

A
Dissertation Report
On
**SMART STICK FOR VISUALLY
IMPAIRED PERSON**

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In

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By

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June, 2017



**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
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CERTIFICATE

This is to certify that the dissertation report entitled “**SMART STICK FOR VISUALLY IMPAIRED PERSON**” submitted by **RICHHPAL JAT** (2015PEV5146), in partial fulfillment of Degree **Master of Technology in Very Large Scale Integration (VLSI)** during academic year 2016-2017. To best of my knowledge and belief that this work has not been submitted elsewhere for the award of any other degree.

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DECLARATION

This is to certify that the dissertation report entitled “**SMART STICK FOR VISUALLY IMPAIRED PERSON**” being submitted by me in partial fulfillment of degree of **Master of Technology in Very Large Scale Integration (VLSI)** during **2016-2017** in a research work carried out by me under supervision of **Dr. Ritu Sharma**, and content of this dissertation work in full or in parts have not been submitted to any other institute or university for award of any degree or diploma. I also certify that no part of this dissertation work has been copied or borrowed from anywhere else. In case any type of plagiarism is found out. I will be solely and completely responsible for it.

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Finally, I extend my sincere thanks to **My Parents** and **Friends** for constant support and encouragement throughout the study.

Date

Place

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ABSTRACT

Blind people consists of a large group of people in our society. Losing their eyesight has caused them inconvenience in performing daily tasks. Hence, smart cane had been developed in order to increase the life quality of a blind person. The purpose of this project is to design a smart cane with ultrasonic sensor and global system for mobile (GSM) for the blind. This embedded system mainly has two parts, mobility and navigation system. For mobility system, it is equipped with ultrasonic sensor, HCSR04 and vibrating motor. Ultrasonic sensor will send the trigger pulse to detect obstacles. When an obstacle is detected, signals will be sent to vibrating motor and activate it. The vibrating motor will vibrate with different strengths according to the distance of the obstacle. The microcontroller used in this embedded system is Arduino UNO. The prototype of smart cane was built to increase the mobility of the blind people and with navigation system.

This project reports on a study that helps visually-impaired people to walk more confidently. The study hypothesizes that a blind stick that alerts visually-impaired people over obstacles in front could help them in walking with less accident. The aim of this project is to address the development work of a stick that could communicate with the users through vibration, which is named smart stick. The development work involves coding and physical installation. This study found that the Blind stick functions well as intended, in alerting users about the obstacles in front.

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LIST OF ABBREVIATIONS

GSM	Global System for Mobile
USART	Universal Synchronous Asynchronous Receiver Transmitter
TX	Transmitter
Rx	Receiver
LED	Light Emitting Diode
GPRS	General Packet Radio Services
EDGE	Enhanced Data rates for GSM Evolution
ETSI	European Telecommunications Standards Institute
MODEM	modulator-demodulator
SIM	Subscriber Identity Module
IMEI	International Mobile Equipment Identity
DTE	Data Terminal Equipment
DCE	Data Circuit-terminating Equipment

CHAPTER 1

INTRODUCTION

1.1 Motivation

The primary goal of this venture is to outline a smart stick to enhance the portability of a visually impaired person and to actualize a route framework. To expand the versatility capacity, ultrasonic sensor is utilized to detect deterrents and alarm the visually impaired individuals through vibration. Global system for mobile is used to give the information to a known person if blind person is in trouble.

1.2 Literature Review

In 2010, the Welfare Department accounted for 64,000 blind people registered in Malaysia and the estimated number of the blind was 4 to 5 times higher [1]. This shows that the population of blind people in Malaysia is quite high. Total Blindness is the condition when there is completely no light perception and for blindness that has light perception, they can only sense light but unable to have sight vision. The most common diseases that bring to blindness are cataracts, retinal diseases, uncorrected refractive errors, corneal diseases and glaucoma [2]. Blind people are able to move independently after they are trained with tools. Professionals such as orientation and mobility specialists are able to help blind people to move safely, independently and confidently. Tools that are commonly used by blind people are a white cane and guide dogs. Blind people swing the white cane around their feet to detect the existence of an obstacle around their step. A guide dog is trained to help their master to avoid all the obstacles and it is able to guide their master to go up and down the staircase. Traditional white cane has its limitation. It can only detect the obstacles when the white cane has contact with it. Traditional white cane cannot detect the obstacle precisely and unable to detect the knee level obstacles. Moreover, normal white cane does not have navigation technology to guide a blind person to move to a location they are unfamiliar with. Consider on the limitation of the traditional white cane, research and development group across the nation had

developed various types of smart cane to help blind people. The smart cane developed normally using the ultrasonic sensor, an infrared sensor, audio assistance or vibration to increase the mobility.

1.3 Problematic Description

Customary white stick absence of clever innovation to enhance the expectation for everyday comforts of visually impaired individuals. Blind people should be taught by experts so as to use the white stick to play out their day by day tasks. White stick can just detect an obstruction up to one meter. It can't caution the client when there is a deterrent in their way until the point when the client has touched it. A few instances occur because of visually impaired person did not detect the presence of a hitch. The instances might result in severe damage on blind person. Besides, white stick additionally does not be able to direct the client to go to the coveted area. Blind individuals may get lost and face some hazard or threat when they have to travel. They have to rely on upon individuals to convey them to a specific area or they can just go in a place they know about. Loss of vision conveys many burdens to a visually impaired individual.

1.4 Scope

The venture scope comprises of two sections, equipment and programming outline. For equipment part, it for the most part comprises of an ultrasonic sensor, global system for mobile, vibrator, and Arduino UNO. For programming part, C programming dialect is utilized to control the equipment.

1.5 Organization of this thesis

This thesis divided into six chapters.

First Chapter –In first chapter overview of the project and past work done is concisely described.

Second Chapter- Second Chapter is Literature Review and comprises of a talk of equipment and programming parts that are identified with the project's subject and furthermore some smart stick related works.

Third Chapter-Third Chapter is Methodology and contains the stream of the venture and furthermore the techniques to actualize the venture.

Fourth Chapter- Fourth Chapter is Results and Discussion. The yield of the outline will be talked about.

Fifth Chapter Fifth Chapter will be Conclusion and it will finish up the entire venture and furthermore prescribe some future works for the venture.

Sixth Chapter- Sixth Chapter is project management.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The principle target of this venture is to examine the outline of smart stick with the ultrasonic sensor and global system for mobile for the visually impaired. To outline a smart stick with various purposes, it can expand the expectation for everyday comforts of a visually impaired individual. By planning this keen stick, visually impaired individuals can distinguish deterrents all the more proficiently. Moreover, they can utilize a GSM module to educate the known individual to keep them from getting lost.

2.2 White Cane

It is a long stick that is utilized by visually impaired individuals for portability reason and to know surroundings they are going through. The main white stick is composed after War World I [3]. It is made using aluminum material or fiberglass. Holding end of this cane is made of either metal tip or fiber. The motivation behind planning white stick is for a man to recognize the hurdle. It can be utilized to recognize openings, staircase, pit, and slant of the ground or any items around a man. When utilizing the white stick, one end of the stick is hold by the person and the flip side is touching the ground. A visually impaired individual will swing the stick and moves on the path he or she tapped. This helps blind person to maintain a distance from obstacle which is harmful for the blind person [4]. White stick is categorized into four types. The first kind of white stick is a long stick. The length of this sort of stick is the longest. A long stick is the most ordinarily utilized by [5] visually impaired individuals as it is the most essential, alterable and lesser maintenance required. Essential training is required for blind individuals to habituate this sort of white stick. By using this stick they can move freely. Guide cane is the second type of white cane. Guide stick is considerably shorter than long stick and it is just to the abdomen of the blind person. Thus, it has bring down portability work. It focuses mainly on the lower portion of the user where it

concentrates on the askew position of the guide stick. It can be utilized to recognize gaps, stones, and check. The third form of white stick is identification stick. It is also called symbol stick. This kind of white stick is not intended for portability reason as it is intended to remind people that the client is visually impaired individuals. The outline of this white stick is for general society to provide helping hand to visually impaired individuals. The last kind of white stick is a kids' stick or kiddie stick. The reason for planning this sort of white stick is for kids' utilization. It has comparable properties like long stick [5].

2.3 Ultrasonic Sensor

Ultrasonic sensors are used for detecting the objects in front of them and it responds in terms of distance measured. Frequency is used by the ultrasonic sensor to detect objects. The frequency range for ultrasonic sensor is 20 kHz to 100 kHz to detect the object. It is frequently used in extensive noise level, spill identification and testing of materials [6]. It is very much used because of its simple design, economic and efficient.

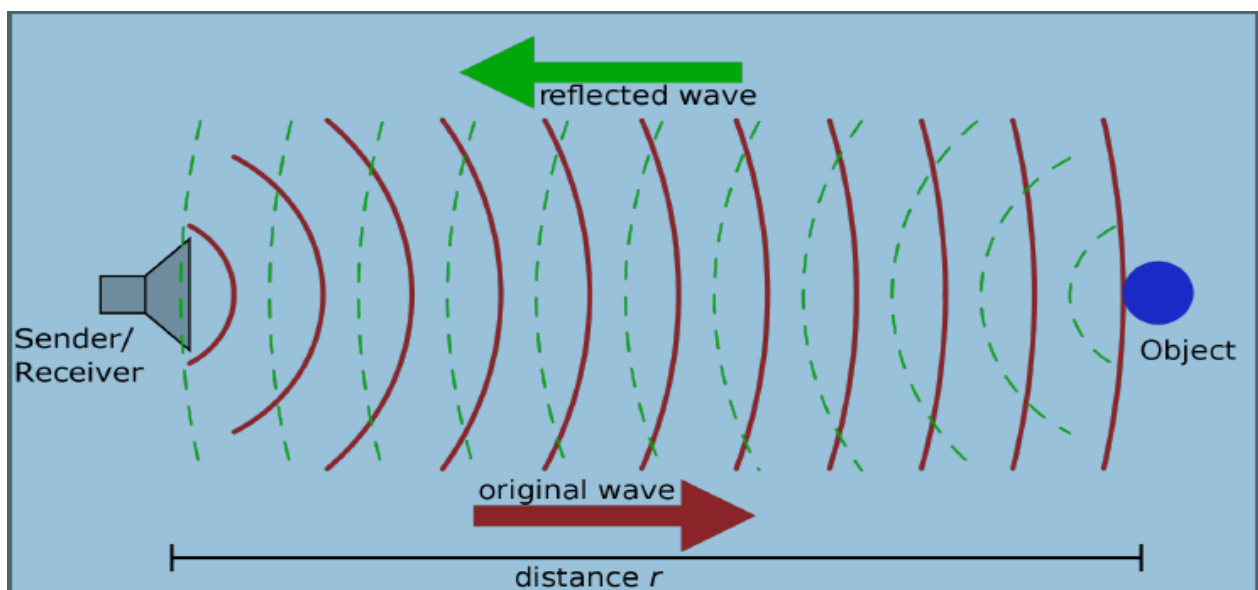


Figure 2.1 Sonar Diagram [12]

Object can be detected by using the ultrasonic sensor. A transducer is actualized with profoundly directional ultrasonic range sensor to identify things in the environment. Figure 2.1 demonstrates the function of ultrasonic sensor to transmit and get sonar to identify things. The ultrasonic sensor comprises of counter mass, wave maker, radiation area and amplifier. Ultrasonic waves weakened more frequently, which improves it turn into for directivity than different sorts of waves. The transmitter of ultrasonic sensor can be composed utilizing Gallego Juarez's ventured plate where it comprises of wave era, intensification, and radiation while the amplifier is utilized as a recipient. Gallego Juarez's ventured plate is likewise utilized as a part of creating extreme wave for the parametric cluster reason [7].

Figure 2.2 demonstrates the schematic outline of an ultrasonic sensor. Toward the finish of the transducer is the place the counter mass is situated with a specific end goal to guarantee transducer produces same hub point. The transducer material utilized is Lead Zirconate Titanate with various polarization. Linear Horn is utilized as intensification and transmitting plate will comprise of increased high-force of ultrasound.

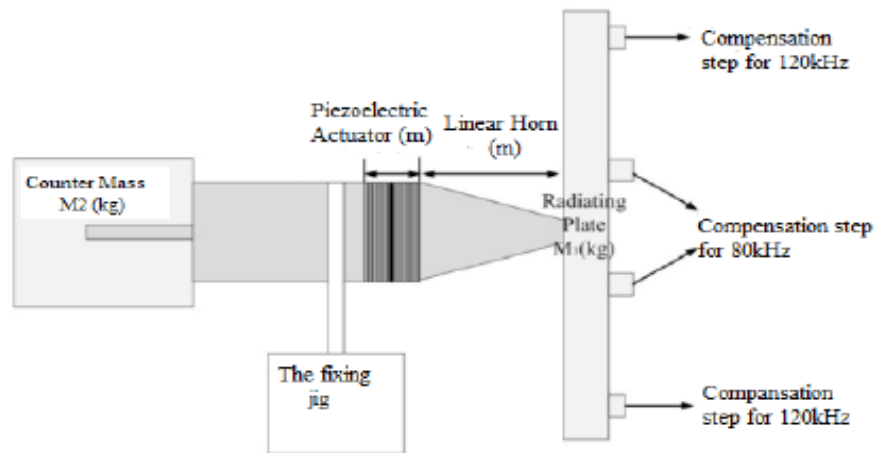


Figure 2.2 Functional diagram of HC-SR04 [7]

Double frequency wave is utilized as it has higher sufficiency spread. By utilizing this strategy, single wave era can be enhanced as a solitary wave can't identify both question and separation recognition precisely. The two waves need distinctive frequencies. Two distinct frequencies are created through axisymmetric mode with various nodal circles. A scientific model is expected to alter the radiation segment with a specific end goal to deliver double frequency wave [7].

2.4 Universal Synchronous Asynchronous Receiver Transmitter (USART)

USART controller works in the serial communications fashion of a computer. It takes information in terms of bytes and transmits bit by bit in the sequential manner. The communication (COM) port of the computer is utilized to interface with other peripherals.

USART has two method of operation, first one is synchronous and another is asynchronous mode. In asynchronous mode, TX and RX is used for sending and receiving data respectively for the operation. Information is transmitted from LSB to MSB bit and it transmits the data worth of 8-bit. Baud rate of USART must be remain same in the transmission and reception.

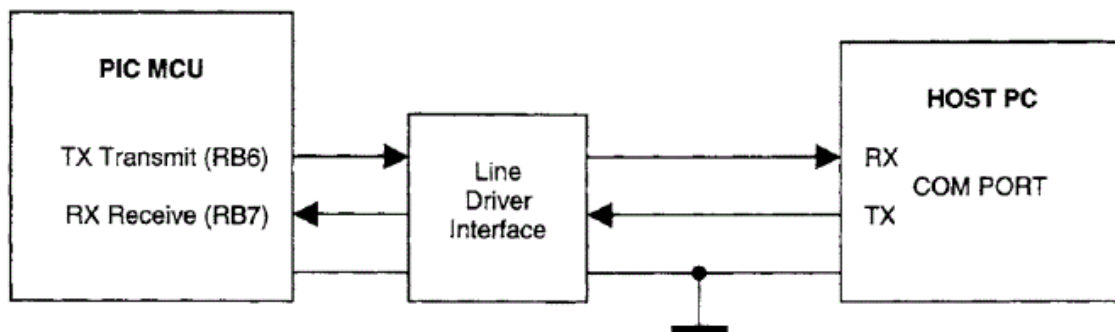


Figure 2.3 Interfacing between PC and USART [17]

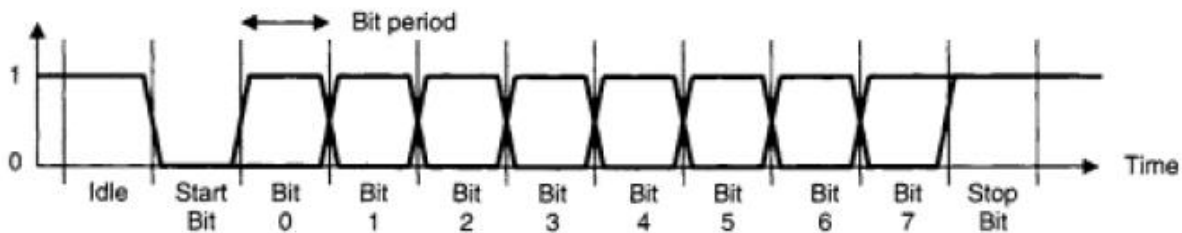


Figure 2.4 PC Port and Signal [17]

In the Figure 2.3, connections is shown between the PIC MCU and HOST PC. TTL voltages is used for operation in PIC USART therefore it required an external device, which is called line driver, to interface between PIC and COM. It uses high line voltage which help in transmission and reduce the noise problem which occur in transmission. TTL form of the signal is shown in Figure 2.4 [11].

2.4.1 Mobifree

It can be divided into two parts. First one is MobiFree sunglass and another one is MobiFree echo [8]. MobiFree is intended to recognize impediments, venture off, and openings. Above knee level obstacle is detected by the MobiFree sunglasses, whereas distant obstacle is detected by the Mobifree echo utilizing the instruction speaker.

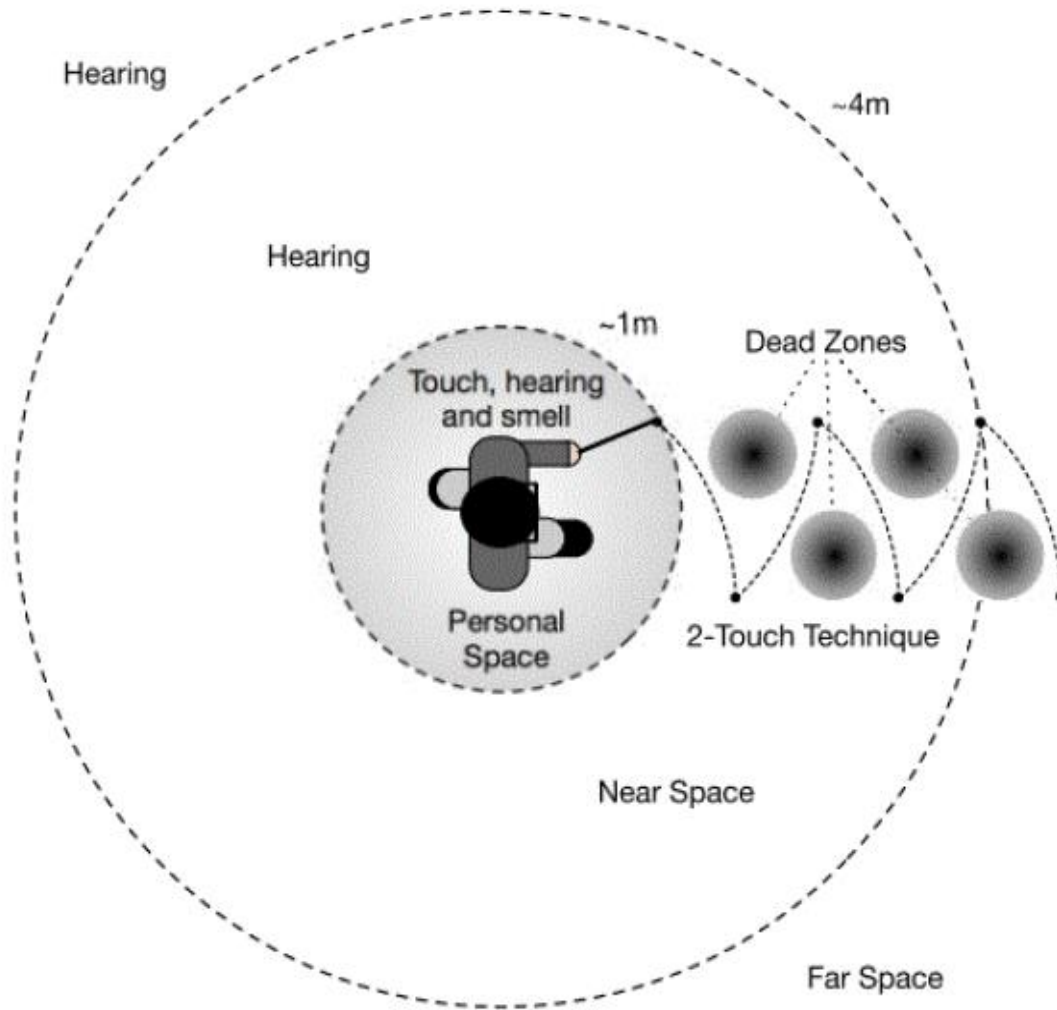


Figure 2.5 usage and function of MobiFree [8]

Operation of MobiFree and its work is shown in figure 2.5. Ultrasonic sensor is used to detect obstacles and holes and it is utilized as input to the vibrator to aware the user. A blinking LED is attached with the surface of the cane when light is detected by the sensor then LED will ON. Moreover, photovoltaic cells is used as a power source in the Mobifree.

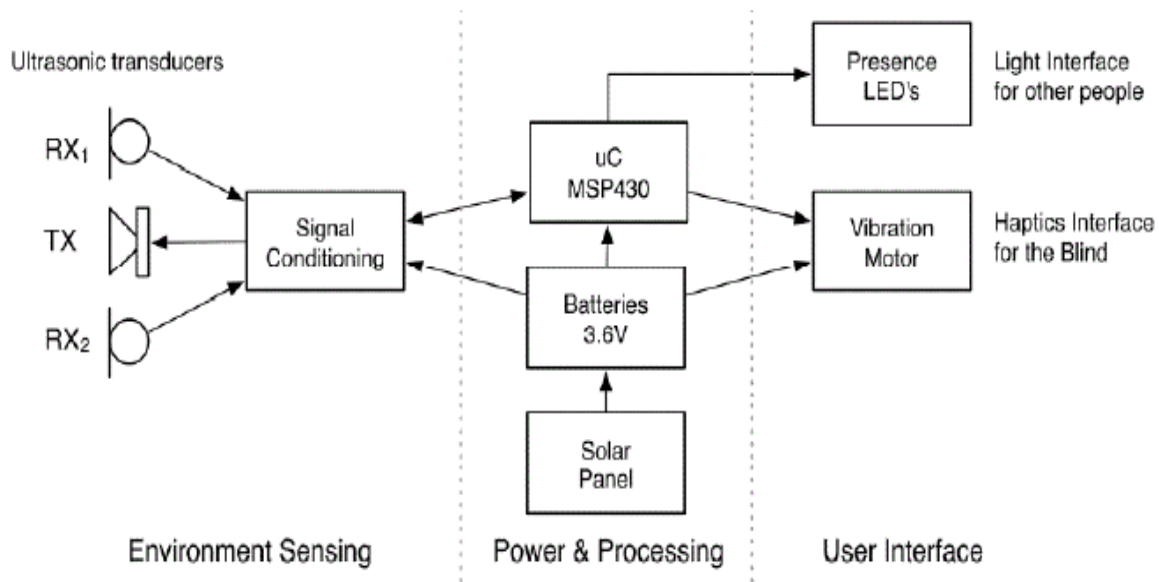


Figure 2.6 Architecture of MobiFree [8]

The systematic diagram of MobiFree is illustrate in Figure 2.6. It uses two ultrasonic sensor for better recognition of object. One ultrasonic sensor is placed above than other. Various types of a wave are received and consolidated together, subsequently ready to expand the differences of the system. The microcontroller utilized is with low power capacity and utilizing a sunlight based board to store power. Car drivers will be alerted by the LED signals for safety concern. The presence of obstacle is detected by using a vibration motor which pass the information to the user [8]. MobiFree has great capacity in distinguishing impediment as it utilized long stick, shades and hearing gadget to recognize obstruction encompassing and inside a separation restrict.

2.4.2 Electronic Long Cane

The purpose behind using Electronic Long Cane is to identify the object above waist. The vibration quality is as indicated by the separation between the impediment and user. The obstructions are identified by utilizing an ultrasonic sensor which interfaces with micromotor to provide the vibrational output.

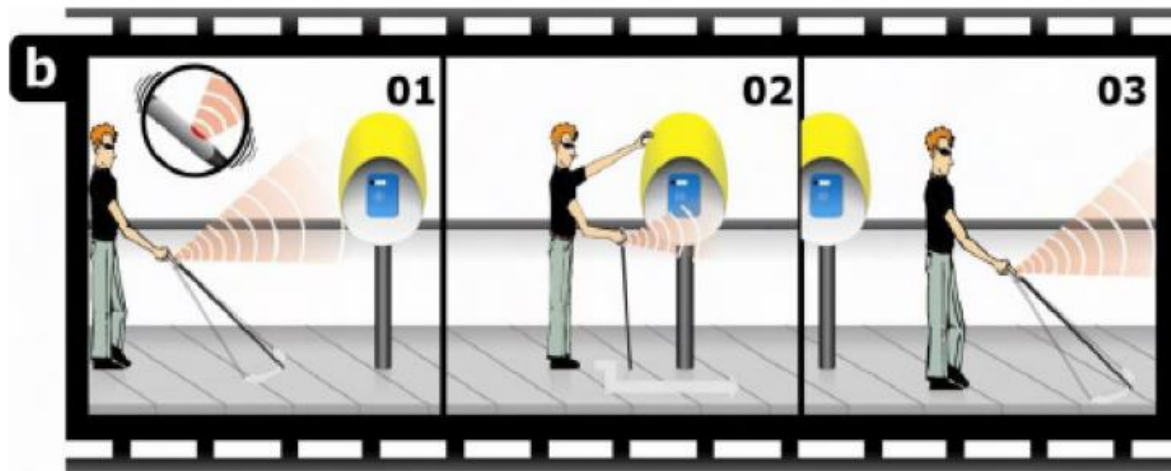


Figure 2.7 Function of electronic long cane [9]

Figure 2.11 demonstrates the operation of an Electronic long stick. Electronic long stick utilizes an ultrasonic sensor which is set amidst the smart stick. Micromotor utilized depends on an Atmel AVR microcontroller and batteries of 9V capacity are used to provide energy to the system [9]. Electronic long stick primarily concentrates on identifying any sort of physical obstruction over the waistline. It is essentially the enhanced adaptation of conventional long white stick where it doesn't have an extra propelled work.

2.4.3 Virtual Cane

The main purpose of Virtual Cane by utilizing the internal force sense to identify about the presence of deterrent around. Haptic force generator and gyroscope are the main components of virtual cane. This cane is developed by using the theory of inertia. If length of the rod is increase then moment of inertia of rod also increase hence moment of inertia of rod is function of its length.

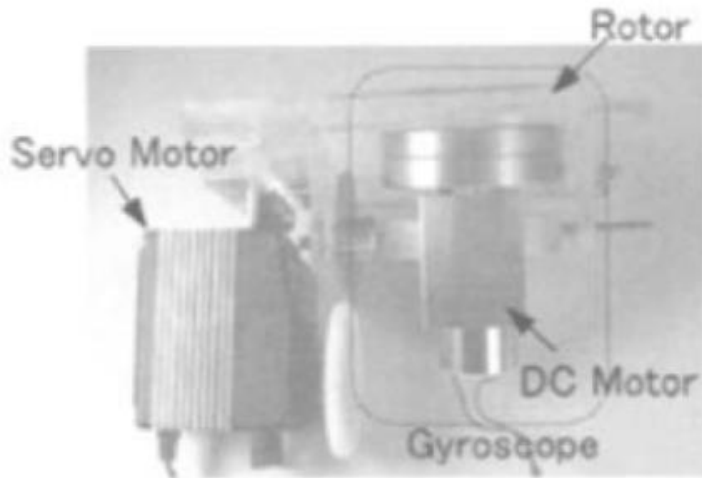


Figure 2.8 Haptic force generator [10]

Moment of inertia increases exponentially with the length of the rod. It is utilized to produce torque that will generate moment of inertia. Rotor rotates by using DC motor at fast. Pulse width modulation circuit manages the servo motor. This kind of smart stick is utilizing haptic compel generator with the spinner as non-introducing and non-preparing gadget [10]. Virtual stick still needs a considerable measure of examination as its outline is as yet in view of idea and hypothesis without down to earth test. See length that identifies with the shallow snapshot of latency and haptic fantasy still needs some innovative work as the outcomes acquired are influenced by a ton of variables and commotion.

2.4.4 Hybrid Infrared Ultrasonic Electronic Travel Aids

This framework utilizes a blend of the ultrasonic sensor and infrared-red. Two IR sensor are utilized to detect littler items which are not identified by the ultrasonic sensor while the ultrasonic sensor is utilized to detect surfaces. The vibrating engine is introduced to alarm the client to the presence of impediments and the microcontroller is utilized to control info and yield of signs.

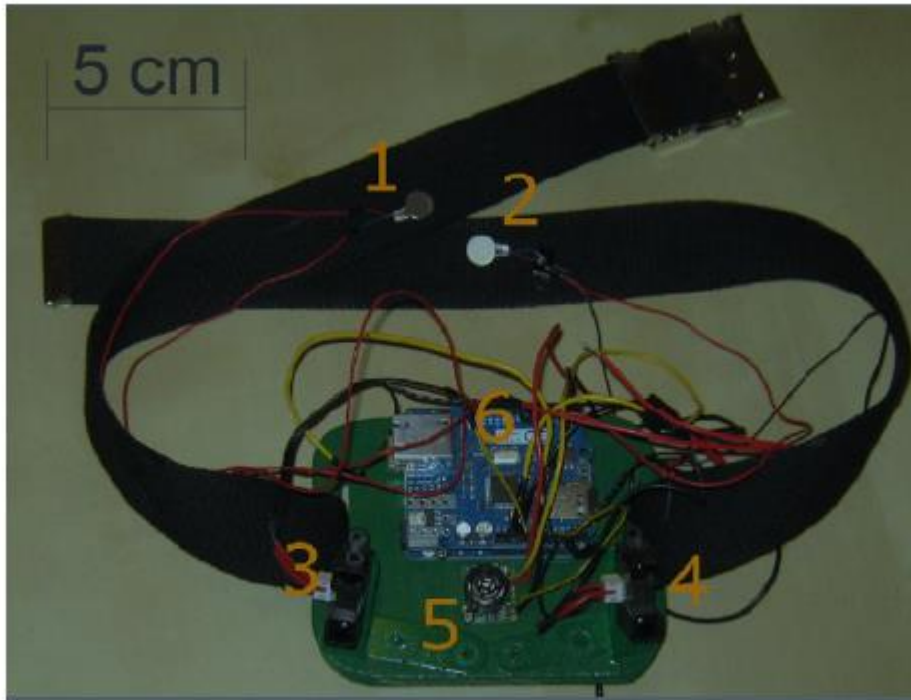


Figure 2.9 Hybrid Infrared Ultrasonic Electronic Travel Aids [11]

This travel aid is outlined in the shape of belt hence it can be tied and simple to convey. It is divided into six sections. Section first and second are vibrating motors, section third and fourth are IR sensors, section five is the microcontroller and section six is the ultrasonic sensor. It consists of four vibrating motors which are situated at the back and the front of the belt. There are 4 vibrating motors which are located at the front and the back of the belt. Along these lines, when an obstruction is recognized, vibrating engine can caution the client of the impediment situated toward left or right and front or back.

Arduino UNO board has a microcontroller which is the ATmega328 type [11]. It is a straightforward outline of travel aids for the visually impaired. It utilizes an ultrasonic sensor and IR sensor for a hurdle finding reason which is minimal effort and effective. Still, it is outlined with a belt rather than stick which may cause bother for dazzle individuals as they may feel shaky without the white stick.

2.4.5 Global System for Mobile (GSM)

A Global System for Mobile (GSM) or a GPRS (General Packet Radio Services) module is a chip or circuit that will be utilized to set up correspondence between a cell phone or a registering machine and a GSM or GPRS framework.

2G systems created as a substitution for original (1G) simple cell systems, and the GSM standard initially portrayed as a computerized, circuit-exchanged system advanced for full duplex voice communication. This extended after some time to incorporate information interchanges, first by circuit-exchanged transport, at that point by bundle information transport by means of GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution or EGPRS).

GSM systems represented over 75% of the overall cell organize showcase. GSM, surprisingly, set a typical standard for Europe for remote systems. It was additionally received by numerous nations outside Europe. This enabled supporters of utilization other GSM systems that have meandering concurrences with each other. The basic standard diminished innovative work costs since equipment and programming could be sold with just minor adjustments for the neighborhood advertise.

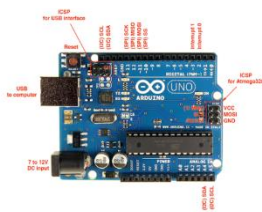
CHAPTER 3

METHODOLOGY

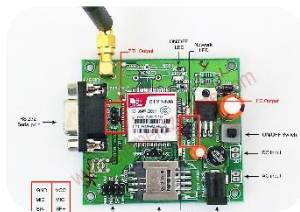
In this chapter we will discuss about the flow of project and the technique to actualize the project. We will also discussed about Hardware design and coding to control each section of the project.

3.1 Outline of the project

This project primarily has two parts, first one is hardware part, and second one is software part. Hardware part comprises of three sections: Arduino UNO has a microcontroller which works as brain of an embedded system. To detect the obstacle an ultrasonic sensor is utilized which gives input to vibrating motor. Then, GSM (global system for mobile) is used to provide the information of the person if he is in danger through a message to the known person. Software design is mainly controlled by using C programming.



Arduino



GSM module



Vibrater motor



Ultrasonic

Figure 3.1: Overall component used in hardware of smart stick [14]

The output of the ultrasonic sensor is used as the input to Arduino UNO which is interfaced with GSM Module. GSM module is used to receive the message. The signal comes from an ultrasonic sensor is utilized as the input to vibrating motor.

3.2 Project step

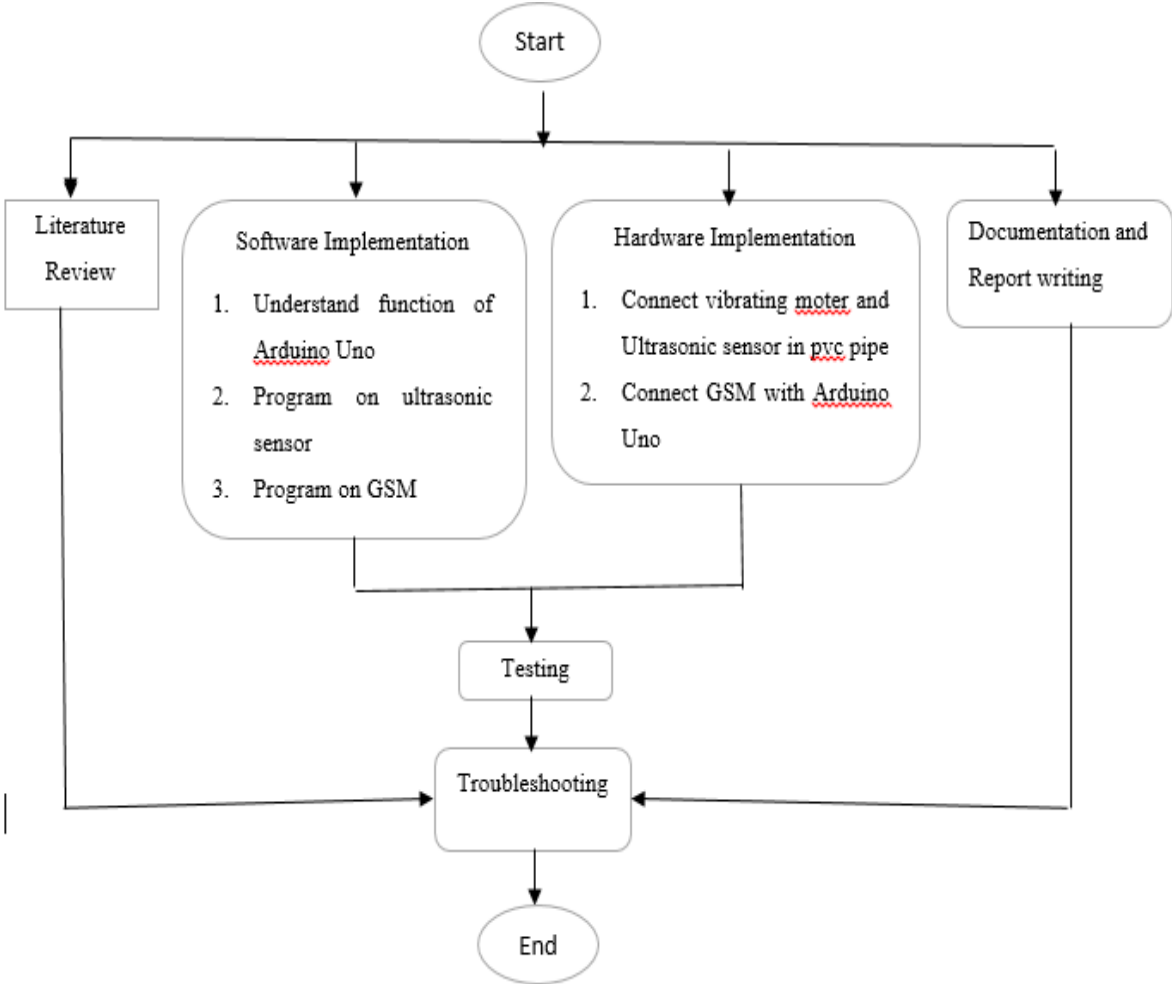


Figure 3.2 Flow diagram of the project

3.3 Microcontroller

Microcontroller is an integrated circuit which works as a mini computer. It has microprocessor, external memory and input-output peripherals. It is designed to perform a dedicated task. Figure 3.3 depicts the architecture of microcontroller.

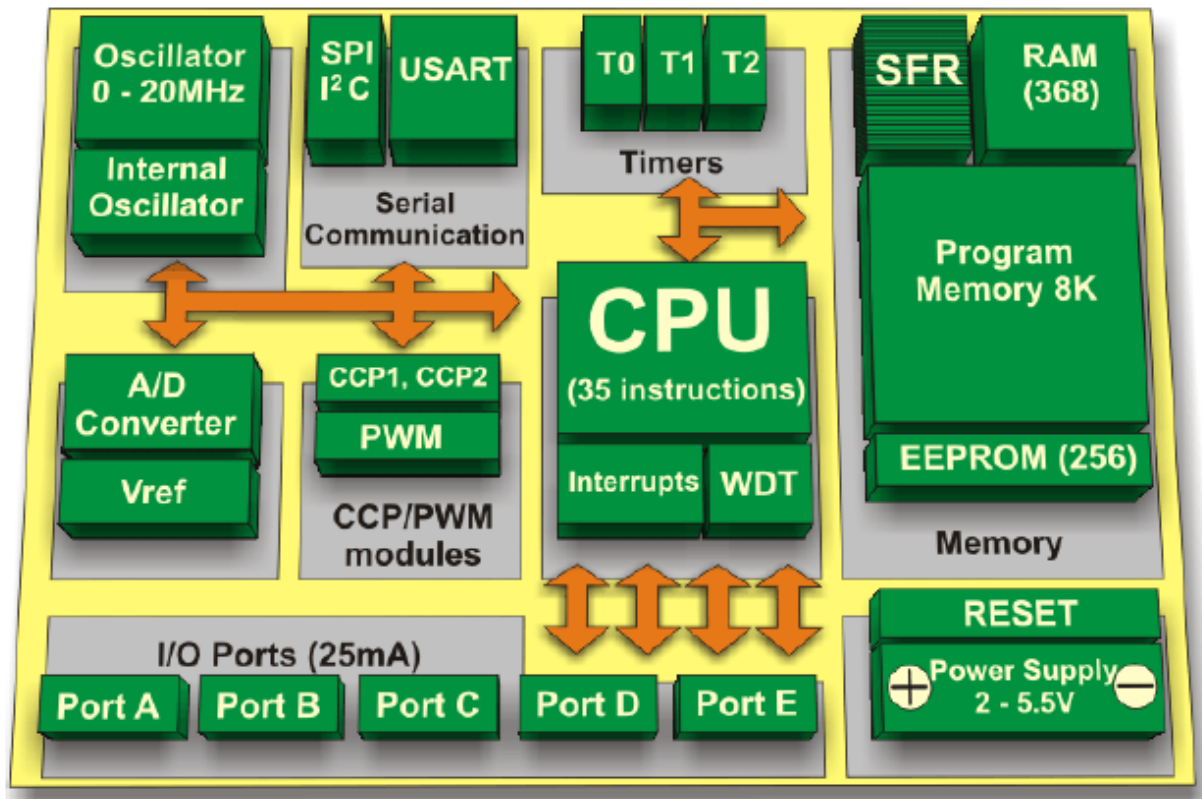


Figure 3.3: Architecture of Microcontroller [12]

3.3.1 Arduino UNO

The microcontroller used in this design is Arduino UNO. It has ATmega328 in AVR 8 bit RISC design. Arduino UNO has six analog input pins, 14 digital I/O pins, a USB port and power supply port. It also has a ceramic resonator with resonating frequency of 16 MHz. It has EEPROM (electrically erasable programmable read only memory) memory with read write facility. UART TTL is used for Communication in Arduino UNO.

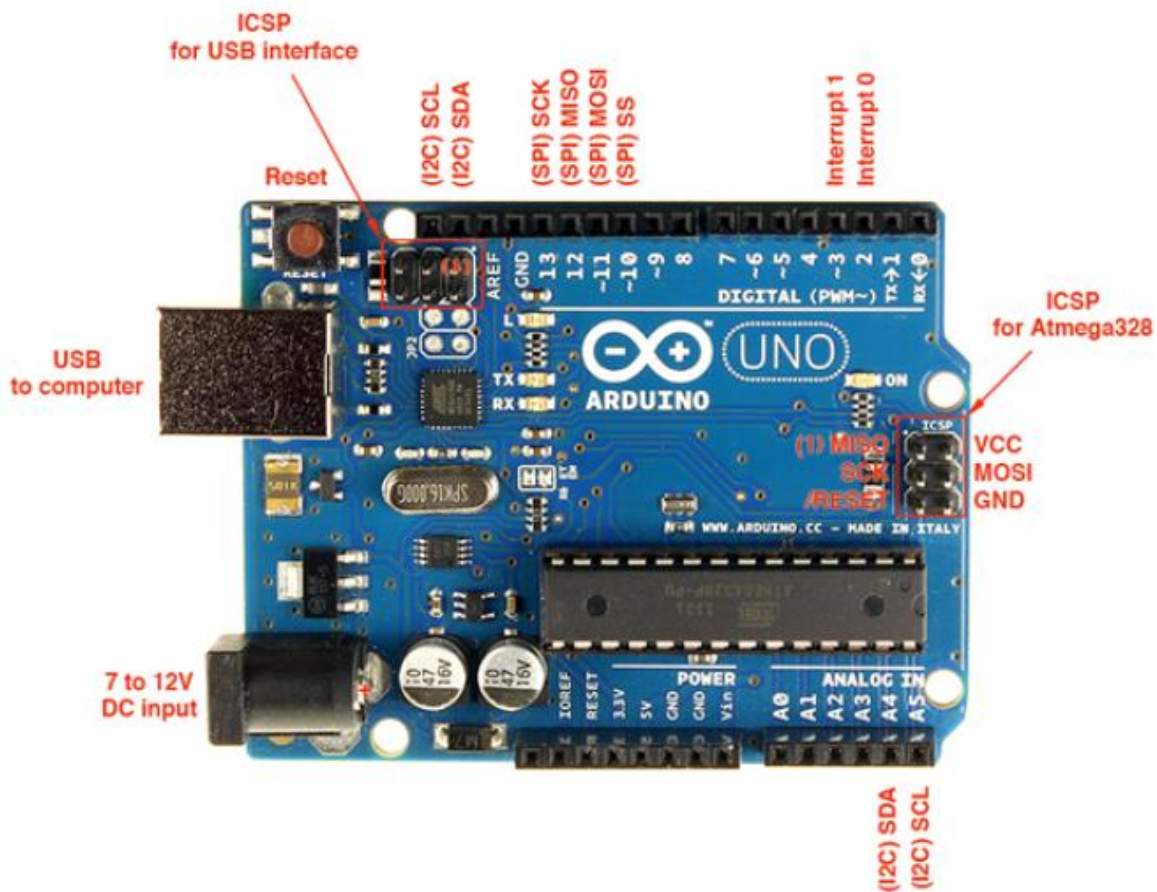


Figure 3.4: Circuit Board of Arduino UNO [14]

3.3.2 Register Port

Embedded system is interfaced with Arduino UNO through digital I/O ports. Port B and Port D are used as I/O ports. In ATmega328, DDR register is used to establish connection of input or output by setting the connection with high or low.

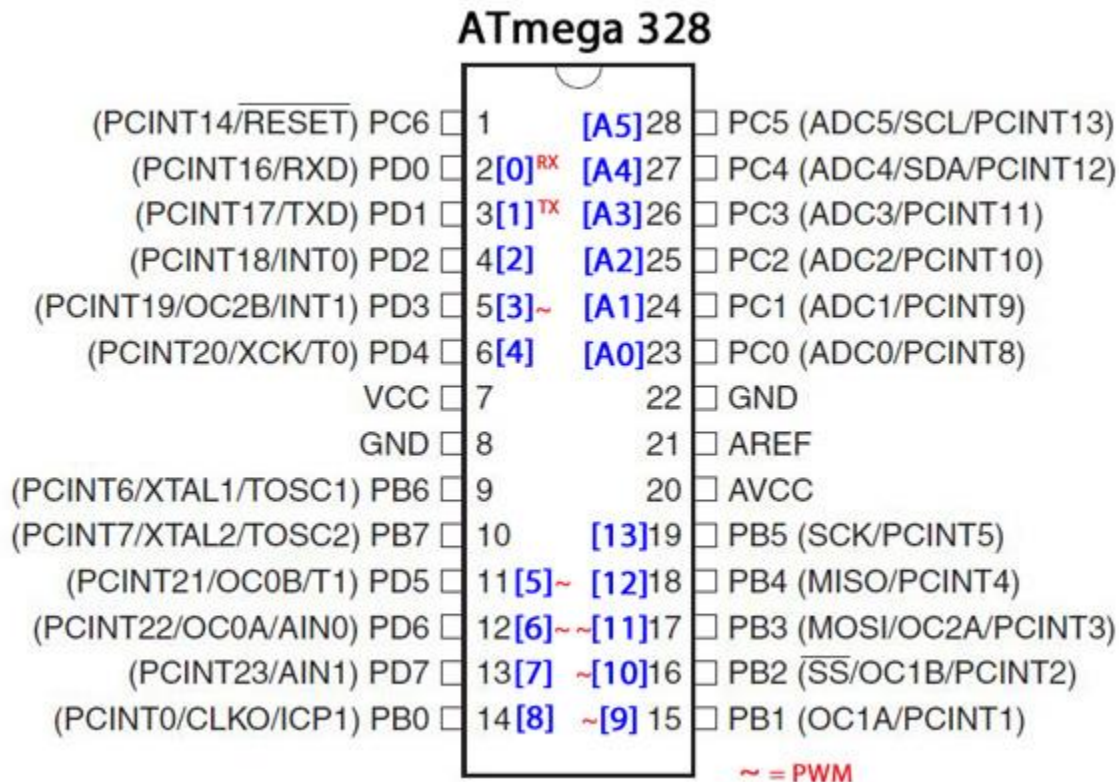


Figure 3.5: ATmega to Arduino pin mapping [15]

Figure 3.5 illustrates the pin diagram of ATmega328.

3.4 Hindrance Recognition Device

It is planned by utilizing ultrasonic sensor. Execution of hindrance recognition device in smart stick is essential because obstacle below the knee level is detected by this.

3.4.1 Performance of HC-SR04

HC-SR04 ultrasonic sensor is used in my project. Sonar is used to find out the distance from an object. It can sense the object up to the distance of 5cm to 500cm in angle of 30 degrees. Sensitivity of the sensor may be up to 10mm. The performance of HC-SR04 is shown in Figure 3.6.

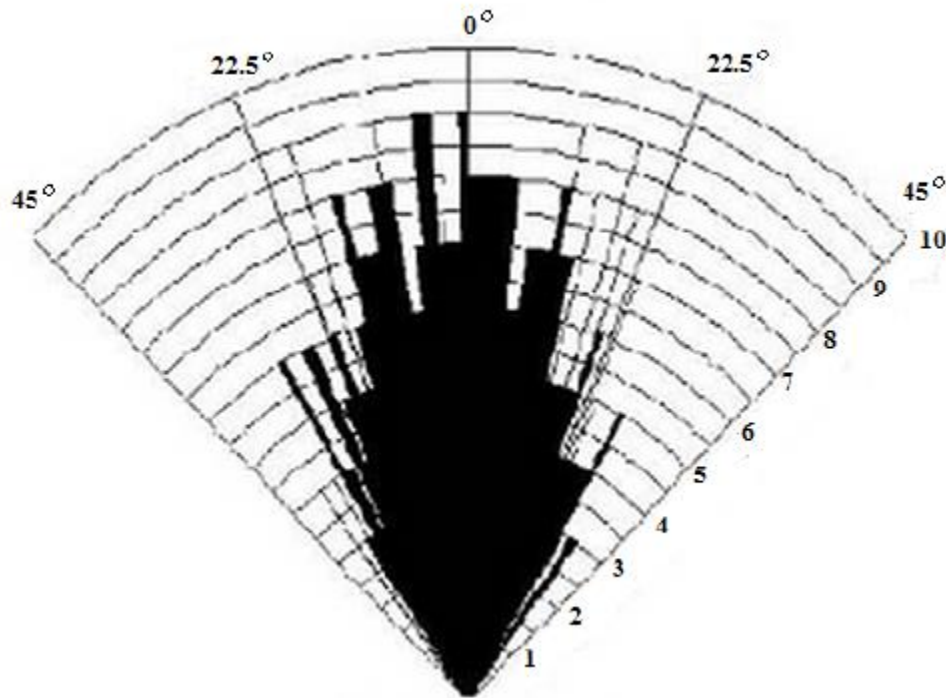


Figure 3.6: 30 degree angle performance of HC-SR04 [13]

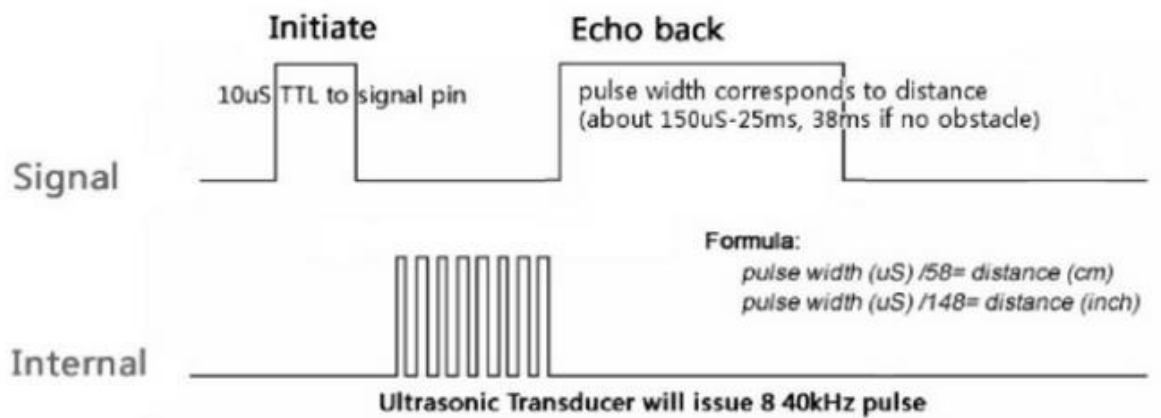


Figure 3.7: Timing diagram [13]

It is shown in figure 3.7 that a high pulse is received by the sensor HC-SR04 which starts the sensor. Each time, a signal is transmitted from the ultrasonic sensor to detect an object which has the frequency of 40 kHz. Therefore distance can be measured in centimeters by the formula given is $\text{distance} = 2 \cdot \text{time} / 116$.

3.4.2 Flowchart of Obstacle Detection System

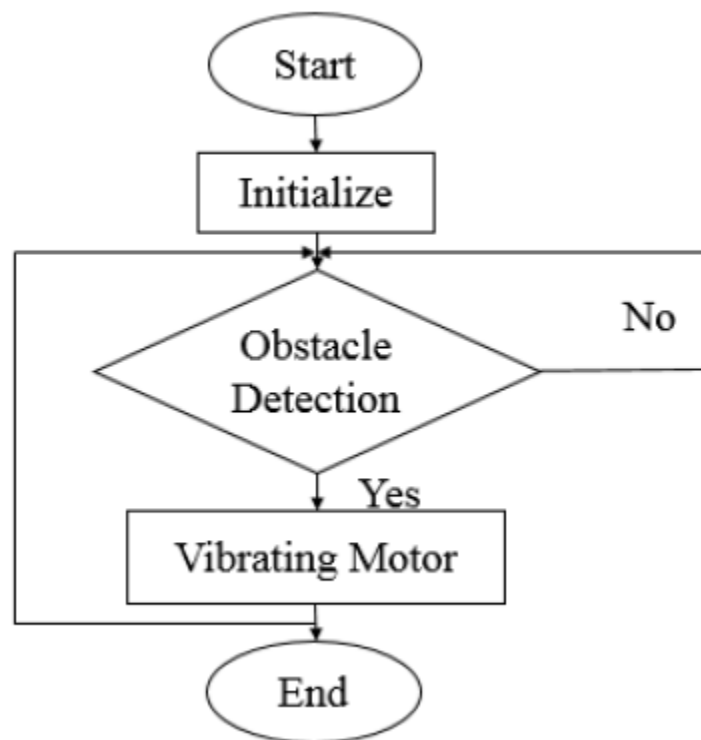


Figure 3.8: Dataflow diagram of obstacle recognition

Table 3.1: Strength of vibrator with respect to the distance from object

Distance to Obstacle, β (cm)	Vibrating Motor Strength-PWM, $\% (\%)$
$2 < \beta \leq 10$	100
$10 < \beta \leq 20$	90
$20 < \beta \leq 30$	81
$30 < \beta \leq 40$	64
$40 < \beta \leq 50$	38
$\beta > 50$	0

Operation and performance of ultrasonic for detection of obstacle is shown in Table 3.1 and Figure 3.8. When there is no hurdle in the specified range, the ultrasonic sensor output is zero and continuously detecting for the obstacle. If there is any obstacle in the range of ultrasonic sensor then it gives the output to the vibrator hence it vibrates with different strength as shown in table 3.1.

3.5 Global System for Mobile (GSM)

3.5.1 Introduction

GSM (Global System for Mobile Communications, initially Group Special Mobile), is a standard created by the European Telecommunications Standards Institute (ETSI).

It was made to portray the conventions for second-era (2G) computerized cell systems utilized by cell phones and is currently the default worldwide standard for versatile interchanges with more than 90% piece of the pie, working in more than 219 nations and domains. Before we get into what a GSM module is, let us get our essentials right and comprehend what GSM and GPRS are. A GSM module or a GPRS module is a chip or circuit that will be utilized to set up correspondence between a cell phone and a figuring machine and a GSM or GPRS framework. A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. The modem (modulator-demodulator) is a critical part here.

These modules consist of a GSM module or GPRS modem powered by a power supply circuit and communication interfaces (like RS-232, USB 2.0, and others) for the computer. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities.

A GSM module or GPRS modules are similar to modems, but there's one difference: A GSM/GPRS Modem is an external equipment, whereas the GSM/GPRS module is a module that can be integrated within an equipment. It is an embedded piece of hardware.

A GSM mobile, on the other hand, is a complete system in itself with embedded processors that are dedicated to providing an interface between the user and the mobile network.

Wireless modems generate, transmit or decode data from a cellular network, in order to establish communication. A GSM/GPRS modem is a class of wireless modem, designed for communication over the GSM and GPRS network. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. Also, they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for their identification.

3.5.2 How GSM module works

- The MODEM needs AT commands, for interacting with processor or controller, which is communicated through serial communication.
- These commands are sent by the controller/processor.
- The MODEM sends back a result after it receives a command.
- Different AT commands supported by the MODEM can be sent by the processor/controller/computer to interact with the GSM and GPRS cellular network.

3.5.3 Applications of GSM module

They can feature all the functionalities of a mobile phone through the computer like making and receiving calls, SMS, MMS etc. These are mainly employed for computer based SMS and MMS services.

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services. The GSM/GPRS module demonstrates the use of AT commands. They can feature all the functionalities of a mobile phone through the computer like making and receiving calls, SMS, MMS etc. These are mainly employed for computer based SMS and MMS services.

AT commands are instructions used to control a modem. AT is the abbreviation of Attention. GSM/GPRS modems and mobile phones support an AT command set that is specific to the GSM technology, which includes SMS-related commands like

AT+CMGS (Send SMS message),

AT+CMSS (Send SMS message from storage),

AT+CMGL (List SMS messages) and

AT+CMGR (Read SMS messages).

Starting “AT” is the prefix that informs the modem about the start of a command line. It is not part of the AT command name. For example, D is the actual AT command name in ATD and +CMGS is the actual AT command name in AT+CMGS. However, some books and websites use them interchangeably as the name of an AT command.

Tasks performed by AT commands-

Here are some of the tasks that can be done using AT commands with a GSM/GPRS modem or mobile phone:

- Get basic information about the mobile phone or GSM/GPRS modem. For example, the name of the manufacturer (AT+CGMI), model number (AT+CGMM), IMEI number (International Mobile Equipment Identity) (AT+CGSN) and software version (AT+CGMR).
- Get basic information about the subscriber. For example, MSISDN (AT+CNUM) and IMSI number (International Mobile Subscriber Identity) (AT+CIMI).
- Get the current status of the mobile phone or GSM/GPRS modem. For example, mobile phone activity status (AT+CPAS), mobile network registration status (AT+CREG), radio signal strength (AT+CSQ), battery charge level and battery charging status (AT+CBC).
- Establish a data connection or voice connection to a remote modem (ATD, ATA, etc).
- Send and receive a fax (ATD, ATA, AT+F*).

- Send (AT+CMGS, AT+CMSS), read (AT+CMGR, AT+CMGL), write (AT+CMGW) or delete (AT+CMGD) SMS messages and obtain notifications of newly received SMS messages (AT+CNMI).
- Read (AT+CPBR), write (AT+CPBW) or search (AT+CPBF) phonebook entries.
- Perform security-related tasks, such as opening or closing facility locks (AT+CLCK), checking whether a facility is locked (AT+CLCK) and changing passwords (AT+CPWD).
- (Facility lock examples: SIM lock [a password must be given to the SIM card every time the mobile phone is switched on] and PH-SIM lock [a certain SIM card is associated with the mobile phone. To use other SIM cards with the mobile phone, a password must be entered.]
- Control the presentation of result codes/error messages of AT commands. For example, you can control whether to enable certain error messages (AT+CMEE) and whether error messages should be displayed in numeric format or verbose format (AT+CMEE=1 or AT+CMEE=2).
- Get or change the configurations of the mobile phone or GSM/GPRS modem. For example, change the GSM network (AT+COPS), bearer service type (AT+CBST), radio link protocol parameters (AT+CRLP), SMS center address (AT+CSCA) and storage of SMS messages (AT+CPMS).
- Save and restore configurations of the mobile phone or GSM/GPRS modem. For example, save (AT+CSAS) and restore (AT+CRES) settings related to SMS messaging such as the SMS center address.

Mobile phone manufacturers usually do not implement all AT commands, command parameters and parameter values in their mobile phones. Also, the behavior of the implemented AT commands may be different from that defined in the standard. In general, GSM/GPRS modems designed for wireless applications have better support of AT commands than ordinary mobile phones.

Some AT commands require the support of mobile network operators. For example, SMS over GPRS can be enabled on some GPRS mobile phones and GPRS modems with the +CGSMS command (command name in text: Select Service for MO SMS Messages). But if the mobile network operator does not support the transmission of SMS over GPRS, you cannot use this feature.

3.5.4 Snapshot of GSM Coding

```
void SendSMS()
{
  Serial.println("AT+CMGF=1"); //To send SMS in Text Mode
  delay(100);
  Serial.println("AT+CMGS=\"7791801523\""); //Change to destination phone number
  delay(100);
  Serial.println("Hello from GSM Modem!"); //the content of the message
  delay(100);
  Serial.println((char)26); //the stopping character Ctrl+Z
  delay(100);
}
```

3.5.5 Interfacing of GSM module with Arduino

This is a minimal effort and straightforward Arduino GSM and GPRS module. We utilize the module SIMCom SIM900A. It's the less expensive module now available in the market. This post will enable you to make Arduino controlled calls and furthermore send instant messages.

This module supports communication in 900MHz band. We are from India and most of the mobile network providers in this country operate in the 900 Mhz band. If you are from another country, you have to check the mobile network band in your area. A majority of United States mobile networks operate in 850 Mhz band (the band is either 850Mhz or 1900Mhz). Canada operates primarily in 1900 Mhz band.

Our gsm module requires a 12 volts input. So we feed it using a 12V, 1A DC power supply. I have seen gsm modules which require 15 volts and some other which needs only 5 volts. They differ with manufacturers. If you are having a 5V module, you can power it directly from Arduino's 5V out.

BOOTING UP THE GSM:

- Insert the SIM card into the module and lock it.
- Connect the adapter to the module and turn it ON!
- Now wait for some time (say 1 minute) and see the blinking rate of 'status LED' (GSM module will take some time to establish connection with mobile network)

- Once the connection is established successfully, the status LED will blink continuously every 3 seconds.

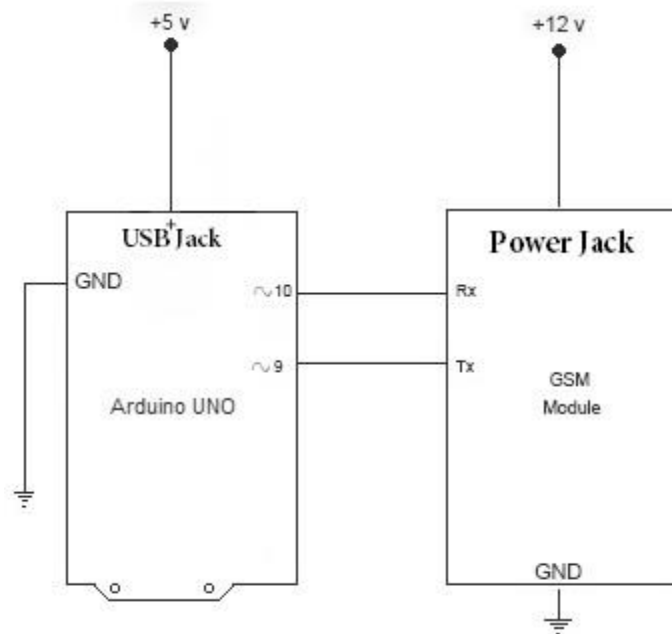


Figure 3.9 interfacing of Arduino with GSM module [16]

There are two ways of connecting GSM module to Arduino. In any case, the communication between Arduino and GSM module is serial. So we are supposed to use serial pins of Arduino (Rx and Tx). So if you are going with this method, you may connect the Tx pin of GSM module to Rx pin of Arduino and Rx pin of GSM module to Tx pin of Arduino.

Now connect the ground pin of Arduino to ground pin of gsm module! So that's all! You made 3 connections and the wiring is over! Now you can load different programs to communicate with gsm module and make it work.

The problem with this connection is while programming. Arduino uses serial ports to load the program from the Arduino IDE. If these pins are used in wiring, the program will not be loaded successfully to Arduino. So you have to disconnect wiring in Rx and Tx each time you burn the program. Once the program is loaded successfully, you can reconnect these pins and have the system working

3.6 RS-232

There are two basic types of serial communications, synchronous and asynchronous. With Synchronous communications, the two devices initially synchronize themselves to each other, and then continually send characters to stay in sync. Even when data is not really being sent, a constant flow of bits allows each device to know where the other is at any given time. That is, each character that is sent is either actual data or an idle character. Synchronous communications allow faster data transfer rates than asynchronous methods because additional bits to mark the beginning and end of each data byte are not required.

Asynchronous means "no synchronization", and thus does not require sending and receiving idle characters. However, the beginning and end of each byte of data must be identified by start and stop bits. The start bit indicates when the data byte is about to begin and the stop bit signals when it ends. The requirement to send these additional two bits cause asynchronous communications to be slightly slower than synchronous however it has the advantage that the processor does not have to deal with the additional idle characters.

A serial port sends and receives data one bit at a time over one wire. While it takes eight times as long to transfer each byte of data this way, only a few wires are required. In fact, two-way (full duplex) communications are possible with only three separate wires - one to send, one to receive, and a common signal ground wire.

The serial port on your PC is a full-duplex device meaning that it can send and receive data at the same time. In order to be able to do this, it uses separate lines for transmitting and receiving data. Some types of serial devices support only one-way communications and therefore use only two wires in the cable - the transmit line and the signal ground

RS-232 devices may be classified as Data Terminal Equipment (DTE) or Data Circuit-terminating Equipment (DCE); this defines at each device which wires will be sending and receiving each signal. According to the standard, male connectors have DTE pin functions, and female connectors have DCE pin functions. Two terms you should be familiar with are DTE and DCE. DTE stands for Data Terminal Equipment, and DCE stands for Data Communications Equipment. These terms

are used to indicate the pin-out for the connectors on a device and the direction of the signals on the pins. Your computer is a DTE device, while most other devices are usually DCE devices.

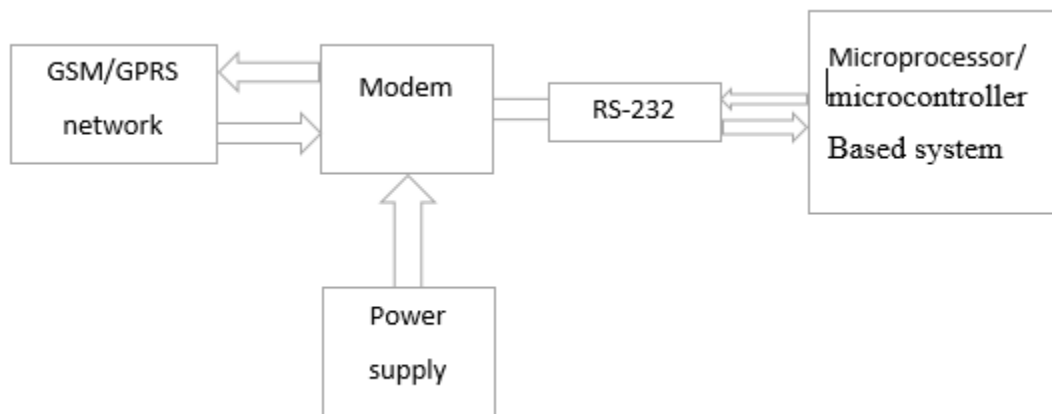


Figure3.10 RS-232 Interface with Microcontroller

CHAPTER 4

RESULTS AND DISCUSSION

In this section, the afterword effects of the project are talked about. The outcomes are tried and checked keeping in mind the end goal to guarantee the capacity of the venture satisfies the destinations

4.1 Mobility System

HC-SR04 is utilized to recognize the presence of an obstruction. At the point when the ultrasonic sensor recognizes the presence of a deterrent, the flag will send to vibrator to vibrate with various vibration qualities.

A signal of 40 kHz is sent by the ultrasonic sensor. In this project three ultrasonic sensor is used. Two sensor is used for obstacle detection and one sensor is used for pit detection. For obstacle detection, we set a threshold distance which is 400cm. If detected distance is less than the threshold distance then vibratory motor will vibrate. The vibration strength of motor is the function of detected distance. As any obstacle is coming towards the sensor then vibration strength of motor is increasing and vice-versa. One sensor is used for pit detection, for pit detection we set a threshold distance of 5cm. if distance is greater than 5cm then it gives the signal to the sensor and sense for the pit. Figure 4.1 shows the output of HC-SR04 ultrasonic sensor for the obstacle detection. Figure 4.2 shows the output for pit detection.

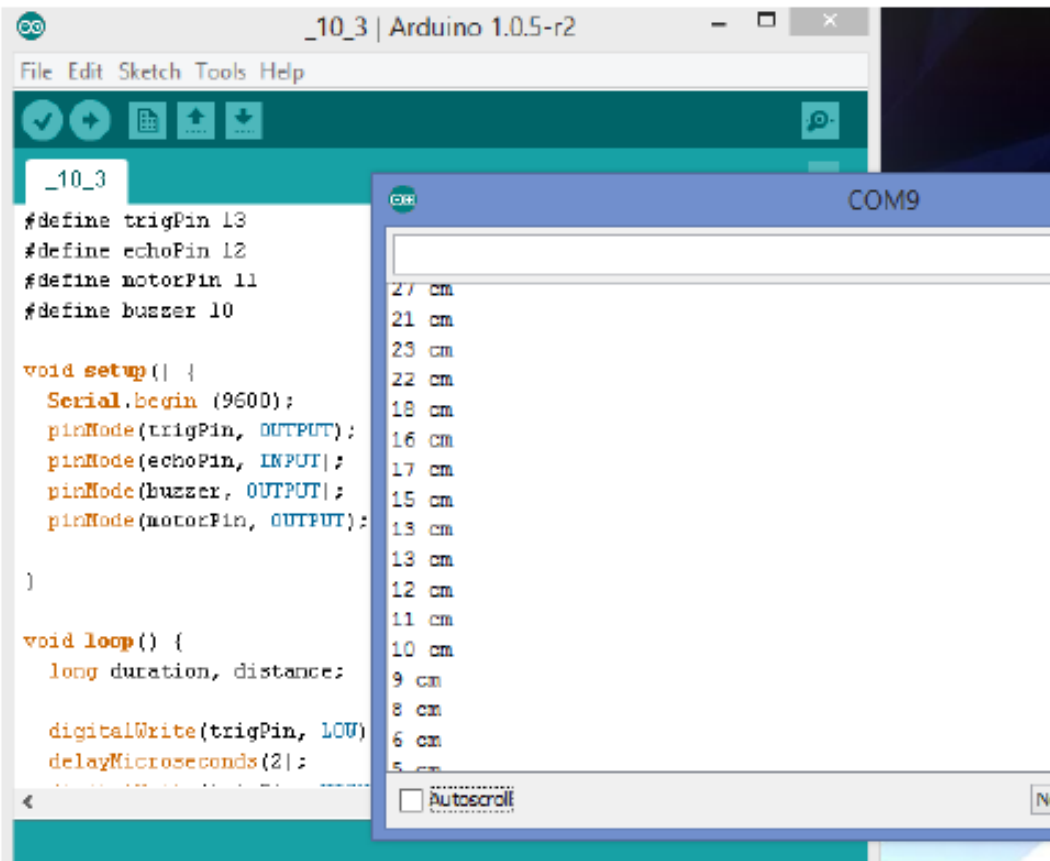


Figure 4.3: Sensed Distance by HC-SR04

Table 4.1 Actual and sensed distance of ultrasonic sensor and average error

NO	Measure Distance(cm)	Sensor Detected Distance(cm)	Error(cm)
1	0	0	0
2	5	4	-1
3	10	8	-2
4	15	14	-1
5	20	19	-1
6	25	25	0
7	30	29	-1
8	35	33	-2
9	40	39	-1
10	45	43	-2
11	50	49	-1
12	55	54	-1
13	60	59	-1
Average Error			-1.0769

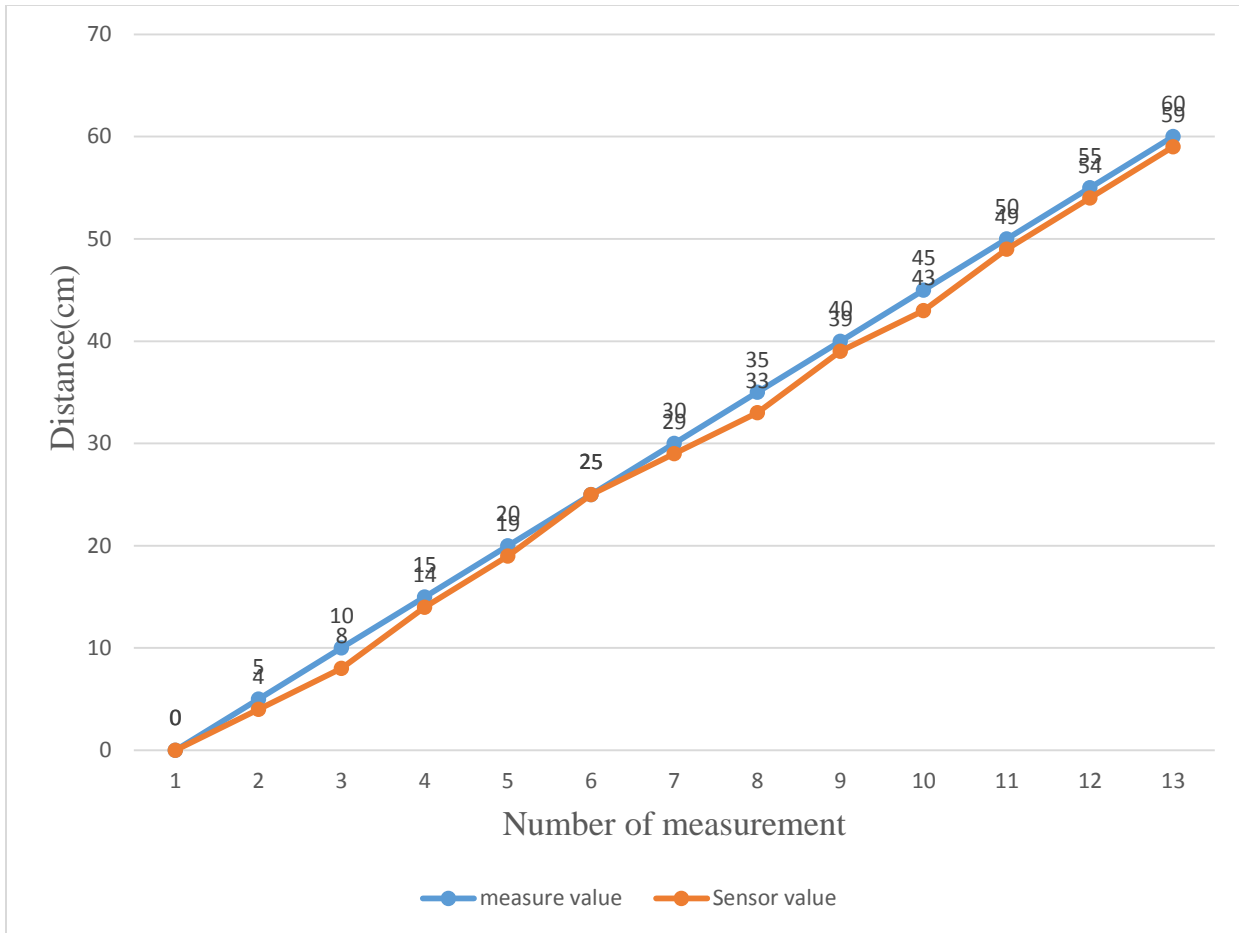


Figure 4.4 Graph between actual and detected distance

Difference of actual value and measured value between ultrasonic and obstacle is shown in Table 4.1 and Figure 4.4. The average error between measured values and the ultrasonic sensor is small that is -1.0769 cm that is reliable.

CHAPTER 5

CONCLUSION

In this chapter the work done in previous chapters for the project smart stick for visually impaired person will be concluded and future scope of the work also included.

5.1 Conclusions

In the conclusion, this project comprises of some hardware parts like GSM module, ultrasonic sensor, Arduino UNO, and vibrator. Programming used in Arduino is visual basic. We can also use c/c++ as the programming in Arduino UNO. There are two primary objectives of the project first one is to enhance the mobile capability and second one is to inform the known person through the message if the person is in danger zone.

To increase the mobile capacity of the impaired person, vibrator and ultrasonic sensor are used. If any object is exist in front of the blind person then he will recognize the obstacle before getting touch. It is suitable to travel in the unknown environment for the blind person and enhance the safety. By implementing this an impaired person can move to an unfamiliar environment without any human guidance. The blind people can move more positively and independently. It sends the message to a registered mobile number if the blind person is in a danger.

The hardware and software of the project had been successfully integrated and worked to meet the requirements. The prototype of a smart cane is built and the function meets the objectives of this project.

The equipment and programming of the venture had been effectively coordinated and attempted to meet the necessities. The model of the smart stick is built and the functionality capacity meets the main motive of the project.

5.2 Future scope

There is some future scope to fulfill the requirement by the smart stick. Obstacle detection capability of this project can be increased by introducing the ultrasonic sensor which has better accuracy and precision angle width. We can introduced GPS system to find the exact location of the person. By implementing voice recognition system we can improve the accuracy of the project.

CHAPTER 6

PROJECT MANAGEMENT

Project management is discussed in this chapter. The main motive of this chapter is to strategy and steps of the project.

6.1 Project Plan

The step followed in the project is shown in the figure 6.1 and 6.2. Project chart of semester 3 and 4 are shown in figure 6.1 and 6.2 respectively. Research work related to this project is done in third semester. Structural design and usage of GSM module and Ultrasonic are studied to know the procedure to design the smart stick. In fourth semester more focus is given to the programming of ultrasonic sensor and GSM module. Hardware part of the project is built to fulfill the requirement of the blind person.

No	Item	Week													
		2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Literature review	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2	Research on Ultrasonic Sensor				■	■	■								
3	Research on GSM						■	■							
4	Arduino								■	■					
5	Ultrasonic Sensor testing										■	■	■		
6	GSM testing												■	■	■
7	Presentation													■	■

Figure 6.1 Project plan (3rd sem)

No	Item	Weeks															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Final Report Writing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2	Programming on Ultrasonic Sensor			■	■												
3	Building of ultrasonic circuit.					■	■										
4	Programming on GSM							■	■								
5	Building GSM circuit									■	■						
6	Project testing					■	■	■	■	■	■	■	■	■			
7	Hardware implementation												■	■	■		
8	Presentation														■	■	

Figure 6.2: Project plan (4th sem)

6.2 Approximation Cost

Estimation cost of the project is shown in Table 6.1. GSM module and Arduino kit are main part of this project which are costly. Table 6.1 shows estimation cost of each item to make the stick.

Table 6.1 cost of Project

No.	Articles	Quantity	cost(rupees)
1	Arduino UNO	1	530
2	GSM shield SIM900	1	900
3	Ultrasonic Sensor(HC-SR04)	3	375
4	Vibrating Motor	2	120
5	Other items	-	155
Total			2080

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