SMART BLIND STICK

Project #09

Session:2019-2023

Project Supervisor: Dr. Asma Javaid

Submitted By

Zubair Khan

Kashan Kaleem

Department of Software

Engineering

University of Azad Jammu and Kashmir

Certification

This is to certify that Zubair Khan, **2019-SE-33**and **Kashan Kaleem 2019-SE-15** have successfully completed the final project **Smart Blind Stick,** at the **University of Azad Jammu and Kashmir**, to fulfill the partial requirement of the degree **BSc Software Engineering.**

External Examiner

[Name of Examiner]

[Designation]

Project Supervisor

Dr Asma Javaid

[Designation]

Chairman

Department of Software Engineering, University of Azad Jammu and Kashmir

Project Title (mention project title here)

Sustainable Development Goals

(Please tick the relevant SDG(s) linked with FYDP)

SDG No	Description of SDG	SDG No	Description of SDG
SDG 1	No Poverty	SDG 9	Industry, Innovation, and Infrastructure
SDG 2	Zero Hunger	SDG 10	Reduced Inequalities
SDG 3	Good Health and Well Being	SDG 11	Sustainable Cities and Communities
SDG 4	Quality Education	SDG 12	Responsible Consumption and Production
SDG 5	Gender Equality	SDG 13	Climate Change
SDG 6	Clean Water and Sanitation	SDG 14	Life Below Water
SDG 7	Affordable and Clean Energy	SDG 15	Life on Land
SDG 8	Decent Work and Economic Growth	SDG 16	Peace, Justice and Strong Institutions
		SDG 17	Partnerships for the Goals

Range of Complex Problem Solving			
	Attribute	**Complex Problem**	
1	Range of conflicting requirements	Involve wide-ranging or conflicting technical, engineering and other issues.	
2	Depth of analysis required	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models.	
3	Depth of knowledge required	Requires research-based knowledge much of which is at, or informed by, the forefront of the professional discipline and which allows a fundamentals-based, first principles analytical approach.	
4	Familiarity of issues	Involve infrequently encountered issues	
5	Extent of applicable codes	Are outside problems encompassed by standards and codes of practice for professional engineering.	
6	Extent of stakeholder involvement and level of conflicting requirements	Involve diverse groups of stakeholders with widely varying needs.	
7	Consequences	Have significant consequences in a range of contexts.	
8	Interdependence	Are high level problems including many component parts or sub-problems	
Range of Complex Problem Activities			
	Attribute	**Complex Activities**	
1	Range of resources	Involve the use of diverse resources (and for this purpose, resources include people, money, equipment, materials, information and technologies).	
2	Level of interaction	Require resolution of significant problems arising from interactions between wide ranging and conflicting technical, engineering or other issues.	
3	Innovation	Involve creative use of engineering principles and research-based knowledge in novel ways.	
4	Consequences to society and the environment	Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation.	
5	Familiarity	Can extend beyond previous experiences by applying principles-based approaches.	

Abstract

In this study, an intelligent blind stick is designed and used to help blind people that they can move about without much problem on their own. In the event that a person leaves the intended location, this system is intended to detect the obstacle and communicate the individual's current location. By using anultrasonic sensor uppermost part of the stick, the stoop over obstacle recognition and prevention system detects obstacles in front of the user and activates an alarm and vibration to help prevent accidents and enable autonomous movement. In order to prevent someone from falling and perhaps causing significant injury, a technique for avoiding and detecting potholes is accomplished by installing an additional ultrasonic sensor in the blind stick. In the relevant range that the Arduino has specified, the ultrasonic sensor regularly detects obstructions. If any barriers are encountered, use the vibration of the blind stick to produce a buzzer sound to warn the blind person of his surroundings. A humidity sensor is positioned at the bottom of the stick to monitor the wetness, soil content, and availability of water and to alert the user whenever that amount surpasses a measurement's limit that could immerse his foot. In an emergency, the person's precise location is recorded via Global Positioning System (GPS) and transmitted to the caregiver via the Global System for Mobile communication (GSM) module. The microcontroller and various modules are constantly in contact with one another. As a result, when the switch is touched, the GPS module records the latitude and longitude of the spot where the blind person is standing and transmits it to the microcontroller, which transforms it into a Google map link and sends it to the caretaker's designated mobile number via the GSM module. All obstacles are correctly detected by this smart blind stick. The implemented blind stick is economically friendly and easy to use. This stick is designed such a way that it worked properly and quickly.

Keywords: Smart Stick, Arduino board, Ultrasonic Sensor, Moisture Sensor, Buzzers, Vibration Motor, GPS Module, GSM Module

Undertaking

I certify that the project **Smart Blind Stick** is our own work. The work has not, in whole or in part, been presented elsewhere for assessment. Where material has been used from other sources it has been properly acknowledged/ referred.

Zubair Khan

2019-SE-33

Kashan Kaleem

2019-SE-15

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All praise is to Almighty Allah who bestowed upon us a minute portion of His boundless knowledge by virtue of which we were able to accomplish this challenging task.

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Table of Contents

1. List of figures

2. List of TABLES

Chapter 1

1.1 Introduction

Visually impaired people have difficulty in interacting with others. They have little contact with environment around them. Physical movement is a challenging task for the visually impaired persons, as they find it difficult to recognize the obstacles else are unable to move easily from one place to another. They mainly depend on their families for their mobility issues and financial support. This limited mobility prevents them from interacting with people and do social activities by themselves. In the past, various systemic devices were designed with limitations, without any solid understanding of non-visual perception. Researchers have spent decades developing a clever, smart stick to help visually impaired people which can provide information about their location. In recent years, new devices have been developed to with an efficient design and reliable system for visually impaired persons to detect obstacles and warn them of danger places. [1]

Smart blind stick is specially designed to detect obstacles which may help the blind to navigate care-free movement. The buzzer and vibration motor will keep the user alert which reduces the risk of accidental injuries. This system provides a concept of a smart electronic aid for blind persons, both in public and private spaces. The proposed system contains two Arduino modules, GPS module and GSM module, front ultrasonic sensor, left ultrasonic sensor, right ultrasonic sensor, depth sensor, water sensor, mq5 sensor, buzzer, vibration motor, wireless IP camera IP and DF mini player speaker.

The Stick measures the distance between the objects and the walker by using an ultrasonic sensor of smart stick. When any object or obstacle come in range of an ultrasonic sensor, the buzzer will alert blind person by beeping specific beeps (once, twice, and thrice). If obstacle is in front buzzer will beep only one time. If it’s on left side, buzzer will beep twice and if it’s on right buzzer will beep thrice. Furthermore, if no depth will be detected, the depth sensor will send information to microcontroller, and vibration motor will start vibrating. Rain sensor gives them information about water presence on ground and also gives information about whether it is raining or not, by playing sound “water” with the help of DF mini player and speaker. MQ5 Gas sensor can detect gas or smoke as well. When this sensor detects gas or smoke, “smoke” sound will be playing instantly. A wireless IP camera has been installed there because with the help of this camera you can watch live video of environment where your blind person is moving. You can save video on your mobile or in SD card by inserting card in the camera. The NEO-6M GPS receiver module uses USART communication to interact with microcontroller. It receives information like latitude, longitude etc. The Arduino GSM shield allows an Arduino board to connect to the internet, sends and receives SMS, even make voice calls using the GSM library. Here GPS will extract the location of blind person and sends this by using GSM.

The Smart Cane is a simple and purely a mechanical device for detecting obstacles on the ground. This device is lightweight and portable but its range is limited due to its own size. It provides the best travelling aid to the person. A blind person can move from one place to another independently, without taking help of others. The main objective of this system is to provide an effective navigational aid for the blind that provides a sense of vision by providing information about their environment and objects around them.

1.2 Statement of the problem

- Blind people can’t easily recognize obstacles or stairs while using normal blind stick.
- No safety features on the normal blind stick.
- Can’t locate the location of the normal blind stick user when they are having an emergency problem or lost in a public area.

1.1.1 Existing Stick

Many Existing smart blind sticks were built that use ultrasonic sensor, attached on the front of stick. Previously built sticks have only GSM Module, which can send message like “I am in trouble” etc. These sticks do not have advance features like rain sensing system, left and right obstacles detecting system and many more. Even these sticks were not too much efficient and reliable.

1.1.2 Drawbacks of Existing Sticks

- <u>Left and Right Sensors</u>
  - Existing sticks don’t have left and right ultrasonic sensors which means these sticks were unable to detect left and right obstacles.
- <u>Depth Sensor</u>
  - Existing sticks don’t have depth sensor that’s why these sticks were unable to detect depth.
- <u>Rain Sensor</u>
  - Previous sticks don’t have any rain sensors so these sticks were unable to detect water on ground.
- <u>Smoke and Gas Sensors</u>
  - Previous sticks don’t have any mq5 sensors that’s why these sticks cannot detect smoke or any type of gas in environment.
- <u>Mp3 Voice Module</u>
  - Previous sticks don’t have any mp3 voice module so these sticks were unable to guide blind person with the help of sound.
- <u>GPS Module</u>
  - Previous sticks don’t have any GPS module so blind person was unable to send his location to his/her caretaker if he/she stuck in some trouble.
- <u>Distance</u>
  - Previous sticks can only detect objects within the range of 10cm.
- <u>Wireless IP Camera</u>
  - Previous sticks don’t have any IP camera so caretaker was unable to view live video of blind person’s environment.

1.3 Goals/Aims & Objectives

The main objective of this project is to design and implement an intelligent device that will be able to detect obstacles and alert blind users of the dangers that may be in their way. It aims to provide the blind and visually impaired communities with a smart device that enables them to have independent personal mobility outside their homes. This smart technology sends ultrasonic waves to alert users of any obstacles in their path.

1.4 Motivation

This research aims to investigate the potential benefits and limitations of incorporating electronic sensors and assistive technologies into traditional blind sticks to create a smart blind..

1.5 Methods

In this system ultrasonic sensors are used to detect the obstruction (if any). The sensors are set at a threshold limit and if any obstruction is detected within this limit it emits a specific beep through a buzzer. Obstacles in different directions are indicated by different beeps for easy identification. The sound will sound once for front obstacles, twice for left obstacles and three times for right obstacles. Ultrasonic sensors emit a range of sounds with frequencies in the ultrasonic spectrum (> 20 kHz), which is inaudible to the human ear. The sound waves bounce off the obstacle and bounce back to the detectors. Four ultrasonic sensors are used for detecting objects/obstacles which are in front, left and right and down side (depth sensor).

After the collection of data, the calculations are done according to the formula: distance = duration*0.034/2. Once the distance of the obstacle is calculated then the conditions are checked. Then send to microcontroller to operate a beeps the microcontroller reads the distance of the obstacle using sensor and also commands the beeps. The beep twice for left side obstacle, once for front obstacles and thrice for right obstacles. If depth is not detected depth sensor will send message to microcontroller and microcontroller will turn on the vibration motor and motor will starts vibrating. If some gas or smoke detected by mq5 sensor, then it will play “smoke” sound with the help of DF mini player and speaker. Also if some water detected by rain sensor it will play “water” sound with the help of DF mini player and speaker. GPS and GSM are installed to Arduino 2. If blind person stuck in some trouble, he/she can press the button and send his/her location with the help of GPS and GSM modules.

For our project, the information about visually impaired people has been collected throughout every source that leads to our project. All of this information has been used in our project which is Smart Blind Stick. During our designing phase, we found out that there is interference between the ultrasonic sensors, sometimes wires will come in the front of sensors and sensors start detected these wires as obstacles, so we stick the wires with glue in order to reduce the interference. First we used DF player with front, left and right sensor for obstacle alert but then we realize that using DF player for these sensors is reducing the efficiency so we used buzzer instead of DF player for these sensors. We used DF Player for rain sensor and MQ5 sensor for sound navigation. For depth sensor we used vibration motor for better efficiency.

Chapter 2

2.1 Literature Review

3 A voice-activated outdoor navigation system for the visually impaired developed by Rahul Patil (2012**)** [2] uses a stick equipped with ultrasonic sensors, GPS and an audio output system. The stick has a GPS which will have a memory card which is used to store various locations. The user can determine the location by voice and the GPS will guide the person to his location. The system will also provide the speed and remaining distance to reach the destination. When the ultrasonic sensors detect an obstacle, the acoustic system activates a warning sound. This system can be classified as a low cost system which is affordable for the user. In addition, it can provide voice guidance to the user with maximum accuracy. The system uses an ARM processor with more memory space, resulting in a relatively high running speed. But this system cannot work at home because there will be no GPS signal possible. The accuracy of the GPS signal needs to be improved because it can only be checked within a radius of 5 meters. Finally, the blind must be installed in the system to be able to use it effectively.

4 Shruit (2011**)** [3] built a system for the use of smart staff for blind people. It provides obstacle detection, artificial vision and real-time support via GPS. This system uses GPS, artificial vision systems, detection and voice interference. This system works through a camera on the user's head, the camera algorithm will be used to identify heights and obstacles in front of a blind person. This system also contains ultra-sonic sensors to detect obstacles. In addition, this system contains a GPS system to reach the desired destination. Once any obstacle is detected or the destination is reached the voice circuit will activate providing certain type of voice.

5 All these sub systems are connected to microcontroller which controls the entire operation of the system. This system can be classified as a low cost system. The accuracy of the artificial vision unit provides a high accuracy output for the user. In addition to that, the detection distance of the system is 15 meters. However, the complexity of the system requirements makes it difficult to design and understand. Another study in the same field to help blind people uses the pulse echo technique in order to provide a warning sound when detecting the obstacles. This technique is used by the United States military for locating the submarines. They use pulses of ultrasound range from 21 kHz to 50 kHz which hit the hard surface to generate echo pulses. By calculating the difference between the signals transmit time and

the signal receive time, the distance between the user and the obstacles can be predicted.

6 This system is very sensitive in terms of detected interference. The detection range is up to 3 meters and the detection angle is between 0 to 45 degrees. But this system is of greater power to work because of the transmitter and receiver circuits. So, this re-arranged system should work with less power consumption. Another study by (Sung, Young, Kim and IN, 2001) [4] to develop an intelligent staff to guide blind people used an intelligent CPU called MELDOG which uses artificial intelligence. It can identify the exact position of obstacles using ultrasonic sensors and laser sensors.

7 To identify the location, a "map matching technique" was implemented using ultrasonic sensors. This system includes a DC motor controller that is connected to an encoder. When the wheels roll 18 degrees, infrared sensors attached to both wheels transmit a signal to the CPU to provide a location update. This accurate detection system can provide the user with continuous updates to detected obstacles with an angle between 0 degrees to 18 degrees. However, this system is expensive and has a complex design. It is important for other similar systems. The weight of the system is about 5.5 kg. The detection distance of this system is very low which is about 87.5 cm to 105 cm. A study by (Jayant, Pratik and Mita 2012) [5] proposed a smart pen for mobility-aided vision. The system is based on normal ultrasonic sensors and microcontroller. It works with two rechargeable batteries (7.4V) that can be recharged using a USB cable or AC adapter. The control unit is programmed using ATMELAVR microcontroller ATMEGA328P microcontroller. When the trains any vibration is detected and the buzzer will start to alert the user.

8 This is a complicated system to use. It has the ability to cover a distance of up to 3 meters and has a rechargeable battery. Also, this system can be folded into a small piece so that the user can carry it easily. However, this system provides only one part of the detection coverage and is not suitable for detecting obstacles. All of the studies that have been reviewed show that there are many types of tricks for blind people, and they all use different techniques to help the blind person. However, studies show that ultra-sonic sensors are an effective solution for detecting obstacles with a maximum range of 7 meters and 45 degrees of coverage. In addition to that, with the use of a non-complex microcontroller, it will help the blind to use the device (stick) easily and without any problems. Finally, the device should work for a minimum of time with power and recharged. This

system features a stick that uses ultrasonic sensors for detection and a microcontroller that controls the system without complexity. The detection angle is 180

9 2.2 Smart Walking Stick Using Ultrasonic Sensors and Arduino

10 This project was developed by (M.H. Mahmud, R. Saha and S. Islam) [6]**.** The author proposes a function of a microcontroller that have code protected so its security bridge cannot be override except the vendor or owner. It produces different Pulse Width Modulation (PWM) based on the sensors output to operate pager motor. The author focused on the easy way to use the stick and it's maintain, cheap and it is very comfortable to use for blind people. The author approach with subsystems fundamentally sensor based with integral scheme is designed with a circuitry fundament on a PIC microcontroller. The power consumption is low and can be operated easily. The stick is very economic over the conventional one. The Smart Stick acts as a basic platform for the coming generation of more aiding devices to help the visually impaired to navigate safely both indoor and outdoor. It is effective and affordable. It leads to good results in detecting the obstacles on the path of the user in a range of three meters. This system offers a low-cost, reliable, portable, low power consumption and robust solution for navigation with obvious short response time. M.H. Mahmud, R. Saha and S. Islam (February 2015) degrees. It uses a 12-volt rechargeable lithium battery. It is a low cost and light weight system.

11

12 2.3 A computerized Travel aid for the Active Guidance for the Blind Pedestrians

13 The author convinced a stick which allowed a sighted assistant to steer the Guide Cane remotely. A sightless subject would then walk with the Guide Cane, "steered" by the assistant radio-control joystick. The author focused on how to steer the stick so the sensor head is mounted on a steerable with two unpowered wheeled steering axle. The author approach with the ultrasonic sensors that detect any obstacle in a 120o wide sector ahead of the user. Using UM's previously developed, patented obstacle avoidance technique called "Vector Field Histogram" (VFH) in combination with UM's patented "Error Eliminating Rapid

Ultrasonic Firing” (EERUF) method for firing the sonars, allows for travel at fast walking speeds [7].

14

15 2.4 A Multidimensional Walking Aid for Visually Impaired Using Ultrasonic Sensors with Voice Guidance

16 The author propose that voice can being consequently activate by microcontroller when detect any obstacle to warn the sightless subject. The author approach using with a 40 KHz signal sent out by the ultrasonic transmitter. This will be reflected back to the ultrasonic receiver in case there is an obstacle along the pathway of the stick, and this activates one of the input pin of the microcontroller. Once this happened, the microcontroller will consequently activate the voice recording microchip which then gives the relevant output via the speaker. The author focused on how to make the voice guidance as a platform to ease and help the sightless subject [8].

17

18 2.5 Obstacle Detection, Artificial Vision and Real-Time Assistance Via GPS

19 The author convinced the Global Positioning System (GPS) is to identify the position and orientation and location of the blind person any of those solutions rely on GPS technology. The author focused on the GPS to make use of the data stored to compare with the destination location of the user. By this it can trace out the distance from the destination and produce an alarm to alert the user in advance. The author conclude The proposed combination of various working units makes a real-time system that monitors position of the user and provides dual feedback making navigation more safe and secure. The author approach with Microcontroller that integrated using Global Positioning System(GPS).

20

21 2.6 Implementation of Microcontroller Based Mobility Aid for Visually Impaired People

22 The author convinced the proposed that LDR gives a very high resistance value ranging up to 2MΩ and in the day time or when there is sun light it gives a low resistance ranging to 100Ω and sometimes below. From the voltage divider

network at day time the voltage from the LDR is lower there by making pin 2 lower than pin 3 of the comparator giving an output voltage of 0V and at night the VLDR is high making pin 2 greater and the comparator output 5V. The author focused on how LDR can function on white cane with the proper circuit. The system consists of an ultrasonic sensor for obstacle detection, an and a light dependent resistor for dark detection. Each sensor is differentiated from one another through pattern of sounds.

23 This paper presents the design and implementation of Microcontroller Based Mobility aid for visually impaired people. In the world today, about 285 million people are visually impaired. Over the years visually impaired persons have difficulty to interact and feel their environment. They have little contact with their surroundings, and physical movement is a very big challenge to them because it can become tricky to distinguish where he/she is and how to get where he/she wants to go. To navigate to unknown places has to be with individual support. Majority of the blind people in the world are unemployed because of the type of jobs available to them are limited; their mobility opposes them from interacting with people and social activities. This has created very huge concern to people assisting them to walk. This research work aimed at designing mobility aid to the visually impaired persons in order to encourage them to move freely anywhere they want at any time without collision and assistance. The proposed low cost and light weight system is designed with microcontroller that processes signal and alerts the visually impaired person over any obstacle, water or dark areas through beeping sounds. The system consists of special detection sensors, AT89C52 microcontroller for receiving, processing, and sending signals to the alarm system which finally alerts the user for prompt action [10].

Chapter 3

3.1 Project Components

3.1 Components Design:

This section describes the components in detail and how to connected it.

3.1.1 Block Diagram

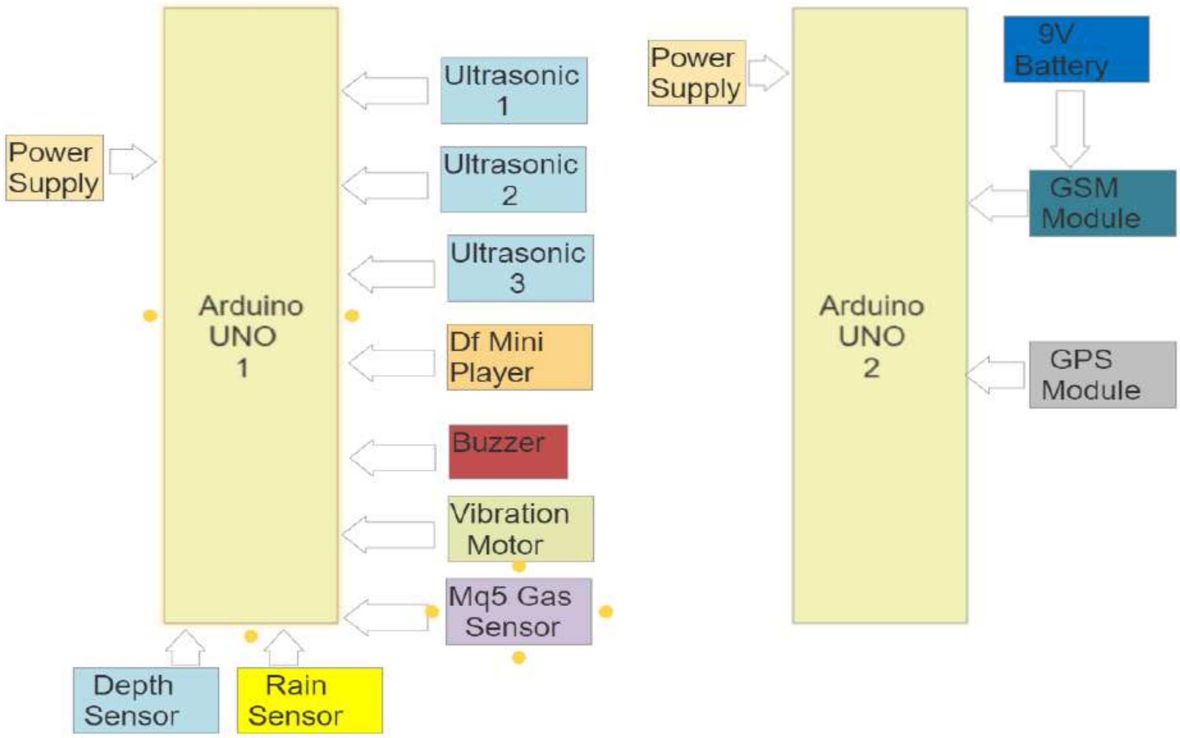


Figure 3.1: Block Diagram

3.1.2 Arduino UNO

Arduino Uno is a microcontroller board based on ATmega328P. It has 14 digital input/output pins (6 of which can be used as PWM outputs), 6 analog inputs, 16 MHz ceramic resonator (CSTCE16M0V53-R0), USB connection, the socket has a power supply, an ICSP connector and a reset button. It includes everything need to support a microcontroller. To get started, connect it to a computer with a USB cable or power it with an AC-DC adapter or battery. You can DIY your Uno without worrying too much about doing anything wrong, worst case scenario you can replace the chip for a few bucks and start over.

"UNO" means one in Italian and was chosen for the Arduino software (IDE) 1.0 release. The Uno board and Arduino software (IDE) version 1.0 were the reference versions of the Arduino, which have now evolved into newer versions. The Uno board is the first in a series of Arduino USB boards, and the reference model for the Arduino platform. For a complete list of current, past, or obsolete boards, see the Arduino Board Index. In this project, it is used to control all hardware components. These hardware components are attached to Arduino Uno through wires. Some hardware components attached to digital pins and some analog pins. When some specific condition true Arduino performs action by activating specific hardware components.

Here's a preview of what you'll see, looking at the chart from top to bottom.

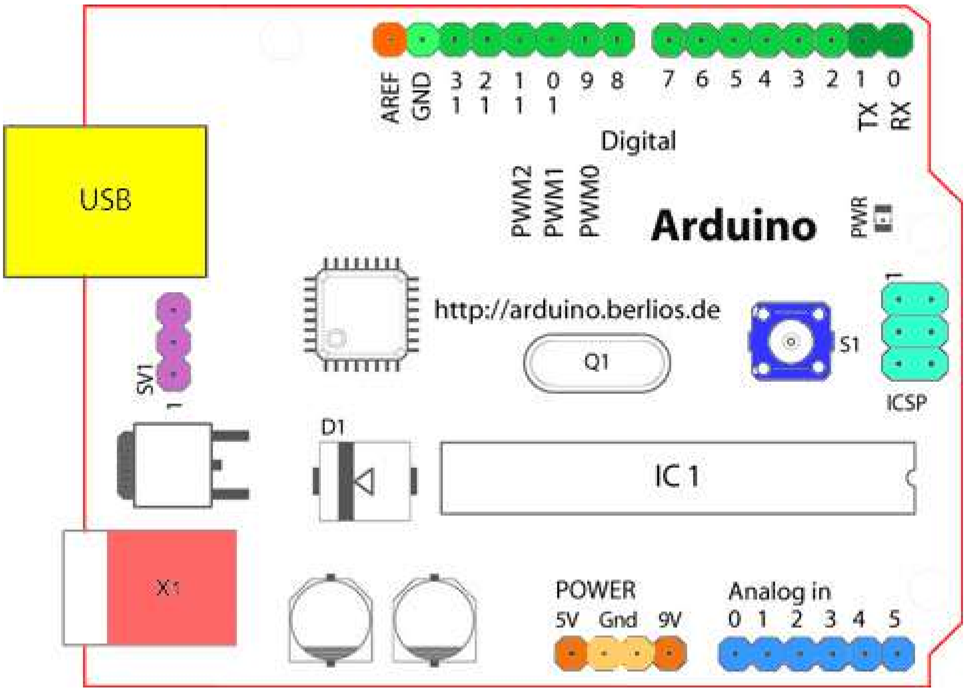


Figure 3.2: Arduino UNO

Starting clockwise from the top center:

- Analog Reference pin (orange).
- Digital Ground (light green).
- Digital Pins 2-13 (green).
- Digital Pins 0-1/Serial In/Out - TX/RX (dark green) - These pins cannot be used for digital i/o (digital-Read and digital-Write) if you are also using serial communication (e.g. Serial.begin).

- Reset Button - S1 (dark blue).
- In-circuit Serial Programmer (blue-green).
- Analog In Pins 0-5 (light blue).
- Power and Ground Pins (power: orange, grounds: light orange).
- External Power Supply In (9-12VDC) - X1 (pink).
- Toggles External Power and USB Power (place jumper on two pins closest to desired supply) - SV1 (purple).
- USB (used for uploading sketches to the board and for serial communication between the board and the computer; can be used to power the board) (yellow).

3.1.2.1 Microcontroller (ATmega328P)

Used on most recent boards.

- Digital I/O Pins: 14 (of which 6 provide PWM output).
- Analog Input Pins: 6 (DIP) or 8 (SMD).
- DC Current per I/O Pin: 40 mA.
- Flash Memory: 32 KB.
- SRAM: 2 KB.
- EEPROM: 1 KB.

3.1.2.2 Digital Pins

In addition to the specific functions listed below, the digital pins on the Arduino board can be used for general purpose input and output via the (pinMode), (digital-Read), and (digital-Write) commands. Each pin has an internal pull-up resistor that can be turned on and off (with a high or low value, respectively) using (digital-Write) when the pin is configured as an input. The maximum current per pin is 40 mA.

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. On the Arduino Diecimila, these pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip. On the Arduino BT, they are connected to the corresponding pins of the WT11 Bluetooth® module. On the Arduino Mini and LilyPad Arduino, they are intended for use with an external TTL serial module (e.g. the Mini-USB Adapter).

- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function. On boards with an ATmega8, PWM output is available only on pins 9, 10, and 11.
- BT Reset: 7. (Arduino BT-only) Connected to the reset line of the Bluetooth® module.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.
- LED: 13. On the Diecimila and LilyPad, there is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

3.1.2.3 Analog Pins

In addition to the specific functions listed below, the analog input pins support 10-bit analog-to-digital conversion (ADC) using the analogRead() function. Most analog inputs can also be used as digital pins: analog input 0 as digital pin 14 to analog input 5 as digital pin 19. Analog inputs 6 and 7 (present on Mini and BT) cannot be used as digital pins.

- I2C: 4 (SDA) and 5 (SCL). Support I2C (TWI) communication using the Wire library (documentation on the Wiring website).

3.1.2.4 Power Pins

- VIN (sometimes labelled "9V"). The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin. Note that different boards accept different input voltages ranges, please see the documentation for your board. Also note that the LilyPad has no VIN pin and accepts only a regulated input.
- 5V. The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an

on-board regulator, or be supplied by USB or another regulated 5V supply.

- 3V3. (Diecimila-only) A 3.3-volt supply generated by the on-board FTDI chip.
- GND. Ground pins.

3.2 Ultrasonic Sensor

The HC-SR04 ultrasonic sensor uses sonar to determine the distance of an object like bats or dolphins do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use 2cm to 400cm or 1" to 13ft package. Its operation is unaffected by sunlight or (although acoustically but it can be difficult to detect soft materials such as fabric.) It comes with an ultrasonic transmitter and receiver module. First sensor for front obstacle detection, 2nd sensor for left obstacle detection, 3rd sensor for right obstacle detection and fourth one for as a depth sensor.

Figure 3.3: Ultrasonic Sensor HC-SR04

3.2.1 Working

The ultrasonic sensor uses sonar to determine the distance to an object. Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensors, like many others, use a single transducer to send a pulse and to receive the echo.

- The ultrasound transmitter (trig pin) emits a high-frequency sound (40 kHz).
- The sound travels through the air. If it finds an object, it bounces back to the module.
- The ultrasound receiver (echo pin) receives the reflected sound (echo).

3.2.2 Pins Description

Table 3.1: Pinout of the HC-SR04 Ultrasonic Sensor

VCC	Powers the sensor (5V)
Trig	Trigger Input Pin
Echo	Echo Output Pin
GND	Common GND

3.3 DF Player Mini MP3

DF player mini is a small, low-cost mp3 module with a convenient audio output that can be connected directly to a speaker or headphone jack. The module can be used as a stand-alone module with a battery, speaker and push buttons or can be used in conjunction with a microcontroller or development board such as an Arduino, which is enabled for RX/TX (serial) communication can also be run thanks to simple serial commands. Perform music and other functions such as play next and previous song, shuffle, pause currently playing song, etc. The module comes with an SD card slot and supports FAT16, FAT32 file systems. In this project DF player used to play only two sounds. We have recorded sounds in SD card and inserted SD card into DF player. Speaker is attached with DF player. One sound is “water” which is played when water is detected by rain sensor present on ground. Other sound is “smoke” which is played when smoke or gas detected by MQ5 sensor.

3.3.1 Specification

- Supported sampling rates (kHz): 8/11.025/12/16/22.05/24/32/44.1/48

- 24 -bit DAC output, support for dynamic range 90dB, SNR support 85dB
- Fully supports FAT16, FAT32 file system, maximum support 32G of the TF card, support 32G of U disk, 64M bytes NORFLASH
- A variety of control modes, I/O control mode, serial mode, AD button control mode
- Advertising sound waiting function, the music can be suspended. when advertising is over in the music continue to play.
- Audio data sorted by folder, supports up to 100 folders, every folder can hold up to 255 songs
- 30 level adjustable volume, 6 -level EQ adjustable.

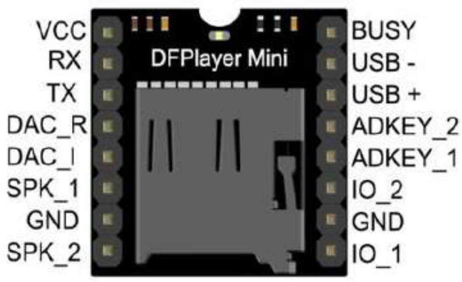


Figure 3.4: DF Player Mini MP3

3.4 Rain Senor

A rain sensor is made up of rain sensing plate, with a comparator that handles the intelligence. The rain sensor detects the lack of water in the circuit board strip. The sensor acts as a variable resistor that will change state, resistance increases when the sensor is wet and resistance decreases when the sensor is dry. In this project rain sensor attached at the bottom of stick. If some water present on ground or it is raining outside and as soon as water hits on plate of rain sensor, the rain sensor will send signal to microcontroller and DF mini player plays the sound “water” in order to alert blind person that water is present on ground.

3.4.1 Working of Rain Sensor:

The working of rain sensor is pretty simple. A sensing pad with a series of exposed copper traces together act as a variable resistor (much like a potentiometer) whose resistance varies with the amount of water on its surface.

- The more water on the surface means better conductivity and will result in a lower resistance
- The less water on the surface means poor conductivity and will result in a higher resistance.

The sensor produces an output voltage depending on the resistance, by measuring which we can determine whether it is raining or not.

Figure 3.5: Rain Sensor

Table 3.2: Pinout of the Rain Sensor

Name	**Function**
VCC	Connects supply voltage- 5V
GND	Connected to ground

D0	Digital pin to get digital output
A0	Analog pin to get analog output

3.5 MQ5 Gas Sensor

This is an Arduino LPG gas sensor. It has an MQ5 probe that is very sensitive with LPG, natural gas, town gas. It is less sensitive to alcohol, cooking smoke and cigarette smoke. The sensitivity can be adjusted by a potentiometer. The output is proportional to the gas density. You can use analog reading to read the data from this sensor. In this project MQ5 Arduino sensor can be used in a variety of situations, to check how reliable it is. For example, to test if there is a gas leakage at home or any other place, you can use the MQ5 sensor. MQ5 sensor can also detect fire or smoke. If smoke or fire detected by MQ5 sensor, it will send signal to microcontroller and microcontroller will activate DF mini player. The mini player will play “smoke” sound in order to alert blind person.

Figure 3.6: MQ5 Gas Sensor

Table 3.3: Pinout of the MQ5 Gas Sensor

Arduino	**MQ5 Gas Sensor**

5V	VCC
GND	GND
NC	NC
Analog A0	SIG

3.6 Wireless IP Camera

It's ultra-small, very convenient to carry, can be used outdoor and indoor as well. It has place of a magnet device and is compatible with magnetic fittings that can be used in different places with 150 degrees super wide-angle for surveillance. The built-in battery can work for 60 minute continuously. This wireless hidden Camera has its own Wi-Fi hotspot. It can also connect to your mobile phone without Router/Wi-Fi. This device has 6 patch infrared lamps, 5-meter night vision distance, and remotely switching on or off via App on the cellphone.

It has a motion sensor, once found something abnormal, it will send an alert message to your phone. Wireless IP camera installed in, because with the help of this camera you can watch live video of environment where your blind person is moving. You can save video on your mobile, else you can save it on SD card by inserting card in the camera.

Figure 3.7: Wireless IP Camera

3.7 NEO-6M GPS Module

The heart of the module is the DENSATION NEO-6M GPS from u-blox. It can track up to 22 satellites in 50 channels and achieves the highest level of sensitivity in the industry i.e. -161 dB tracking while consuming only 45mA of supply current. The u-blox 6 engine positioning also boasts a Time-To-First-Fix (TTFF) of under 1 second. One of the best features of the chip offers Power Save Mode (PSM). System power consumption reduction allows switching selected parts of the receiver ON and OFF. This act dramatically reduces the module's power consumption to just 11mA, making it suitable for power sensitive applications, such as GPS wristwatch. The Neo-6M GPS pegs required a "0.1″ pitch of the broken head.

This includes the pins required for communication with the microcontroller over the UART. In this project we are using NEO-6M GPS Module because it receives extra information like latitude, longitude etc. When blind person finds himself/herself in difficult situation, with the help of GPS module he/she can send his/her location to caretaker via GSM module.

Figure 3.8: NEO-6M GPS Module

Table 3.4: Pinout of NEO-6M GPS Module

Arduino UNO	**NEO-6M Module**
5V	VCC
Digital pin 2	TX
Digital pin 3	RX
GND	GND

3.8 GSM SIM 900

SIM900 Modem is built with Dual Band GSM/GPRS based SIM900 modem from SIMCOM. It operates on frequencies of 900/1800 MHz SIM900 can search these two bands automatically. Frequency bands can also be set by AT commands. Default rate is configurable from 1200-115200 via AT command.

The GSM/GPRS Modem has an internal TCP/IP stack so you can connect it to the internet via GPRS. The SIM900 is ultra-compact and reliable wireless module. This GSM/GPRS module is complete in SMT type and designed with a single-chip process, integrating the powerful AMR926EJ-S core, allowing you to benefit from small dimensions and cost-effective solutions. This module is supportive only on 2G SIM. So if you want to use this module, you can insert 2G SIM only. This module can be used for calling as well as sending and receiving SMS. But in this project it is only used for sending GPS location through SMS.

3.8.1 Booting Up SIM 900

- Insert your SIM card to GSM module and lock it.
- power up your GSM by connecting it to Arduino 5V or 9V power supply and GND.
- Connect the Antenna.

- Now wait for some time (say 1 minute) and see the blinking rate of ‘status LED’ or ‘network LED’ (D6) //GSM module will take some time to establish connection with mobile network.
- Once the connection is established successfully, status/network LED will blink continuously after every 3 seconds. You may try making a call to any mobile number of the SIM card inside GSM module. If you hear a ring back, the GSM module has successfully established network connection.

Figure 3.9: GSM SIM 900

Table 3.5: Pinout of GSM SIM 900

Arduino UNO	**NEO-6M Module**
5V	VCC
Digital Pin 8	TX
Digital Pin 7	RX
GND	GND

3.9 Buzzer

Arduino buzzer is also called piezo buzzer. It's basically a tiny speaker that you can connect to the Arduino directly. You can make the tone sound at the frequency you set. The buzzer produces sound as a result of the reverse piezoelectric effect. In this project buzzer will give sound only when front, left or right ultrasonic sensor senses some obstacle. It beeps twice for left side obstacle, once for front obstacles and thrice for right side obstacles.

Figure 3.10: Buzzer

Table 3.6: Pinout of Buzzer

Arduino UNO	**Buzzer**
Negative Pin -	GND
Positive Pin +	A5

3.10 Vibration Motor

The vibration motor is a DC motor in compact size that uses to inform users of the pulse, received in the signals. It has no sound. It doesn't say anything at all. They are mainly used in mobile phones, cards, pagers and so on. In this project vibration motor only vibrates when depth is detected by depth sensor.

Figure 3.11: Vibration Motor

Arduino UNO	Vibration Motor
5V	VCC
GND	GND
A4	IN

Table 3.7: Pinout of Vibration Motor

3.11 Power Bank and 3 Cell Battery

- Power bank will provide voltage to both Arduino. It provides 5V power.

Figure 3.12: Power Bank

3 cell battery will provide voltage to GSM Module because 5V is not enough for GSM for properly power on. Each cell is 3.7V. Minimum power required to turn on GSM is 9V.

Figure 3.13: 3 Cell Battery

3.12 Breadboard

A breadboard, a protoboard, or an array of terminal-based constructions is used to construct semi-permanent prototype electronic circuits. Unlike stripe-board (Veroboard), breadboards do not require soldering or destruction of traces and are therefore reusable. For this reason, boards are also popular in students of education technology. Left ultrasonic, right ultrasonic, front ultrasonic, depth ultrasonic, buzzer, vibration motor, rain sensor, MQ5 sensor and DF mini payer, Arduino all are connected on this board.

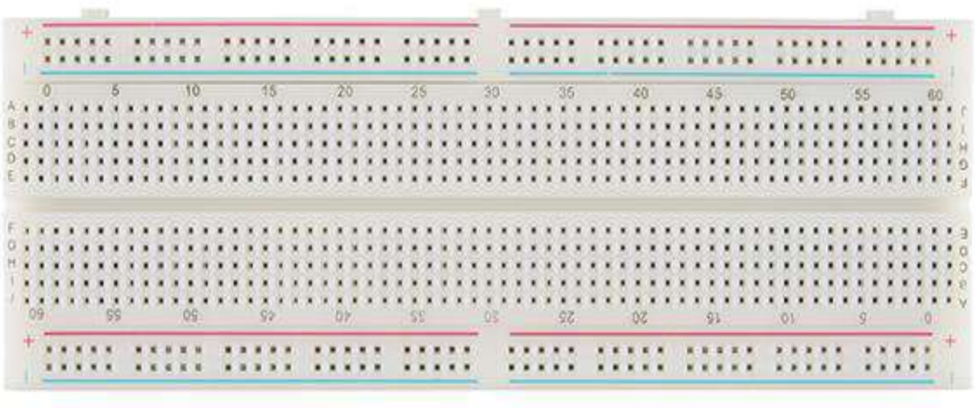


Figure 3.14: Breadboard

Chapter 4

1. 4.1 System Design

4.1 Software

A program for Arduino hardware can be written in a programming language with compilers that produces binary machine code for the target processor. Atmel provides a development environment for its 8-bit avr and 32-bit ARM Cortex-m based microcontrollers: Avr studio (older) and Atmel studio (newer).

4.1.2 IDE

Arduino integrated development environment (ide) is a cross platform (for windows, Marcos and Linux) that is written in the java programming language from the same source for processing languages and wiring. It includes a code editor with features such as text cutting and pasting, text searching and replacing, automatic indentation, bracket matching, syntax highlighting, and provides simple mechanisms to compile and load Arduino board programs. It also contains a message area, a text console, an instrument panel with buttons for common functions and a hierarchy of operation menus.

The source code for ide is released under the GNU General Public License, version 2. ide Arduino supports the C and C++ languages using special code structure rules. The Arduino IDE is a complementary software library for a wiring project that provides many common input and output methods. The user-written code requires only two main functions, the initial outline and the loop of the main program, which is compiled and combined with the main program into an executable program executed cyclically with the gnu toolchain, also included with the IDE distribution. The Arduino ide uses the avrdude program to convert the executable code into a text file written in hexadecimal, which is loaded into the Arduino board, from the program loaded into the board's firmware.

4.1.3 Pro IDE

On October 18th, 2019, Arduino pro IDE (alpha preview) was released. The system still uses Arduino cli (command line interface), but improvements include a more professional development environment, autocompleting support, and git integration. The application frontend is based on the eclipse open source IDE. The main features available in the alpha release are:

- Modern, fully featured development environment.
- Dual mode, classic mode (identical to the classic Arduino IDE) and pro mode (file system view).
- New board manager.
- New library manager.
- Board list.
- Basic auto-completion (arm targets only).
- Git integration.
- Serial monitor.
- Dark mode.

4.1.4 Sketch

A sketch is a program written with the Arduino ide sketches are saved on the development computer as text files with the file extension ino. Arduino software (IDE) pre-1.0 save sketches with the extension pde. A minimal Arduino C/C++ program consists of only two functions:

- Setup: this function is called once when a sketch starts after power-up or reset. It is used to initialize variables, input and output pin modes, and other libraries needed in the sketch. It is analogous to the main function.
- Loop: After setup function exits (ends), the loop function is executed repeatedly in the main program. It controls the board until the board is powered off or is reset. It is analogous to the function (1).

4.2 Flow Chart

A pictorial representation of an algorithm is called a 'Flowchart'. In a flowchart, the steps in an algorithm are represented in the form of various chip shapes and the flow of logic is indicated by connected arrows. Boxes are used to represent different operations and arrows are used to represent the sequence of these operations. Since this is a visual way of representing the algorithm, it helps the programmer/tester to understand the logic of the program.

4.2.1 Ultrasonic Sensors

Figure 4.1 represents a flow chart of the working methodology of the front ultrasonic sensor. In this figure, the system first initialized the ultrasonic sensor. The sensor sends and receives an ultrasound to detect obstacles. If obstacle found within the range of 50cm, the ultrasound sensor sends corresponding measured data to the microcontroller. Microcontroller will turn on the buzzer and buzzer beeps only one time.

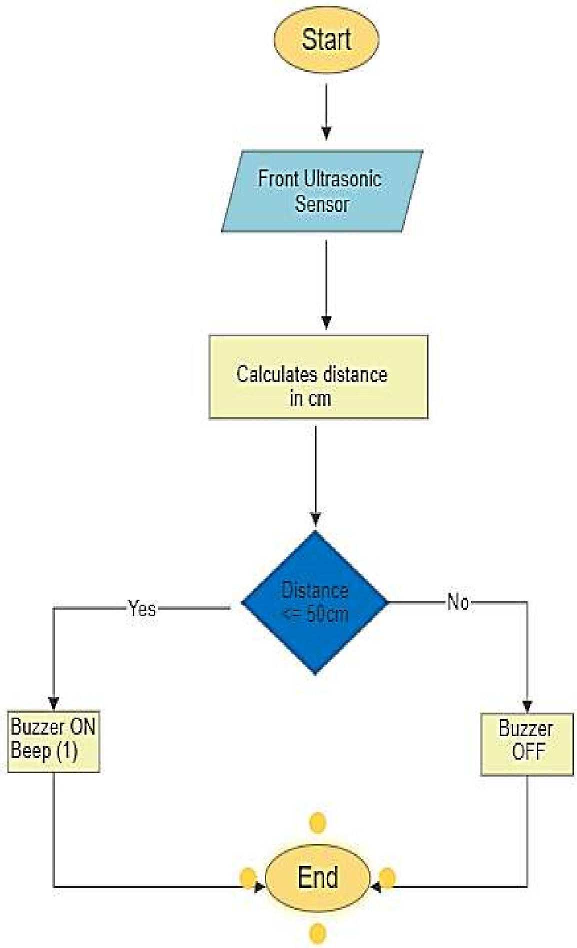


Figure 4.1: Flowchart of Front Ultrasonic Sensor

Figure 4.2 represents a flow chart of the working methodology of the left ultrasonic sensor. In this figure, the system first initialized the ultrasonic sensor. Then sensor sends and receives an ultrasound to detect obstacles. If obstacle found within the range of 30cm, the ultrasound sensor sends the corresponding measured data to the microcontroller. Microcontroller will turn on the buzzer and buzzer beeps two times.

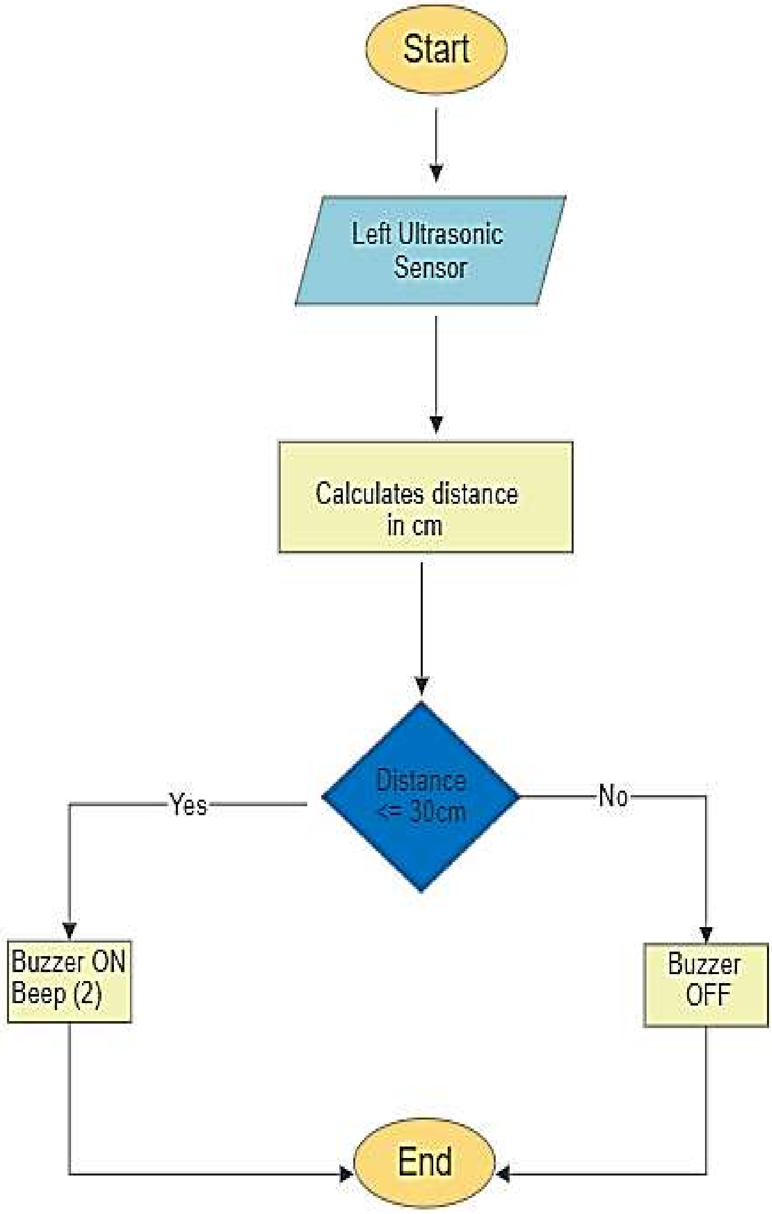


Figure 4.2: Flowchart of Left Ultrasonic Sensor

Figure 4.3 represents a flow chart of the working methodology of the right ultrasonic sensor. In this figure, the system first initialized the ultrasonic sensor. Then sensor sends and receives an ultrasound to detect obstacles. If obstacle found within the range of 30cm, the ultrasound sensor sends the corresponding measured data to the microcontroller. Microcontroller will turn on the buzzer and buzzer beeps three times.

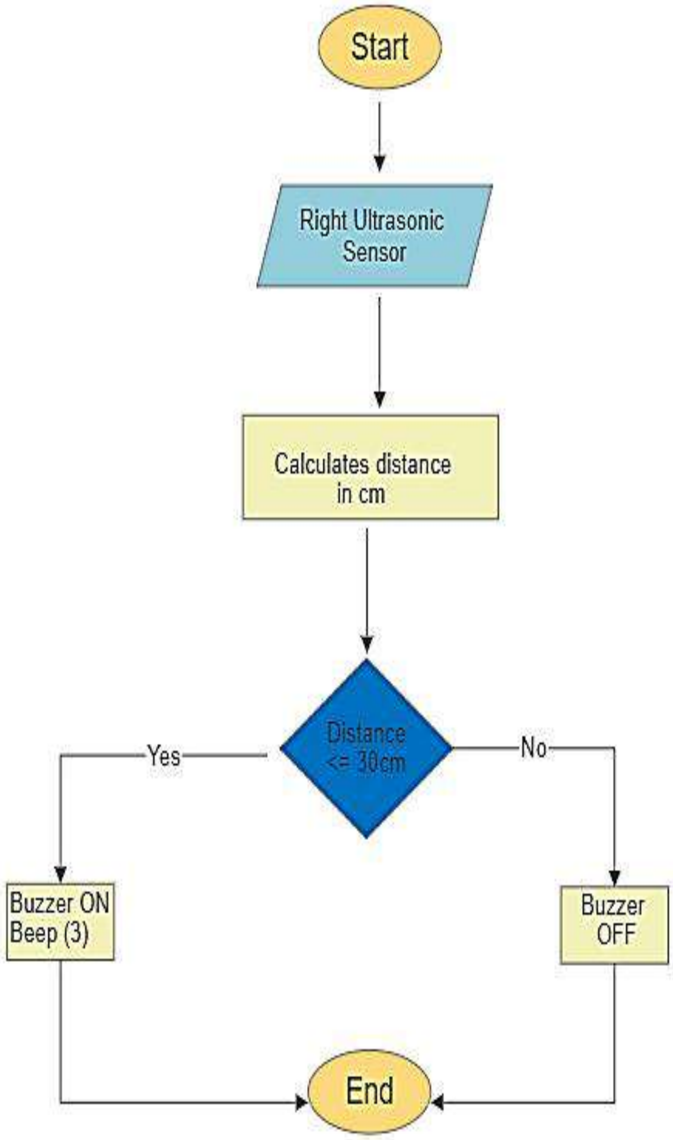


Figure 4.3: Flowchart of Right Ultrasonic Sensor

Figure 4.4 represents a flow chart of the working methodology of the depth sensor. Basically ultrasonic sensor is used as a depth sensor here. In this figure, the system first initialized the depth sensor. Then sensor sends and receives an ultrasound to detect depth. If depth not found within the range of 20cm, the ultrasound sensor sends the corresponding measured data to the microcontroller. Microcontroller will turn on vibration motor and vibration motor will create vibration in stick.

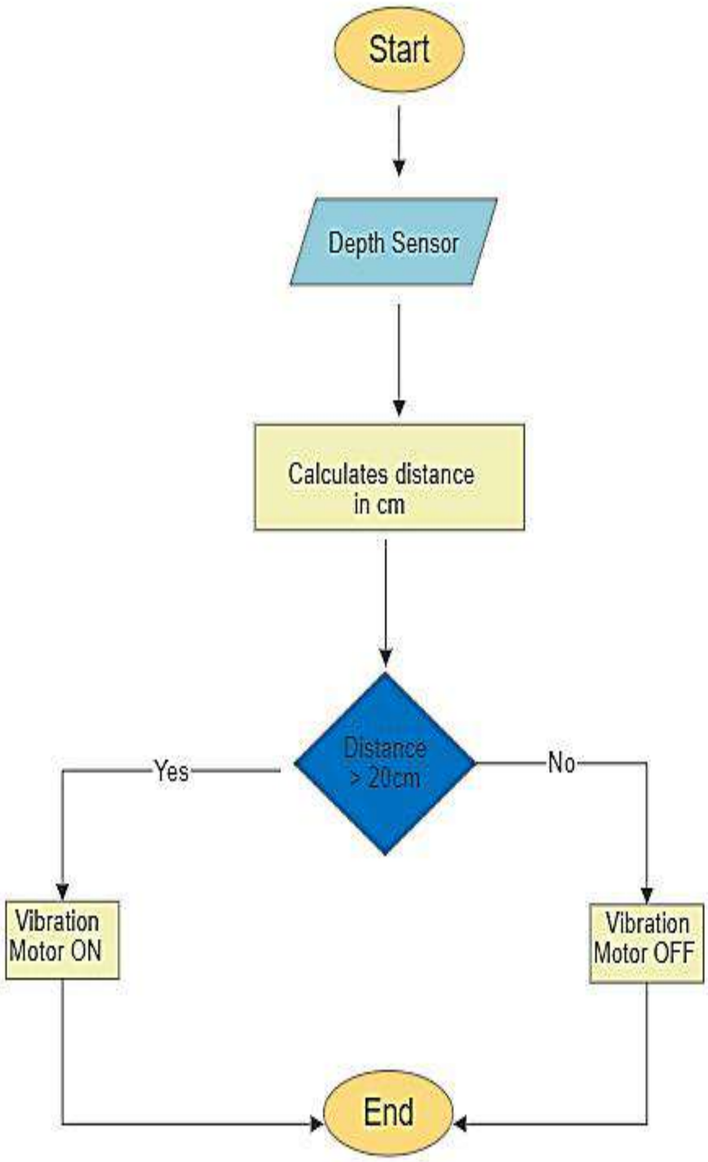


Figure 4.4: Flowchart of Depth Ultrasonic Sensor

4.2.2 Rain Sensor

Figure 4.5 represents a flow chart of the working methodology of the rain sensor. In this figure, the system first initialized the rain sensor. If drops of water hits the plate of rain sensor with value less than 500, the rain sensor sends the corresponding measured data to the microcontroller. Microcontroller will turn on the DF player and DF player will plays the sound “water”.

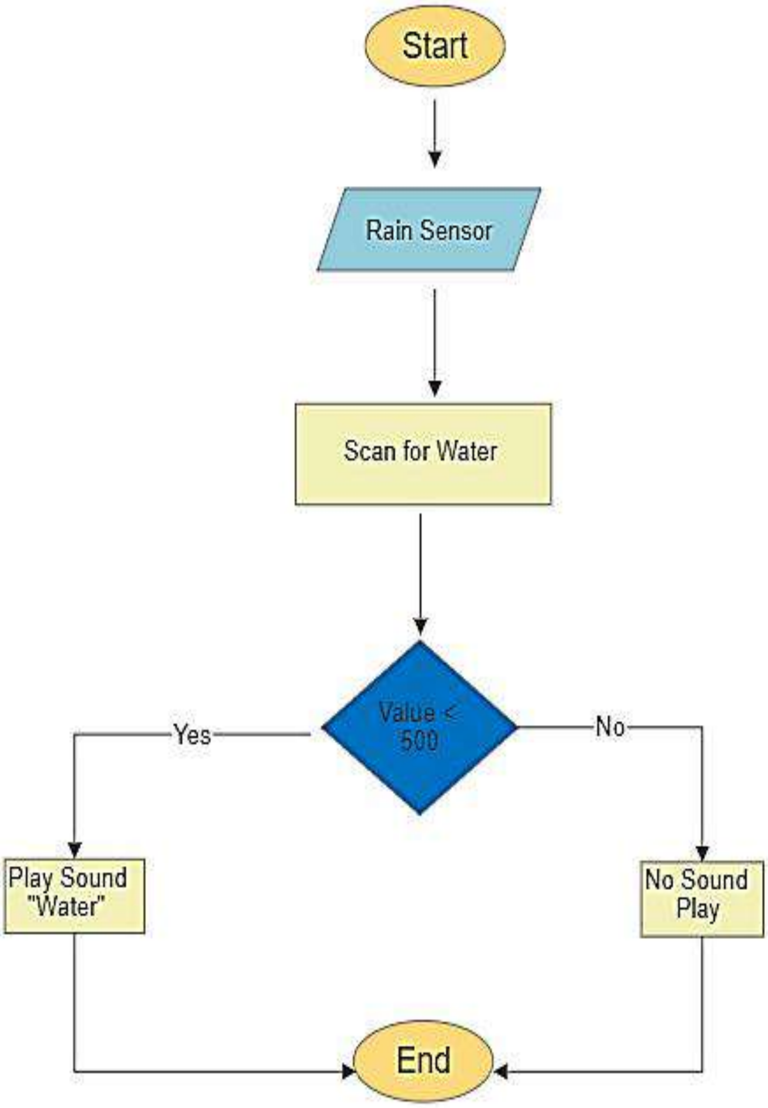


Figure 4.5: Flowchart of Gas Sensor

4.2.3 MQ5 Gas Sensor

Figure 4.6 represents a flow chart of the working methodology of the MQ5 gas sensor. In this figure, the system first initialized the gas sensor. If some gas or smoke detected by gas sensor with value greater than 500, the gas sensor sends the corresponding measured data to the microcontroller. Microcontroller will turn on the DF player and DF player will plays the sound “smoke”.

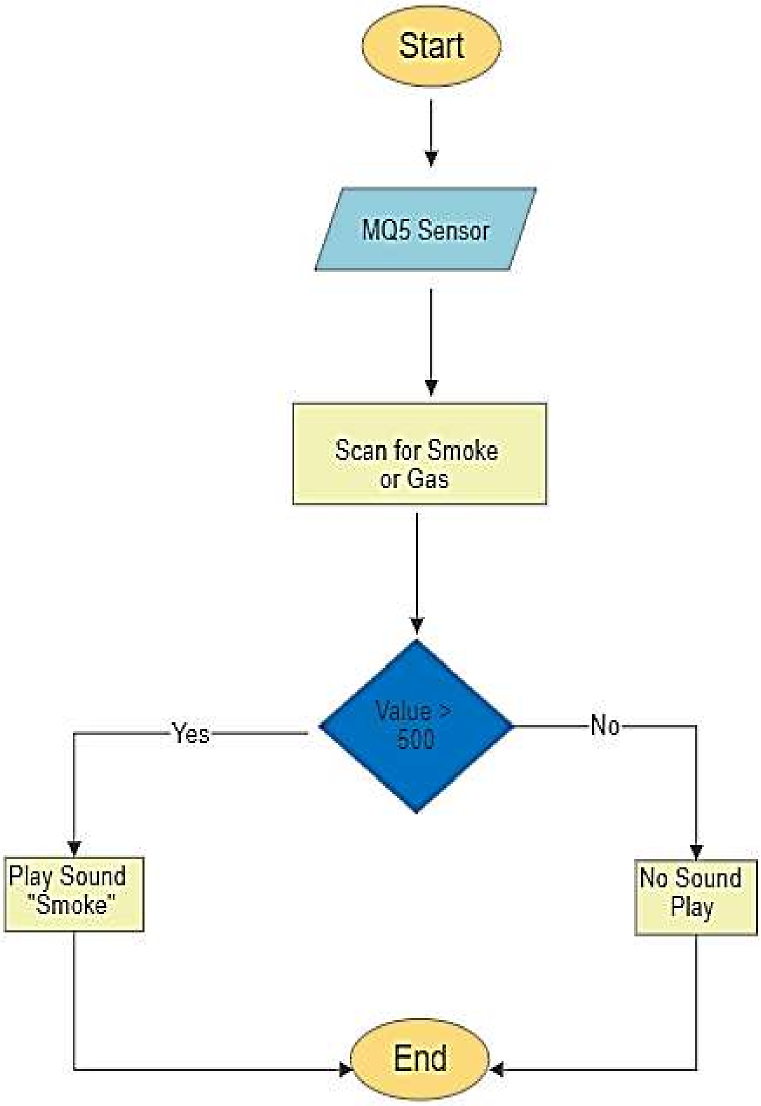


Figure 4.6: Flowchart of MQ5 Gas Sensor

4.2.3 GPS and GSM Module

Figure 4.7 represents a flow chart of the working methodology of GPS and GSM module. In this figure, the system first initialized the GPS module. GPS module updates and uploads the location, if blind person presses the button then system will have initialized GSM module and GSMs will send emergency message to caretaker.

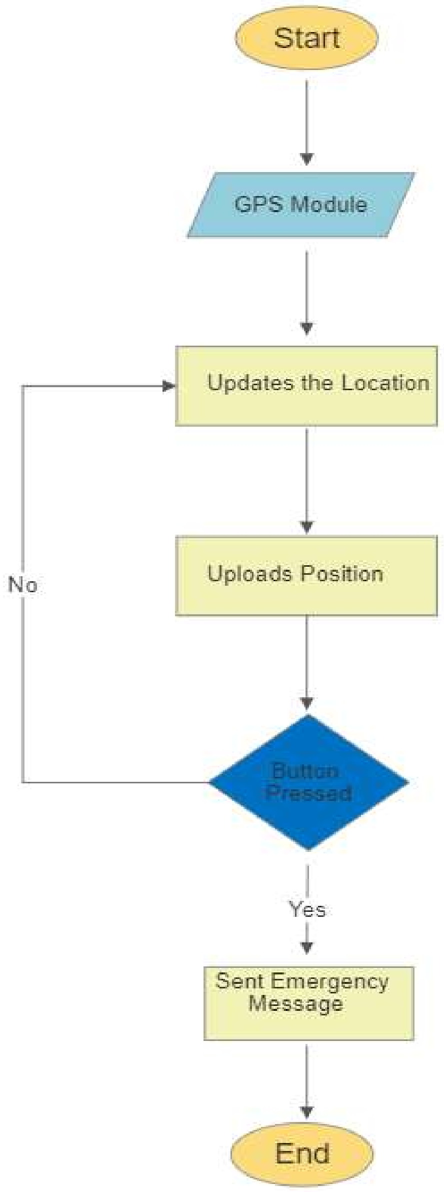


Figure 4.7: Flowchart of GPS and GSM Sensor

4.3 Use Case Diagram

In the Unified Modeling Language (UML), use of case diagram can summarize the detail of your system's users (also known as actors) and their interactions with the system. To build one, you can use a set of special symbols and connections. Effective use of case diagrams can help your team discussion and represent:

- Missions in which your system or application interacts with people, organizations or external systems.

- The goals that your system or application helps in those things (the actors) to achieve.
- The goal of your system in.

Use Case diagram of stick is shown below:

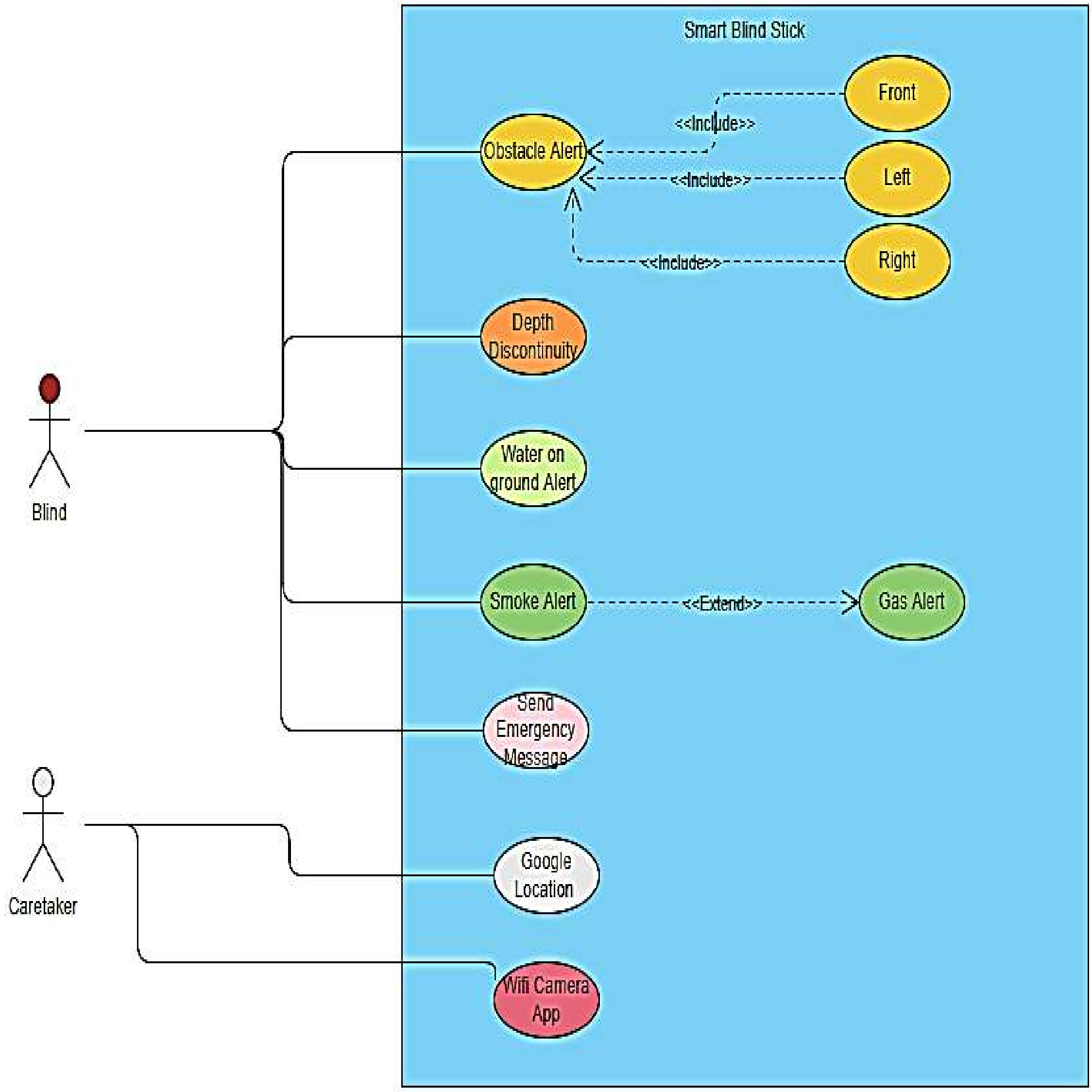


Figure 4.8: Smart Blind Stick Use Case Diagram

4.4 Data Flow Diagram

A data flow diagram shows the way information flows through a process or system. It includes data inputs and outputs, data stored, and various sub processes that data moves through. DFDs are built using standardized symbols and notation to describe various entities and their relationships. Logical DFDs represent logical information flows in relatively abstract terms. This means that they will identify general processes, systems and activities but not provide technology detail. Physical DFDs show more physical information flow detail, particularly details of information systems, applications and databases. They will also often have more elements to better depict what information is flowing, what actions are taken on or with the data and the resources associated with those actions. It's important to note that there are many interpretations of "logical" and "physical" with respect to DFDs

4.4.1 Smart Stick

This section is dedicated to the development of the “Smart Stick and GPS Tracking System”. The Smart Stick is designed to detect the obstacles in front, left, right of the user and alert him/her through the use of buzzer. Depth sensor is also included in the Smart Stick. This smart stick is made up of 5V battery. The sensors will be detecting an obstacle within the provided range, in the program code. The data obtained through the sensor readings will be sent to the Arduino UNO which has power supply of 5V through the battery. The pins of the sensor that are “echo” and “trig” are connected to the Arduino Uno while the other 2 pins are connected to Vcc and ground respectively. The buzzer is also connected to a power supply pin in Arduino and its other pin is connected to ground.

When the ultrasonic sensor detects any object in its vicinity from the sides or front, it will send the data to Arduino Uno which will send the executed command to the buzzer to alert the user. The same concept is applied on the vibrating motor which is connected to the circuit where one of its pins is connected to power supply while the other one is connected to ground. When the depth sensor does not detect any depth in its range, it will send the data to Arduino Uno which will send the executed command to the vibration motor to alert the user. Same as the water and smoke sensor are connected. When water or smoke detected, the Arduino Uno will send the executed command to the DF mini player to alert the user. The following figures show these implementations:

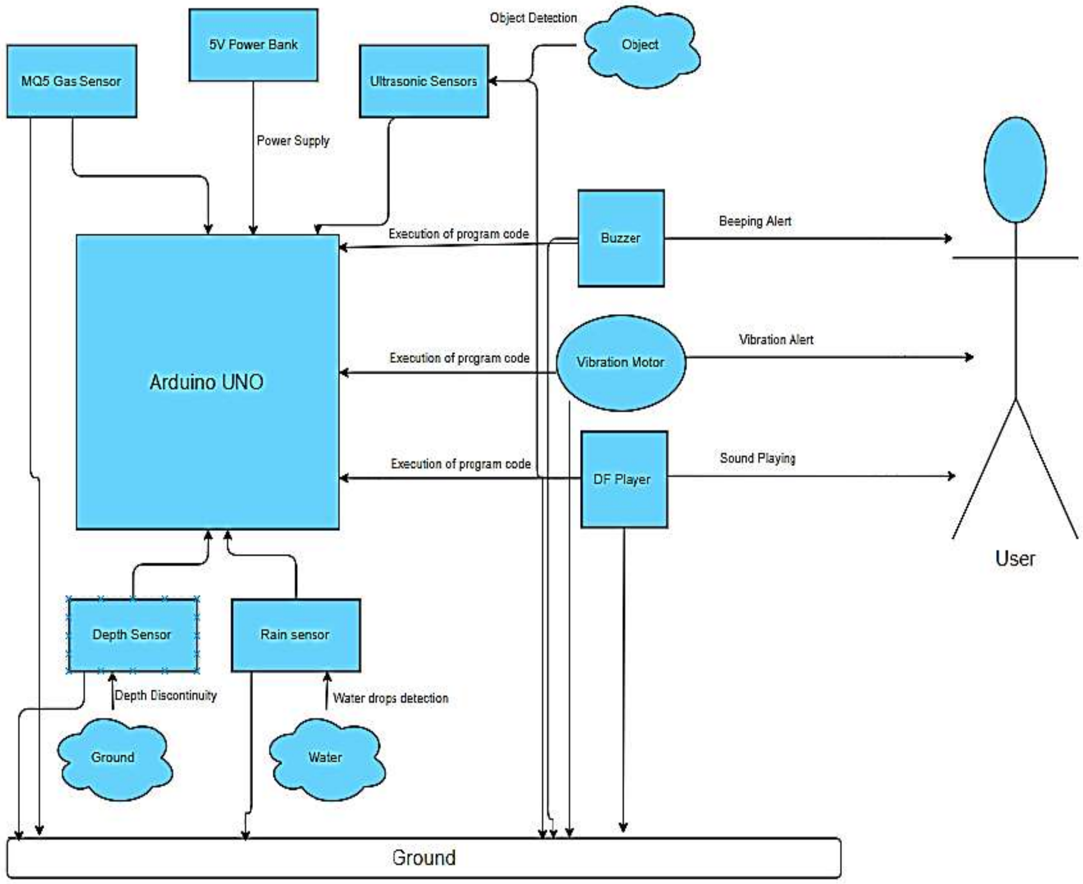


Figure 4.9: Smart Stick Data Flow Diagram

4.4.2 Smart Stick's GPS Tracking System

This section focuses on designing a "GPS Tracking System" that will be able to share the user's location with his/her supervisor. The way the Arduino Uno is programmed, is to send an emergency SMS to the user operator when a button is pressed. The Arduino is powered by a 12V battery. The Arduino is connected to a GPS tracking system component called the GSM SIM900. The code on the Arduino will cause the GPS module to be "ON" to start, which will then send the location data to the Arduino. When the push button is pressed, it will promptly send user's location information via SMS to the administrator. To send data, it will contain the location of the user with some embedded message in the system. The following figures show these implementations:

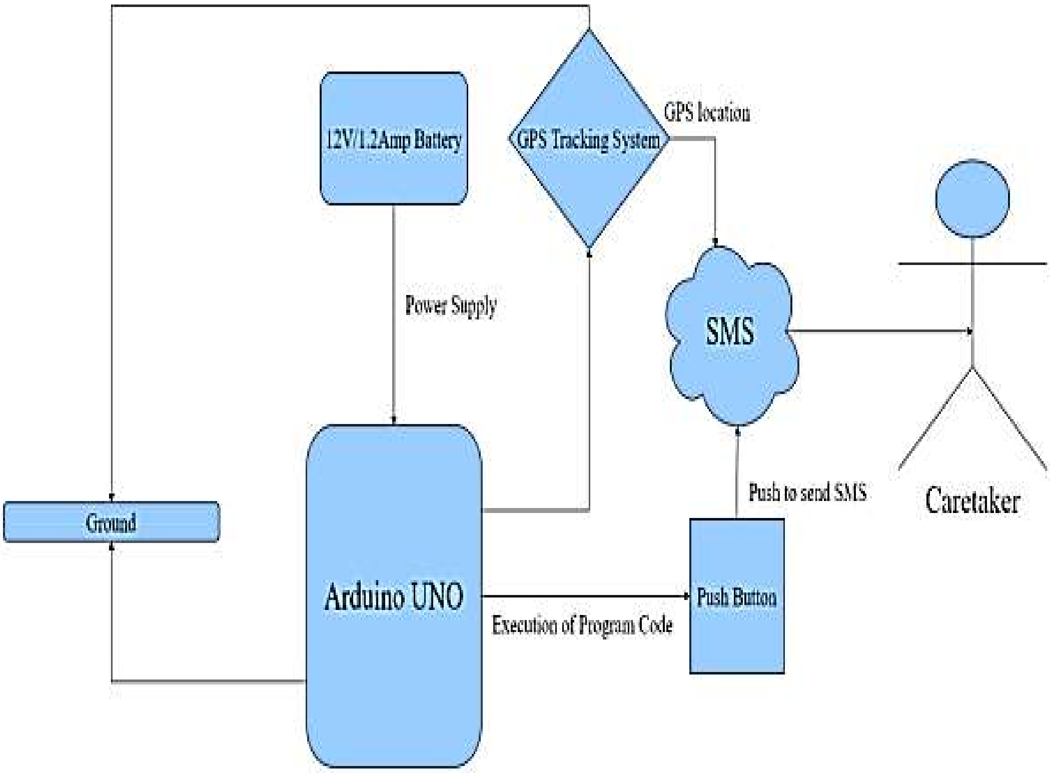


Figure 4.10: GPS Tracking System Data Flow Diagram

4.5 Overall System Design

The overall system design is consisting of two parts: Left ultrasonic, right ultrasonic, front ultrasonic, depth ultrasonic, buzzer, vibration motor, rain sensor, MQ5 sensor and DF mini player connected to Arduino 1 while GPS and GSM module connected to Arduino 2. The whole design is implemented on Proteus software.

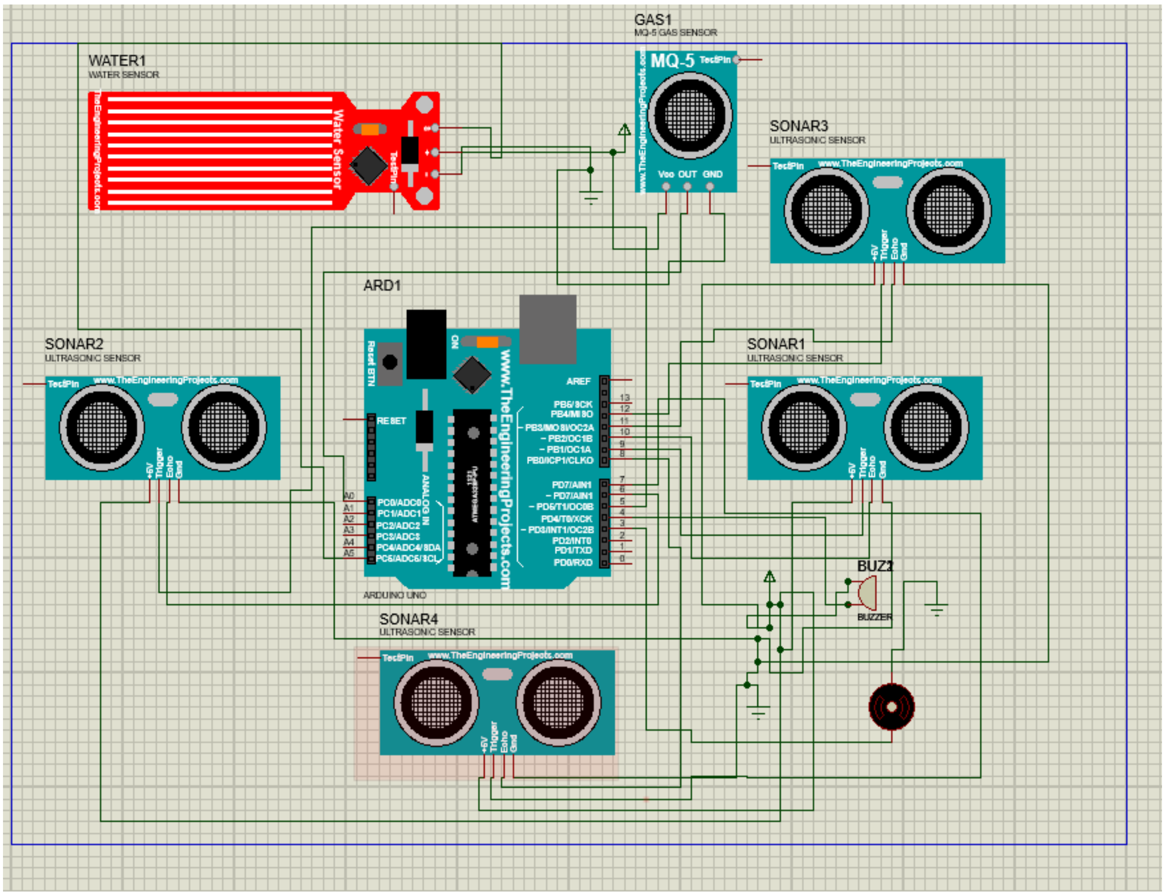
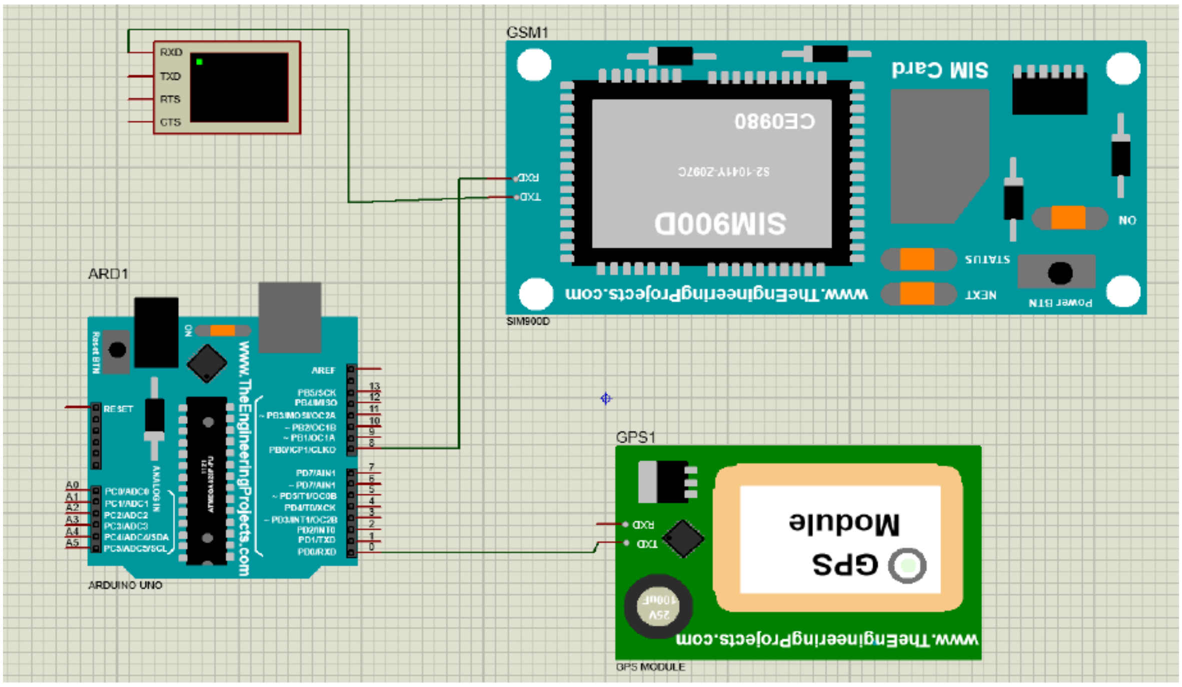


Figure 4.11: Module 1 System Design



Chapter 5

Hardware Implementation

5.1 Introduction

The hardware implementation describes the hardware layout for the Smart Blind Stick including the front, left, right, back side, complete real hardware design and hardware constraints.

5.2 Front Side Design

At the front side two Arduinos are connected. Rain sensor, front ultrasonic sensor, DF mini player and speaker connected to Arduino 1. 3 cell battery, GPS module, push button and GSM Module are connected to Arduino 2. IP camera is also connected just below the GPS module.

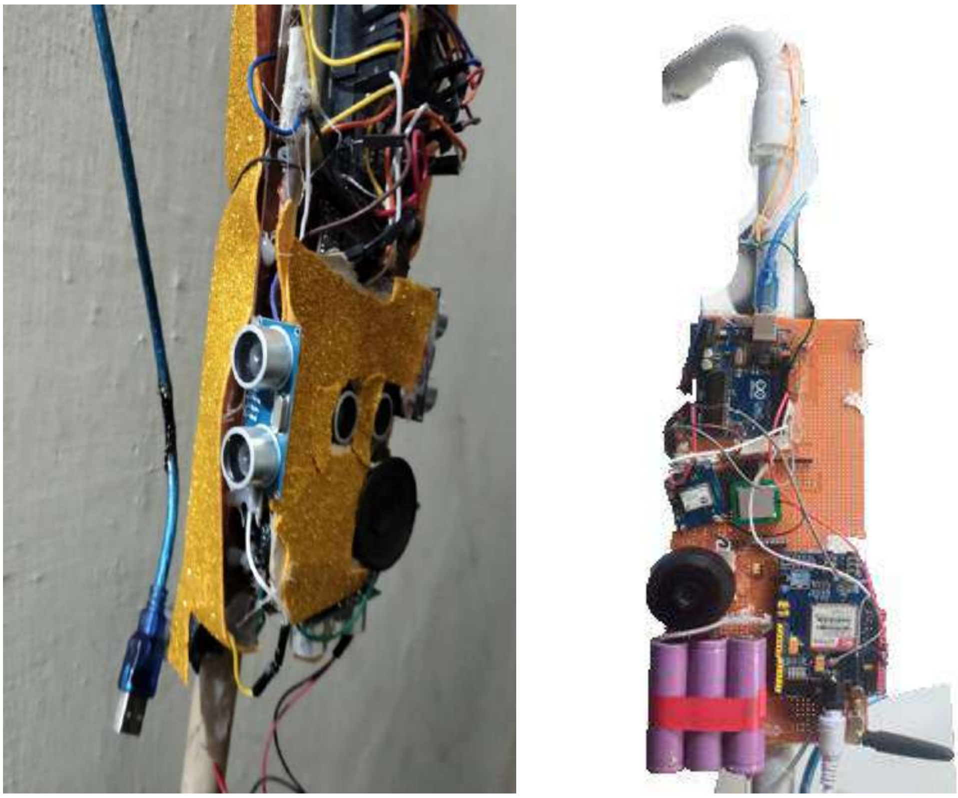


Figure 5.1: Front Side Hardware Design

5.3 Left Side Design

At left side, l eft sensor ultrasonic connected with Arduino 1.

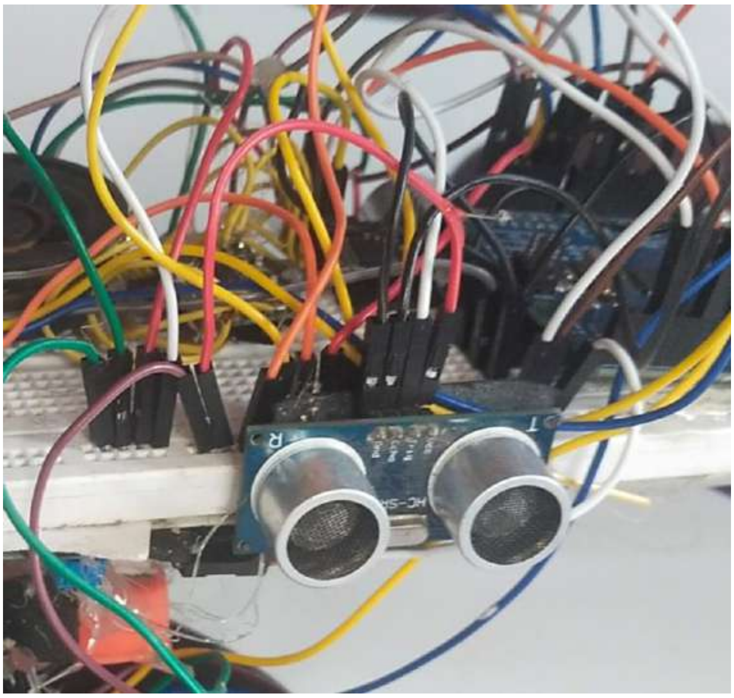


Figure 5.2: Left Side Hardware Design

5.4 Right Side Design

At right side, right sensor ultrasonic connected with Arduino 1.

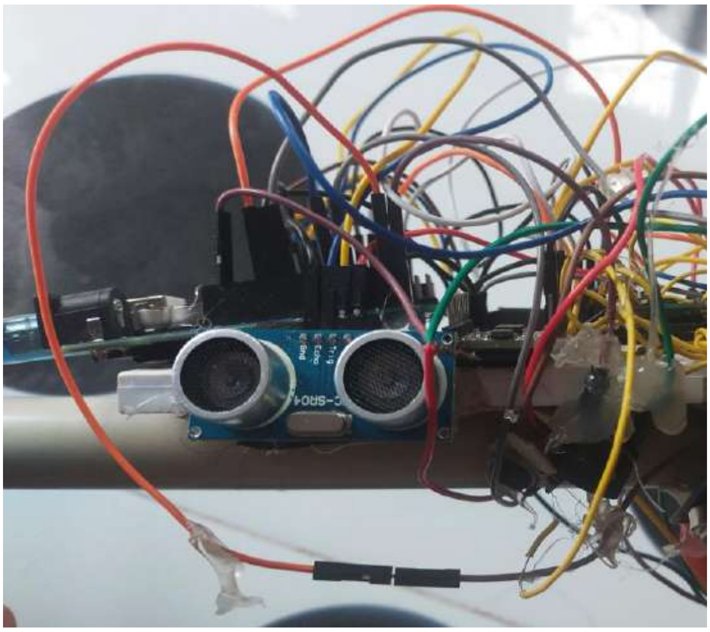


Figure 5.3: Right Side Hardware Design

5.5 Back Side Design

At back side, depth ultrasonic sensor, MQ5 sensor, buzzer and vibration motor connected with Arduino 1.

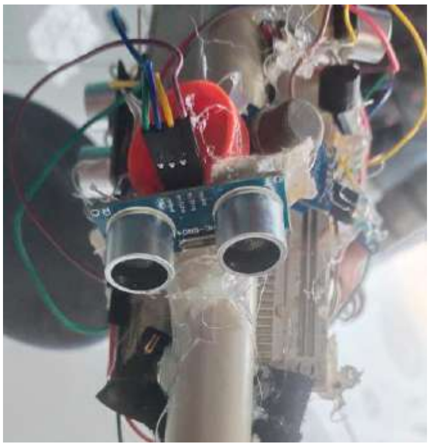


Figure 5.4: Back Side Hardware Design

5.6 Complete Hardware Design

The complete hardware design of Smart Blind Stick is shown below.

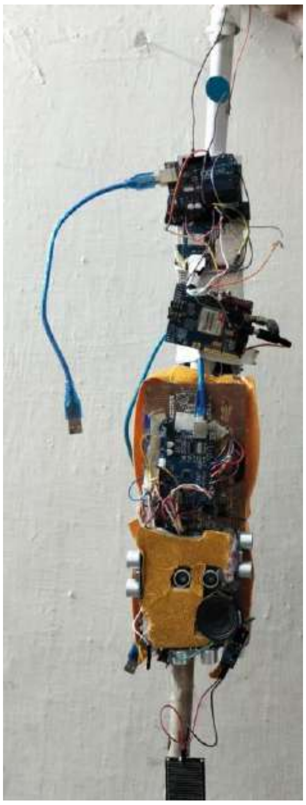


Figure 5.5: Complete Hardware Design

5.7 Hardware Architecture

The hardware model of the Smart Blind Stick System is designed similar to the block diagram of project components and it involved all the hardware components that are discussed in chapter 3.

5.8 Hardware Constraints

All hardware parts used in this project were off-the-shelf components that are widely used in simple analog circuitry, hence using other parts from different manufacturer or vendor would not have given us better results. The most important fact while choosing the components is the cost of component. We try our best to make it cost effective. All components are cheaper in cost and give good performance. There was a major tradeoff when choosing the ultrasonic sensor that can better detect the obstacles. During our hardware-testing phase, we found out that there is interference between the ultrasonic sensors. Sometimes wires will come in the front of sensors and sensors start detected these wires as obstacles, so we stick the wires with glue in order to reduce the interference. First we used DF player with front, left and right sensor for obstacle alert but we realized that using DF player for these sensors is reducing the efficiency, so we used buzzer instead of DF player for these sensors. Using small plastic box to cover Arduino 2 whole module can be a better solution in order to protect it from bad environment conditions but we found it at the end of project, when we have inadequate time and we really apologize for it.

Chapter 6

7.1 Tests and Results

6.1 Introduction

After the completion of the project, we had to check whether the system works under different circumstances and it turns out flexible in certain environment conditions. We implemented all the testing conditions whether they are part of the problem definition or not. The testing occurred two times in the project, first when we logically design our project and implement whole testing scenario over it. Second, when we actually implemented the project in real environment in the form of compact model.

During these testing phases, we had to see if the operations are properly performed, to find out the exceptions of the system's environment. We implemented the system and tested it to verify whether the required goals can be achieved and to see whether our objective is achieved or not. Testing phase is also important for quality assurance, involving efficiency and accuracy in working. This chapter explains the testing and verifications of different modules as how it has been done.

6.2 Testing Levels

We tested the system on different levels. We tested the hardware module and the interfacing of different hardware components. We also tested the quality of hardware components one by one to achieve accuracy and efficiency. System was tested to assure that everything works in an accurate manner. Testing phase also highlights various mistakes that we encountered while testing and should be removed. This system was new for us so the chance of mistake was definitely possible. To diagnose, locate, resolve and fix the errors, it was important to test the system as many times as possible.

6.3 Test Cases

The system has been checked across various cases for checking the output and results of the system in various scenarios. The following sections present the results of the tests that were carried out on the system that has been described in the previous chapters. The obstacles that may present themselves to the blind user were simulated by a deliberate introduction of such obstacles to the system under study. The distance between the ultrasonic sensor and the obstacles was carefully measured and recorded. The actual distance measured by the system and reported on the LCD was also recorded. The value of rain sensor and MQ5 sensor also recorded carefully.

6.3.1 Left Ultrasonic Sensor Testing

Table 6.1 shows the actual distance between the obstacles placed in front of the left sensor together with the actual reading of the distance as measured by the system. The percentage error computed from this table is found to be 1%.

Table 6.1: Distance measured by the system against the distance between obstacle and the left sensor

Actual Distance/cm	**Measured Distance/cm**
29	28.9
27	27.88
24	24.1
20	20.05
13	13.1

6.3.2 Right Ultrasonic Sensor Testing

The accuracy of the readings reported by the front ultrasonic sensor was also consistent with the 1% accuracy.

Table 6.2: Distance measured by the system against the distance between obstacle and the right sensor

6.3.3 Front Ultrasonic Sensor Testing

Actual Distance/cm	**Measured Distance/cm**
28	28.1
27	27.89
26	26.1

The accuracy of the readings reported by the front ultrasonic sensor was also consistent with the 1%.

Table 6.3: Distance measured by the system against the distance between obstacle and the front sensor

Actual Distance/cm	**Measured Distance/cm**
48	48.1
47	47.84
46	46.12
39	39
33	33.15

6.3.4 Depth Ultrasonic Sensor Testing

Similar tests were performed on the depth ultrasonic sensor. The results are detailed in Table 6.4. The error in the readings was found to be about 2%.

Table 6.4: Distance measured by the system against the distance between ground and the

depth sensor

Actual Distance/cm	Measured Distance/cm
19	18.8
17	17.1
11	11.3
9	9.14

6.3.5 Rain Sensor Testing

Table 6.5 shows the actual values between the water placed on plate of the rain sensor together with the actual value as measured by the system. The percentage error computed from this table is found to be 2%.

Table 6.5: Values measured by the system against the value water placed on plate of the rain sensor plate

Actual Value	Measured Value
488	489
418	416
312	310

6.3.6 MQ5 Sensor Testing

Table 6.6 shows the actual values and measured values. The percentage error computed from this table is found to be 2%.

Table 6.6: Values measured by the system against the value smoke hits the MQ5 sensor

Actual Value	**Measured Value**
588	589
612	614
675	676
754	755

6.4 Functionality Assessment

To test the overall alarm functionality of the system, the obstacles were carefully placed in the regions were the commands to the blind person are expected. Table 6.7 shows the conditions were the notification of the presence of the obstacle are expected. For example, the first entry signifies the presence of an obstacle in the right region and the system should utter the beep three times. The table shows also the actual distance at which the alarms were raised and vibration were started.

Table 6.7: Ultrasonic Sensors Result

Front Sensor	**Left Sensor**	**Right Sensor**	**Depth Sensor**	**Beep/Vibration**
DIS<50 (47)	DIS>30	DIS>30	DIS>20	1 beep
DIS>50	DIS<30 (27)	DIS>30	DIS>20	2 beep
DIS>50	DIS>30	DIS<30 (24)	DIS>20	3 beep
DIS>50	DIS>30	DIS>30	DIS,20 (19)	Vibration
DIS<50	DIS<30	DIS<30	DIS<20	Stop

To test the overall sound functionality of the system, the water and smoke were carefully placed in the regions were the commands to the blind person are expected. Table 6.8 shows the conditions were the notification of the presence of the water and are expected. It is to be noted that such systems do not require high levels of accuracy. The 1% level achieved in this project is quite acceptable to assist the blind people to navigate around their environment

Table 6.8: MQ5 and Rain Sensor Result

Rain Sensor	**MQ5 Sensor**	**Sound**
Val<500 (499)	Val<500	Water
Val>500	Val>500 (501)	Rain

3. Conclusion & Future work

Conclusion :

In the end of our project, we can conclude that our project can reduce the number of risk and injuries for the visually impaired person while walking through public places. Nowadays, one can experience blindness or visual impairment even at young age. This phenomenon cannot be taken lightly as they know how much risk it could be. If risks and injuries increase rapidly, the kid or the person will lose their spirit to move independently. The Modern Blind Stick acts as a basic platform for the coming generation of more aiding devices to help the visually impaired to navigate safely, both indoors and outdoors. It is effective and affordable. It leads to good results in detecting the obstacles on the path of the user in a range of two meters. Though the system is hard-wired with sensors and other components, it's light in weight. Furthermore, the aspects of this system can be improved via wireless connectivity between the system components. Thus increasing the range of the ultrasonic sensor and implementing a technology for determining the speed of approaching obstacles.

Future work:

In future, we hope that our project can be commercialize as it has many benefits such as to reduce the risk and injuries for the visually impaired people. Our life is priceless and cannot be replaced because we all have a chance to live our life just once, so seize our lives with positive vibes. We hope we can improvise our project if there is a thing that can make our product more compatible than before.

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General Guidelines for Writing Project's Thesis

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Page Setup

Page Size:	A4
Top margin:	1.00 inch or 2.54 cm
Bottom margin:	1.00 inch or 2.54 cm
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Fonts and Styles:

Use a standard font such as Times New Roman, Arial, or Calibri

Font size should be 12 points for the main text.

Use consistent font sizes and styles (bold, italics) for headings, subheadings, and content.

Footer: Each page shall have a footnote "Page number, right align".

Header: Each page shall have a header "Project/Thesis Title".

Chapter Startup: Each chapter shall be numbered as Chapter 1, Chapter 2, etc.

Paragraph Formatting:

Single-spaced, Line entered paragraph, left align or justified.

Line Spacing:

1.5 spacing is required for the text. Only footnotes, long quotations, bibliography entries (double space between entries), table captions, and similar special material may be single spaced.

Maintain consistent spacing between paragraphs

Images, Figures, Hyperlink:

Ensure that images, figures, and hyperlink are of high quality and are properly labeled.

Tables and Equations:

Format tables with clear column and row headings.

Provide captions for each Table.

Label equations and provide clear explanations.

Citations and References:

Follow a standardized citation style (e.g., APA, MLA, PEC etc.) for references.

Include a separate references section at the end of the document.

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Submitted files are named with a clear and concise title that reflects the content of the paper or thesis.