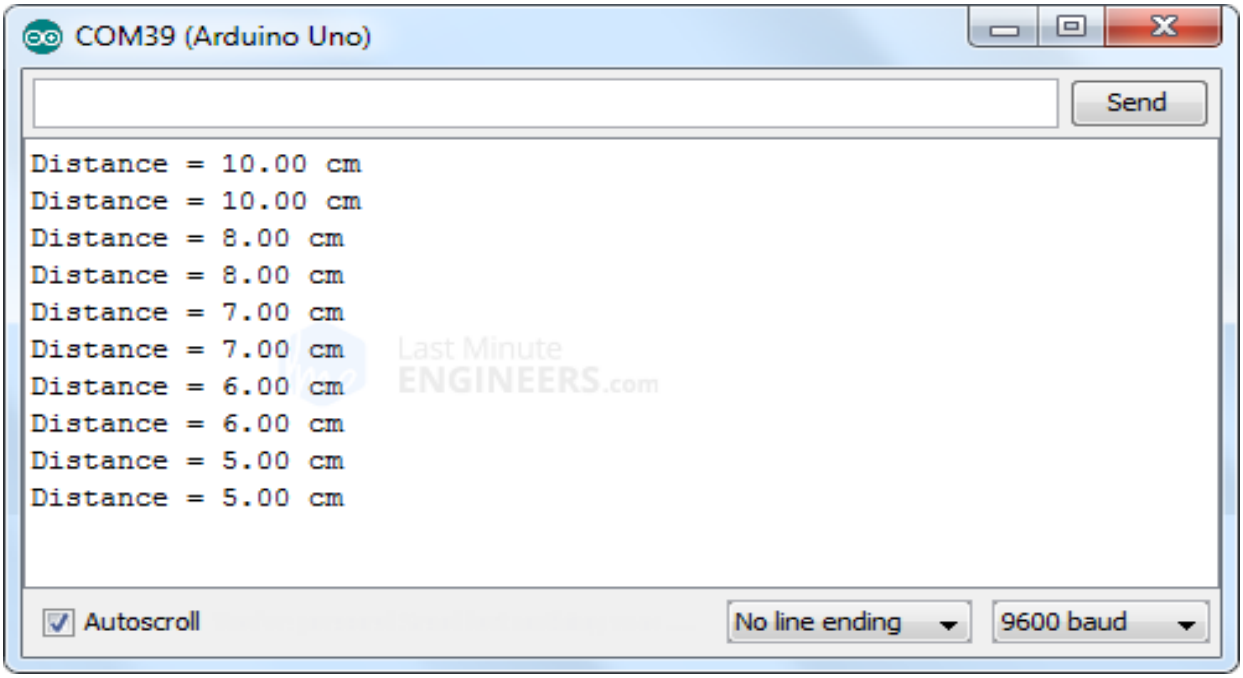

Figure 5.2(a) Output of Obstacle detection in CRT monitor and distance of the object

In this picture we can see the distance value of how far is the object is. Ultra-sonic sensor detects any object within its range tells the distance of the object and also tells how far is that object is from the user.

5.2.2 Water detection:

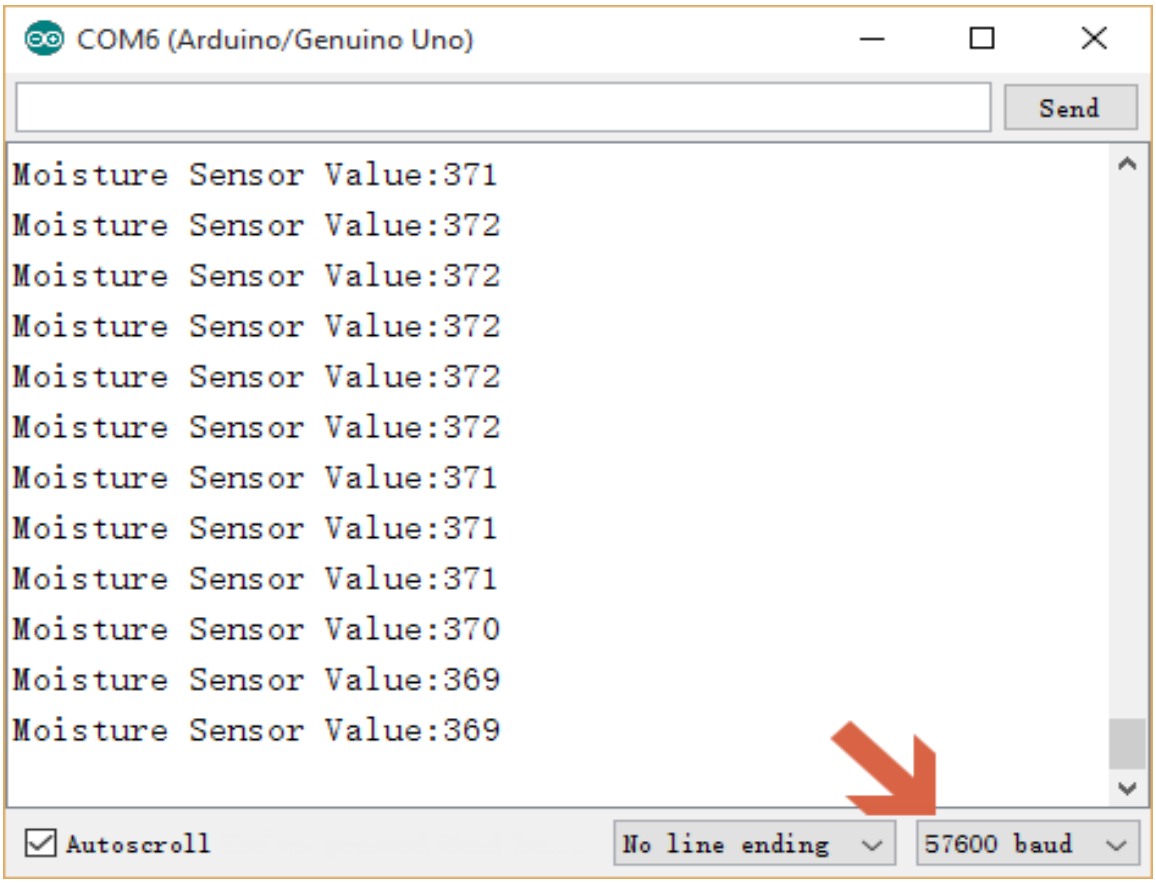

Figure 5.2(b) Output of water detection and water level value

In this picture we can see the output value of moister sensor and the value we are getting is the value of the water level. In our code we have set the value if (value > 300) then it will alert the user with buzzer. The reason to set value > 300 is because value less than 300 is not that dangerous to walk on that, value over 300 is slippery and not a safe surface to walk on.

5.2.3 Location tracking:

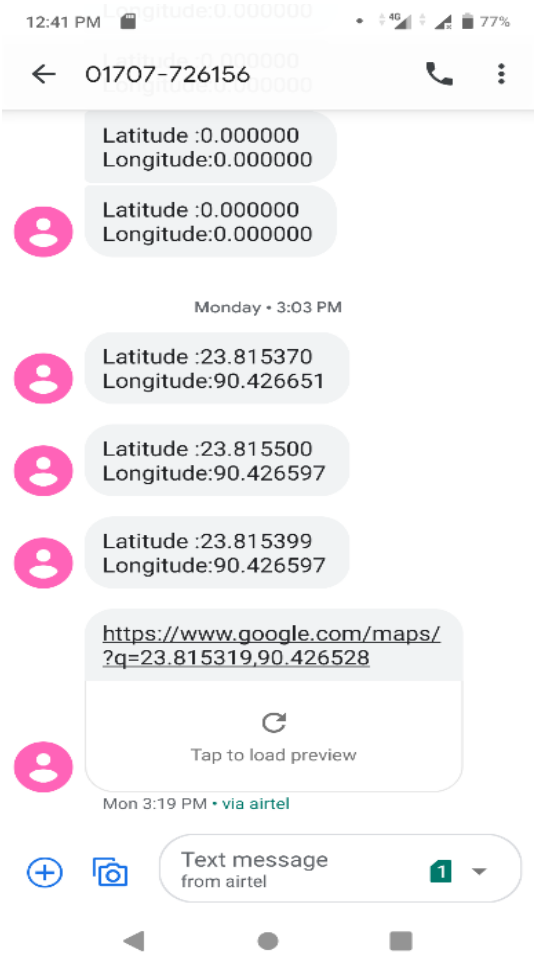

Figure 5.2(c) Sending SMS using GSM

Here in this picture we can see the latitude and longitude of user's location and also with google maps location. Whenever the user is in danger or in emergency user will press a switch on the stick and with the help of GPS and GSM module our srick will send the user's location to emergency contact just like the picture shown here.

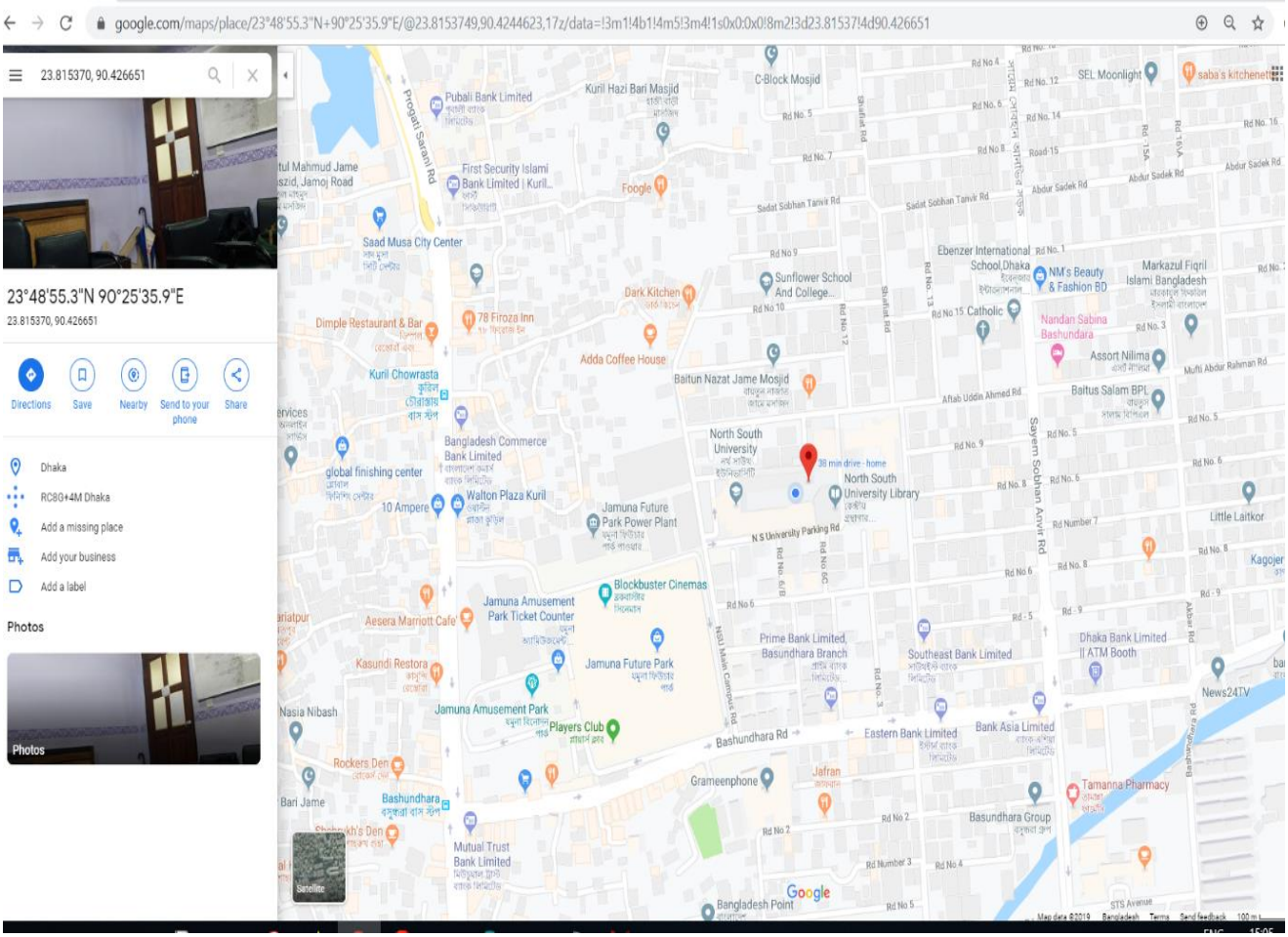

Fig: 5.2(d) Real time location

After putting the latitude and longitude of user's location or going to direct google maps location link, on map we can see the user's location in real time.

5.3 Traffic light detection:

5.3.1 Color detection:

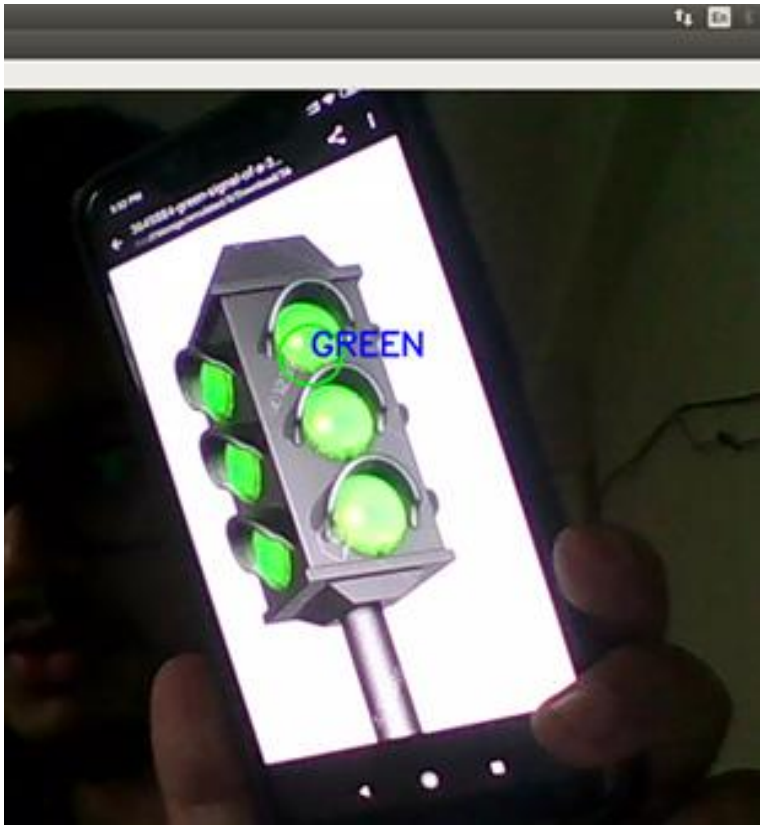

Figure 5.3(a) only color detection of traffic light.

In this picture we can see that our system is detecting the color of traffic light and we have done it with opencv color detection but there was a drawback and that is it detects any kinds of red, green or yellow color objects and gives user misinformation and because of this we started working on object detection with tensor flow and the results are in next page.

5.3.2 Object detection by tensor flow:

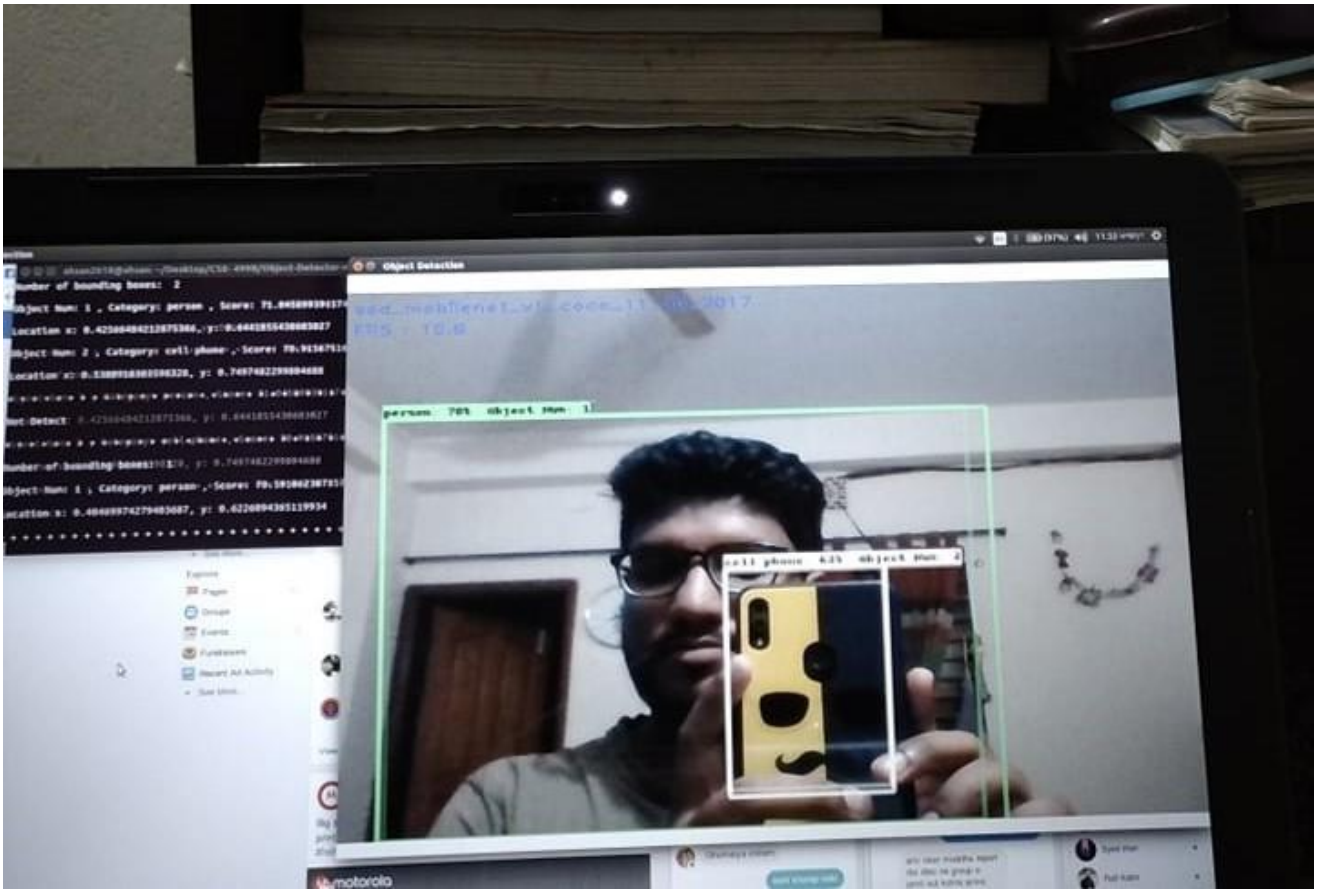

Figure 5.3 (b) Detecting the object (Human and Cellphone)

In this picture we can see that our system is detecting the object that camera captures. For example here in this picture our system is detecting human and also a cell phone. Now the object detection is done our next goal was to detect the traffic light as an object then check its color and send the color information to user by voice command. So in next picture we will show how our object detection detects the traffic light and also its color.

5.3.3 Traffic light and its color detection:

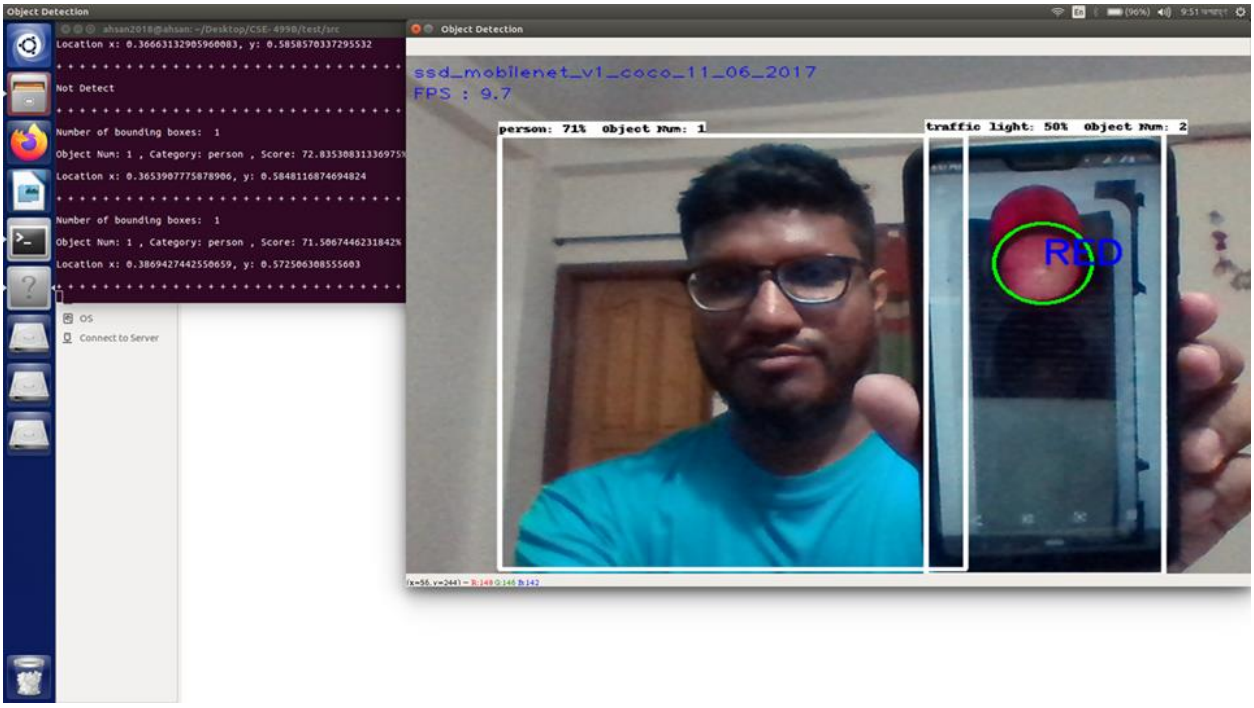

Figure 5.3 (c) Real time traffic light detection with color (RED)

In this picture we can see that our system is detecting the traffic light as an object and also its color. So first our system detected the traffic light as an object and when our system got to know that this is a traffic light then it starts it color detection. In this picture we can see that our system detects the red color.

Summary:

In this section we have shown all of our results that we have got after implementing all the features with pictures and explained those pictures with details.

CHAPTER 6

Conclusion

6.1 Introduction:

Our main goal and focus to build a stick that will help blind people when they are outside walking alone and main target was to help them cross the roads without needing anyone's help. So far we have managed to build a stick that detects objects around the user and alerts them with buzzer then we have implemented real time location tracking system and also wet road detection with moister sensor. Besides these features the main feature of our project that is detecting traffic light with raspberry pi and pi camera and we have managed to implement this feature on stick but because of raspberry pi is a low level cpu it has some drawbacks like for example the pi camera works so slowly like it delays almost 3 to 4 seconds to take every picture in real then raspberry pi takes some time to detect that object and the results comes almost comes 5 to 6 seconds late but the concept that we have wanted to implement was successful and in future when there's more powerful raspberry pi or any other portable cpu comes, it will run even more smoother and efficiently.

6.2 Work Summary:

As we said before, we implemented some features of our Smart blind stick. Now we will discuss about our implemented work. Our progress is as follows:

- Firstly we for all intents and purposes have implemented the object/obstacle detection using an ultrasonic sensor.
- Then we have implemented wet road detection using moisture sensor.
- Inserted a tracking device on our smart stick so that the kind of blind person can be tracked through this device.
- Then we have implemented traffic light detection with the help of raspberry pi and pi camera.

6.3 Future Work:

There are some areas that can be improved for example the first three feature that we have implement on Arduino can be implement on raspberry pi and this will reduce one more equipment from the stick and stick will be less weighted and also in the image processing part detecting traffic light color can be more efficient. As we all know that raspberry pi is a low level cpu and installing

openCV and tensor flow was very hard and python's library was also very tough to work on this low level cpu. So In future when there's more powerful raspberry model comes or any other portable cpu with more ram and processing power the image processing will be more efficient and fast. As of now our stick takes image very slowly and processes the whole detection thing very slowly so in real life and practical use our stick is still usable but because of low level processing power of raspberry pi the image processing lags and gives results very slowly.

Appendices

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