



ADVANCED SMART STICK WITH GPS TRACKING SYSTEM



A PROJECT REPORT

Submitted by

AASHISH JOSEPH

Reg. No.:13BEC003

A.AKASH

Reg. No.:13BEC008

D.DHARANITHARAN

Reg. No.:13BEC031

G.SARAVANA KUMAR

Reg. No.:13BEC238

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

KUMARAGURU COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE - 641 049

ANNA UNIVERSITY: CHENNAI 600 025

APRIL 2017

BONAFIDE CERTIFICATE

Certified that this project report titled **“ADVANCED SMART STICK WITH GPS TRACKING SYSTEM”** is the bonafied work of **“AASHISH JOSEPH [Reg.No.:13BEC003], AKASH.A [Reg.No.:13BEC008], DHARANITHARAN.D [Reg.No.:13BEC031], SARAVANA KUMAR.G [Reg.No.:13BEC238]”** who carried out the project work under my supervision. Certified further that, to the best of my knowledge the work reported herein does not form part of any other project or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

SIGNATURE

Ms.P.Pavithra

PROJECT SUPERVISOR

Department of ECE

Kumaraguru College of Technology

Coimbatore-641 049

SIGNATURE

Dr. K. Malarvizhi

HEAD OF THE DEPARTMENT

Department of ECE

Kumaraguru College of Technology

Coimbatore-641 049

The candidates with **REGISTER No.:13BEC003, 13BEC008, 13BEC031, 13BEC0238** are examined by us in the project viva-voice held on

.....

INTERNAL EXAMINER

EXTERNAL EXAMINER

ACKNOWLEDGEMENT

First we would like to express our praise and gratitude to the Lord, who has showered his grace and blessing enabling us to complete this project in an excellent manner. He has made all things beautiful in his time.

We express our sincere thanks to our beloved Joint Correspondent, **Shri. Shankar Vanavarayar** for his kind support and for providing necessary facilities to carry out the project work.

We would like to express our sincere thanks to our beloved Principal **Dr. R.S. Kumar M.E., Ph.D**, who encouraged us with his valuable thoughts.

We would like to express our sincere thanks and deep sense of gratitude to our HOD, **Dr. K. Malarvizhi M.E., Ph.D**, for her valuable suggestions and encouragement which paved way for the successful completion of the project.

We are greatly privileged to express our deep sense of gratitude to the Project Coordinator **Mr. S. Govindaraju M.E.**, Professor (SRG), for his continuous support throughout the course.

In particular, We wish to thank and express our everlasting gratitude to the Supervisor **Ms. P. Pavithra M.E.**, Assistant Professor for her expert counselling in each and every steps of project work and we wish to convey our deep sense of gratitude to all teaching and non-teaching staff members of ECE Department for their help and cooperation.

Finally, we thank our parents and our family members for giving us the moral support in all of our activities and our dear friends who helped us to endure our difficult times with their unfailing support and warm wishes.

ABSTRACT

The main aim of this project is to assist the visually challenged persons without the human need. It is well known that the visually challenged people carry a hand stick with them where ever they need a support. Sometimes even when they use this stick, there is no guarantee that the visually challenged persons are safe and secure in reaching their destinations. There may be an obstacle in their path but it is not encountered by the persons with the help of the stick. Thus, the people might be injured if the obstacle is big enough or dangerous. A design has been developed to assist the visually challenged by providing a caution if an obstacle or a water body and also it consists of distress signal transmitter and thereby providing GPS co-ordinates to the guardian.

The system consists of an Ultrasonic sensor and Water sensor fixed to the user's stick. While the user moves the stick in the forward direction, the Ultrasonic sensor fixed to the stick tries to detect the obstacle present in the path. If the sensor detects the obstacle, the output of the receiver triggers and this change will be detected by the microcontroller since the output of the receiver is given as the inputs to the microcontroller. Thus, the microcontroller immediately alerts the buzzer as soon it receives the triggered output from any of the sensors. Now the user can change the direction of the stick in any other direction to avoid collision, as soon the buzzer is activated. The entire controlling unit will be fixed to the hand stick.

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LIST OF ABBREVIATION AND SYMBOLS

PWM	Pulse Wave Modulation
GPS	Global Positioning System
PIR	Passive Infrared sensor
GIS	Geographic Information System
KHz	Kilo Hertz
V	Voltage
<i>Cm</i>	Centimeter
<i>M</i>	Meter
μ S	Microsecond
μ /S	Micropersecond
A	Ampere
GHz	Giga Hertz
UHF	Ultra High Frequency
PAN	Personal Area Network
RC	Resistance and Capacitance

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CHAPTER 1

INTRODUCTION

This chapter describes the background of the project, the problem statement, objectives of the project and scope which are linked to the development of an advanced smart stick with GPS tracking system.

1.1 Objectives

The objective of this project is to develop a smart walking stick that can sense obstacles around the visually challenged person. The walking stick will be able to sense different distances between the user and the obstacles up to 70cm long. In addition, the objective of this project is to help the visually challenged to carry out their daily activities and also track them when they are in distress.

Nevertheless, this project also targets to develop a low cost, sturdy and robust walking stick.

1.2 Scope

There are 2 parts involved in this project, namely hardware and software. The hardware part involves microcontroller, ultrasonic sensor, Bluetooth module, monostable multivibrator, a buzzer and a vibrator whereas software part includes the GPS tracking using mobile phone.

CHAPTER 2

LITERATURE SURVEY

Ashraf Mohamed Ali Hassan et al., "*Indoor location tracking system using neural network based on Bluetooth*" in 2nd International Conference on electrical Information and Communication Technology (ICEEOT).IEEE-2015 has designed and implemented a Bluetooth based on indoor location tracking system. This system utilizes the integrated Bluetooth modules in any today's mobile phones to specify and display the location of the individuals in a certain building. The proposed system aim for location tracking/monitoring and marketing applications for whom want to locate individuals carrying mobile phones and advertise products and services. It is an integrated embedded and desktop system that helps the user to get the location of customers/inhabitants/employee within a certain region. The system is composed of a Server Module which is a java application that runs over desktop PC and is used to display the locations of the nearby mobile phones and send location based advertising message. This paper is aimed also to enhance the system positioning estimation accuracy by choosing the suitable number of neurons used in the neural network.

Krishna Kumar; Biswajeet Champaty; K. Uvanesh; Ripunjay Chachan; Kunal Pal; Arfat Anis "*Development of an ultrasonic cane as a navigation aid for the blind people*" International Conference (ICCICCT),IEEE-2014 has described the current study deals with the development of an ultrasonic based cane for the navigation of the blind persons. The developed cane is able to detect both aerial and ground obstacles and potholes (drop-off). The ultrasonic signals are acquired in the Arduino microcontroller, classified and control signals are generated. The control signals are transmitted wirelessly to the receiving device, kept in the shoulder pocket. The receiving device consists of another Arduino microcontroller which triggers 3 speaker panel (worn around the chest) and 3 LED panel. The device works in the range of 5-150 cm and may be used as a navigational aid for the blind persons.

CHAPTER 3

HARDWARE DESCRIPTION

This chapter describes the past and current researches that have been carried out which are related to the project. This review investigates from numerous aspects of sensors, indicators and the overall working system of the related projects.

3.1.1 Characteristic of Ultrasonic Sensor

The ultrasonic model used in this project is HC-SR04. It was designed to be just as easy to use as the Polaroid sonar. The sensor is able to compute the distance of obstacles in maximum range of $10.7m$.

It consists of 5 terminals, namely the power terminal, the ground terminal, trigger pulse terminal, echo pulse terminal and do not connect terminal. An analog voltage signal is produced as output which is proportional to the distance. The current consumption for the sensor is about $2.5A$ during the sonic burst and the power desired to turn it on is $5V$.

The sensor needs to supply a short $10\mu S$ pulse to the trigger input to start the ranging. Then the module will send out an 8 cycle burst of ultrasound at 40 kHz and raises its echo line high. The module is quite large to fit into small systems. Figure 3.1.1 shows the HC-SR04 ultrasonic sensor.



Figure 3.1.1 HC-SR04 Sensor

3.1.2 Hardware Part

There are eight main components in the system which is a charging circuit, a battery, a vibrator, an ultrasonic sensor, water pit indicating sensor, Bluetooth module, monostable multivibrator, mobile phones.

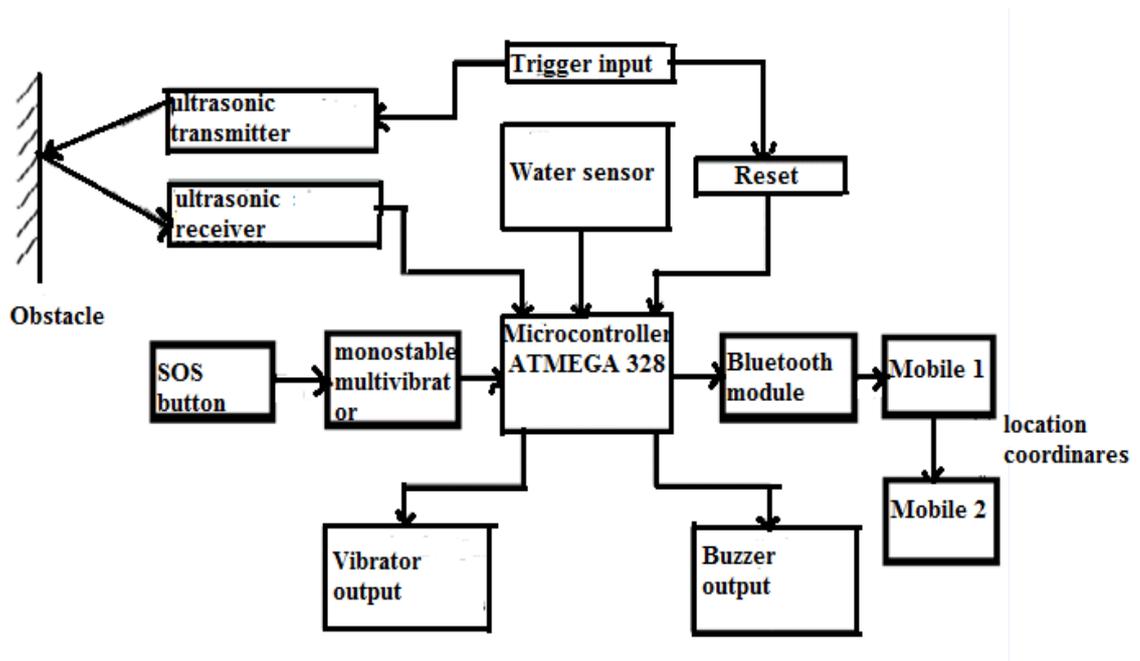


Figure 3.1.2Block diagram of the hardware components

3.1.3 Application of water sensor in Smart stick

Water sensor brick is designed for water detection, which can be widely used in sensing water spills on the ground which helps the visually challenged to prevent slipping. The brick is mainly comprised of three parts: An Electronic brick connector, a 1 M Ω resistor, and several lines of bare conducting wires.



Figure 3.1.3 Water sensor

This sensor works by having a series of exposed traces connected to ground and interlaced between the grounded traces are the sense traces. The sensor traces have a weak pull-up resistor of 1 M Ω . The resistor will pull the sensor trace value high until a drop of water shorts the sensor trace to the grounded trace.

3.1.4 Application of Monostable multivibrator using 555 timer in Smart stick

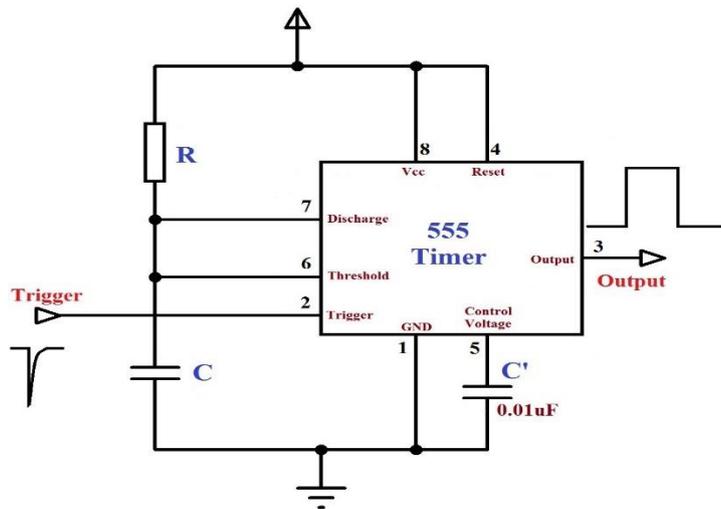


Figure 3.1.4 Monostable multivibrator

In this circuit when the output at pin 3 is low i.e. the circuit is in a stable state, the transistor is on and capacitor C is shorted to ground. When a negative pulse is applied to pin 2, the trigger input falls below $+1/3 VCC$, the output of comparator goes high which resets the flip-flop and consequently the transistor turns off and the output at pin 3 goes high. This is the transition of the output from stable to quasi-stable state. As the discharge of the transistor is cut-off, the capacitor C begins charging toward $+VCC$ through resistance RA with a time constant equal to RAC. When the increasing capacitor voltage becomes slightly greater than $+2/3 VCC$, the output of comparator 1 goes high, which sets the flip-flop. The transistor goes to saturation, thereby discharging the capacitor C and the output of the timer goes low. Thus the output returns back to stable state from quasi-stable state. The output of the Monostable multivibrator remains low until a trigger pulse is again applied. The RC time constant controls the width of the output pulse. The time during which the timer output remains high is given as

$$t_p = 1.0986 RAC$$

where RA is in ohms and C is in farads.

The Monostable multivibrator is used to stabilize the Bluetooth module to prevent quasi-stable state.

3.1.5 Application of Bluetooth module(HC-05) in Smart stick

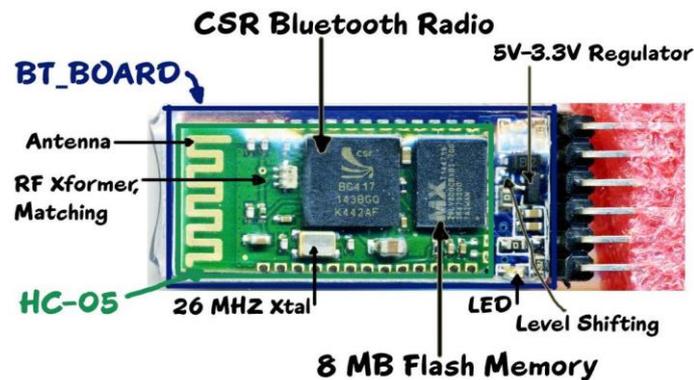


Figure 3.1.5 Bluetooth module

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices, and building personal area networks (PANs). Range is approximately 10 Meters (30 feet). These low-cost Bluetooth Sub-modules work well with Arduino and other Microcomputers (mobile phones) and are more capable that can be set to either Master or Slave. These small modules run on 3.3V power with 3.3V signal levels. The module has two modes of operation, Command Mode where we can send AT commands to it and Data Mode where it transmits and receives data to another Bluetooth module.

Here the Bluetooth module is used to send a single message from the microcontroller to the visually challenged phone. So that the location of them can be shared with another person by using a customized app designed for the smart stick in case of emergency.

3.2 Working Principle

The aim of this work is to design an electronic guiding stick with obstacle avoidance system by using ultrasonic sensor. The designed electronic stick has been embedded with Water sensor brick for water detection, which can be widely used in sensing water spills on the ground and helps the person to prevent slipping. When several lines of bare conducting wires get in contact with water it short circuits the lines of the sensor and sends signals to the microcontroller and activates the output indicators. By pressing the push button(SOS), enables the Monostable multivibrator connected with Arduino which enables the Bluetooth module of the stick connected with the phone of visually challenged person to send the location coordinates to their guardian's phone with the help of the android app developed for the stick. With the information of location coordinates, the blind person can be easily tracked and recovered.

3.3 Arduino NanoV3.0 board

The Arduino Nano is a microcontroller board based on the ATMEGA328. It is an open source single board microcontroller, heir of the open source wiring platform, thus helping in designing electronic project easily. Arduino need to be programmed in order to drive the designed function. The software that can be used for Arduino Nano programming is Arduino software.

It has 14 digital input/output pins of which can be used as PWM outputs, 6 analog inputs, a 16MHz crystal oscillator, a USB connection, a power jack, and ICSP header, and a reset button. It comprises everything needed to support the microcontroller.

3.3.1 Microcontroller

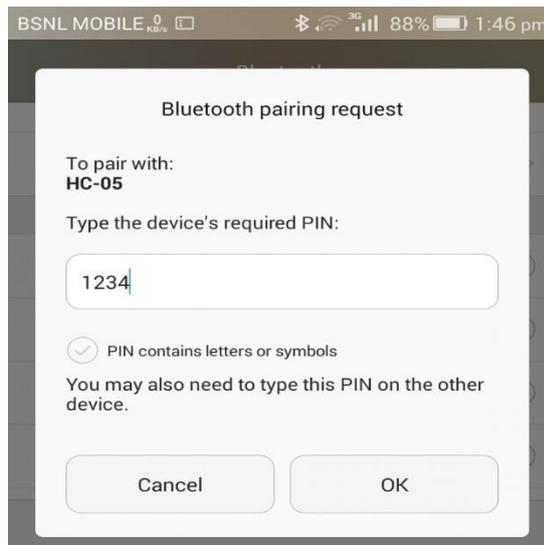
Microcontroller is a compact microcomputer designed to regulate the operation of embedded system in motor vehicles, robots, office machines and numerous other devices. An embedded system is a very sophisticated system that required minimal memory and program length, no operating system and less software complexity.

CHAPTER 4

SOFTWARE DESCRIPTION

4.1 Application software and testing for GPS tracking

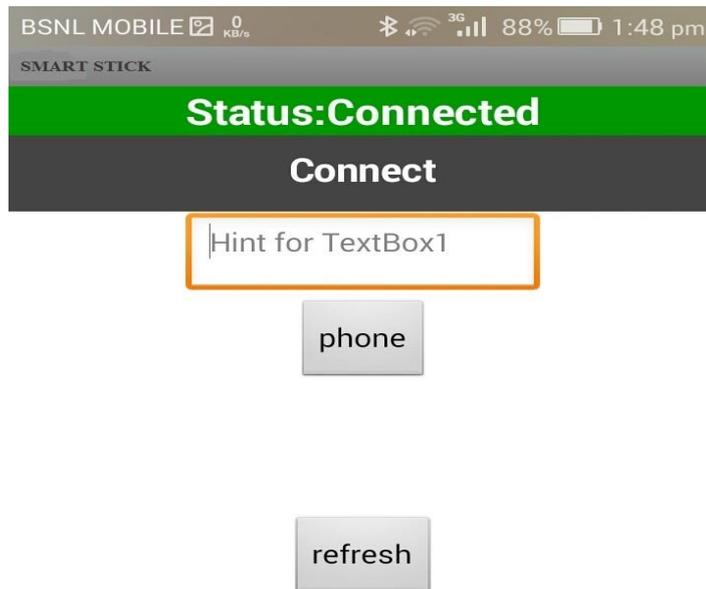
STEP 1: Pair the smart stick Bluetooth module with the visually challenged person's mobile phone.



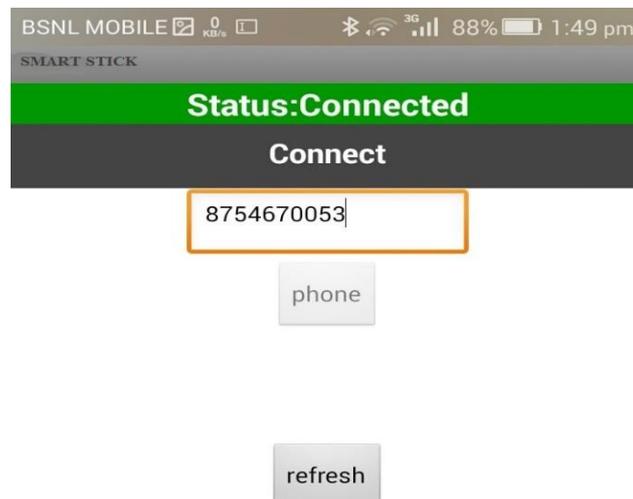
STEP 2: After pairing open the app in visually challenged person's mobile phone with the help of the guardian.



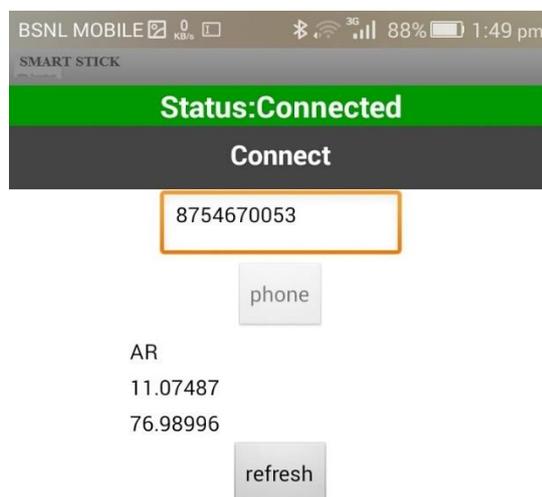
STEP 3: Click on CONNECT icon in the app and select the Bluetooth module HC-05 for the status to show CONNECTED.



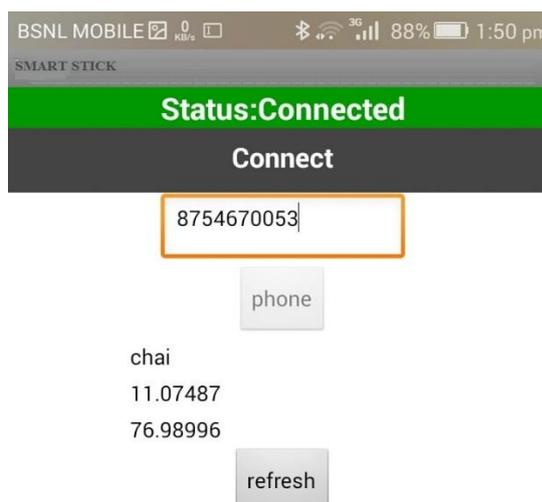
STEP 4: Enter the phone number of the guardian in visually challenged person's mobile phone. And click on the PHONE icon to save the guardian mobile number.



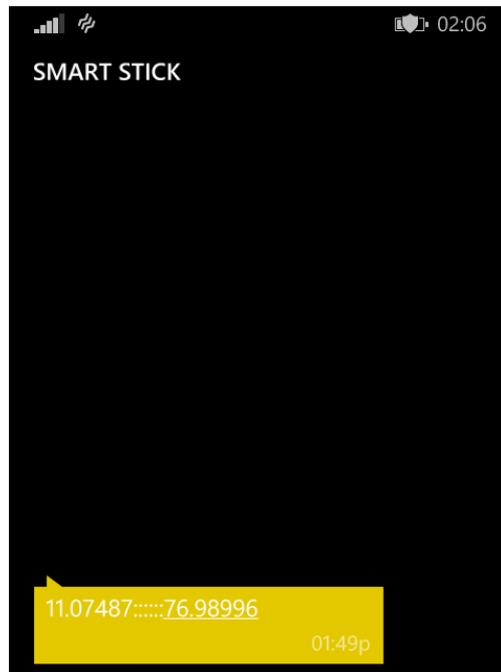
STEP 5: Click on REFRESH icon to obtain the location coordinates of visually challenged.AR indicates initial position before pressing the push button(SOS) button in the smart stick.



STEP 6: Chai indicates that location coordinates has been sent to the guardian's phone number.



STEP 7: The message has been received on the guardian’s mobile phone which has exact coordinates of visually challenged.



An android app “SMART STICK” has been developed to send the location co-ordinates from the visually challenged person’s phone to another phone.

First the user has to pair HC-05 Bluetooth module with their android phone. This can be done by enabling the phone’s Bluetooth and by clicking the connect button provided in the app at the top and select the HC-05 Bluetooth module. Then the person(guardian) has to enter their phone number. So, that as in case of emergency the current location of the person (visually challenged) is sent to guardian’s phone as a message alert. As soon as the android app receives a message form the microcontroller of the stick via Bluetooth. The refresh button is used to refresh the location coordinates initially. With the help of the location co-ordinates the guardian can easily track the visually challenged using “GOOGLE MAPS”.

CHAPTER 5

CONSTRUCTION AND DESIGN

5.1 General Construction

The walking stick used in this project is a ready-made stick readily available from a shop. The walking stick with a hand held is chosen due to several factors such as easy to hold and maintain. Figure 5.1 shows the stick to be used in developing the automated walking stick. The walking stick is estimated about 100cm in length which is suitable for average human height.

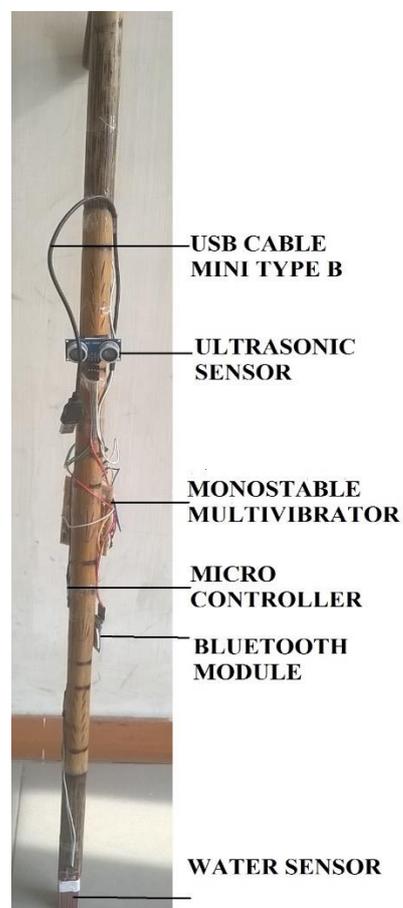


Figure 5.1 Walking Stick

Figure 5.1 demonstrates the block diagram of the proposed system. The system has ultrasonic sensor and water sensor which functions simultaneously to detect obstacles in the user path. The sensors detect the obstacle and resolve the distance between the obstacle and the user. The output of the sensor will be sent to the microcontroller.

The microcontroller receives the output signal from the sensors and processes them. If the output signal is within the programmed distance range, the microcontroller will activate the indicators. In this project, there are two indicators used i.e. a buzzer and a vibrator. In addition, this project is also used to track them when they are in distress with help of wireless communication between the stick and the android app.

5.2 Microcontroller Design

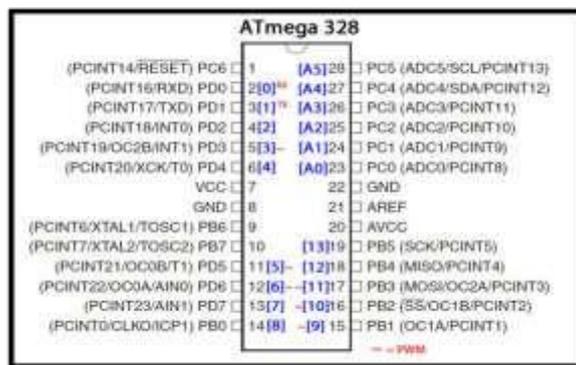


Figure 5.2 Microcontroller Pin Diagram

The brain of the entire system is the microcontroller where most part of the data management is done here. The microcontroller used in this project is Arduino NANOv3.0. Arduino board has an ATMEGA328 microcontroller merged in it. It has 32 KB of flash memory of storing code. It also has 2 KB of SRAM and 1 KB of EEPROM. The detail features of the microcontroller are as in Appendix E.

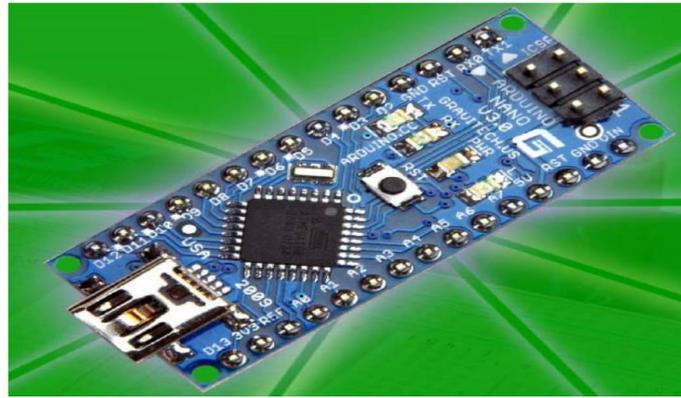


Figure 5.2.1 Arduino Nano v3.0

The microcontroller receives signals from the sensors, modules and performs data processing. It calculates the signals received before any action is taken by the microcontroller.

5.3 Ultrasonic Range Sensor

The ultrasonic range sensor is used to detect the distance between the user and the obstacles for above-knee and below-knee position. The model of the sensor used is HC-SR04. The image of the sensor is illustrated in Figure 5.3 below.

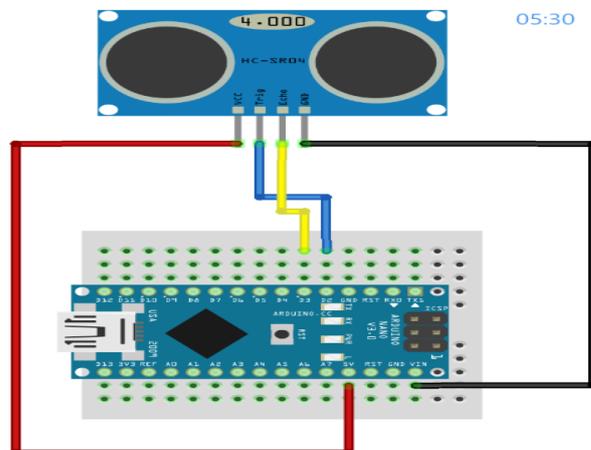


Figure 5.3 HC-SR04 Sensor

Ultrasonic waves are emitted from the module and are able to detect obstructions within the range of 2cm – 400cm long. The operating voltage for the sensor is 5V and the consumption current is 15mA. The range through the time interval between sending signal and receiving echo signal can be calculated using the formula

$$\text{Range} = \text{High Level Time} * \text{Velocity} (340\mu/\text{S})/2$$

5.4 Power Supply

The battery used in this project is Li-ion type. The entire system is powered up by a battery which is able to supply 5V/1A with battery capacity of 400m. the power supply is high enough to power up all the components. Otherwise, the system will not be able to operate well.



Figure 5.4 Battery

5.5 Push Button(SOS)

A push-button(SOS) is a simple switch mechanism for controlling some aspect of a process. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. Buttons are most often biased switches, although many un-biased buttons still require a spring to return to their un-pushed state.

By pressing the push button(SOS), enables the monostable multivibrator connected with Arduino which enables the Bluetooth module of the stick connected with the phone of person to send the location coordinates to his\her guardian's phone.

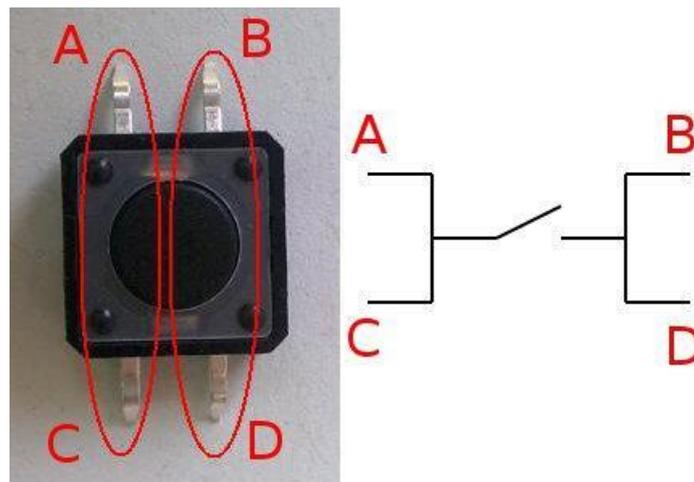


Figure.5.5 Push Button(SOS)

5.6 Programming of the Sensor and Indicators

The ultrasonic sensor, the water sensor, output of monostable multivibrator, the Bluetooth module, the buzzer and the vibrator must be declared in the coding before it can be set within the specific ranges.

CHAPTER 6

RESULTS AND DISCUSSION

6.1 Response of Stick for Various Obstacles

Obstacle	Test 1	Test 2	Test 3
Wall	198	210	203
Human Body	100	114	122
Plastic	115	124	145
Metal	210	199	215

6.2 Sensor Detection Analysis

After analyzing the performance of the sensor, the ultrasonic sensor is tested with the present of indicators as the output. The analysis of both above-knee and below-knee sensor position are explained as follow.

6.3 Above and Below-Knee Position

The range for the sensor is divided into 2 different parts as illustrated in the Figure 6.3.

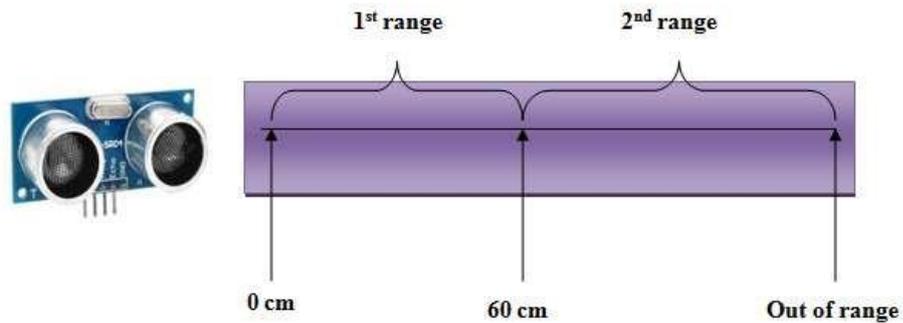


Figure 6.3.1 Range detection

For the first operational range, the distance is set to vary from 0cm to 70cm .

The second range is set from 71cm until it is out of range.

No	Range (cm)	Output
1	0-70	Buzzer and vibrator ON
2	71-Out of Range	No sound and vibrate

Table 6.3.2 Description of Sensor Detection

The ultrasonic sensor is assigned with the same output from the buzzer and vibrator. The output for the first range which is between $0\text{cm} - 70\text{cm}$ produces continuous sound and vibration which indicate that the user is close to the obstacles.

For the second range, which is from 71cm until it is out of range, the buzzer and vibrator will not produce any sound nor vibrate. It shows that the user is safe to continue walking.

6.4 Walking Stick

The walking stick which has a length of 100cm includes microcontroller, ultrasonic sensor, Bluetooth module, monostable multivibrator, a buzzer and a vibrator to assist the visually challenged.



Figure 6.4 Top View of proposed system

CHAPTER 7

CONCLUSION

The advancement of walking stick for the visually challenged can be implemented using several ways of distance measurement detection. Ultrasonic range sensor and Water sensor are examples of sensors that are appropriate for the system.

The water and ultrasonic range sensor, Bluetooth module is used in this project because it is small, light in weight and consumer less power. GPS/GSM modules can also be used for location tracking, but this circuit increases complexity and requires separate power supply which we felt is not suitable. The use of Bluetooth module is very helpful to send the location coordinates from one phone to another thus further reducing the complexity, cost of the stick.

The ultrasonic sensors used in this project are placed in area of the stick to detect the obstacles in the user path. This method is very helpful for the blind especially when they are moving alone for outdoor activities.

Using the Arduino NANO V3.0 as the microcontroller which gives compact structure for the smart walking stick has improved the overall system than by using Arduino UNO. The sensors and indicators are easy to be programmed and easy to be implemented with the microcontroller. In conclusion, the project is successfully done and the objectives of the project are achieved.

CHAPTER 8

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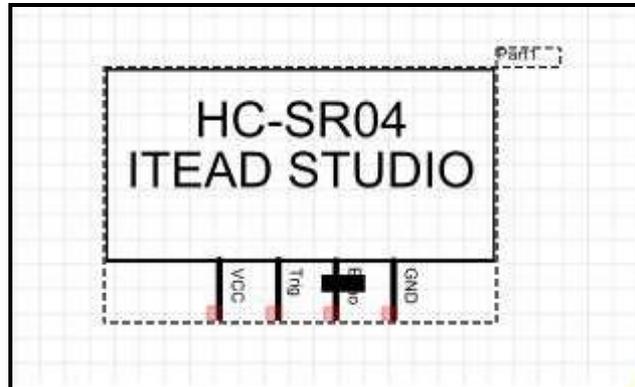
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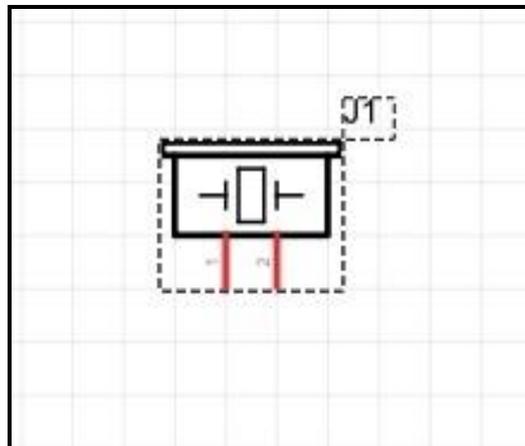
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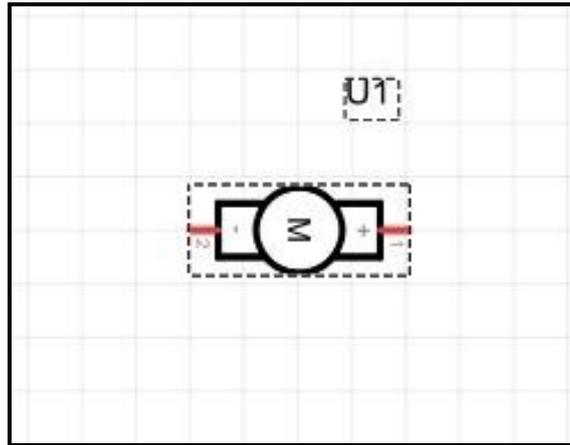
APPENDIX A



A.1 Ultrasonic Schematic Diagram



A.2 Buzzer Interface Schematic Diagram



A.3 Vibrator Interface Schematic Diagram

Features of Microcontroller

- High performance.
- Advanced RISC architecture.
- Peripheral Features.
- Special micro controller features.
- I/O and packages.
- Operating voltage(1.8-5.5v).
- Speed grade (0-2Mhz@ 1.8-5.5v).
- Low power consumption.

APPENDIX B

Source Code

```
#include <SoftwareSerial.h>

#define trigPin 13

#define echoPin 12

SoftwareSerial mySerial(A2,A3);

void setup()

{

Serial.begin(9600);

pinMode(2,INPUT);

attachInterrupt(INT0,khan, RISING) ;

mySerial.begin(9600);

pinMode(trigPin, OUTPUT);

pinMode(echoPin, INPUT);

pinMode(7,OUTPUT);

pinMode(4,OUTPUT);

}

void loop()

{

water();

ultra();
```

```

delay(500);

}

void ultra()
{
long duration, distance;
attachInterrupt(INT0,khan, RISING) ;
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin,HIGH);
delayMicroseconds(1000);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance = (duration/2) / 29.1;
Serial.println(distance);
if(distance<70)
{
digitalWrite(7,1);
digitalWrite(4,1);
}
else
{
digitalWrite(7,0);
digitalWrite(4,0);
}
}

```

```

    }
}

void water()
{
int x=analogRead(A1);
Serial.println(x);
if(x>550)
{
digitalWrite(7,1);
digitalWrite(4,1);
delay(100);
}
else
{
digitalWrite(7,0);
digitalWrite(4,0);
}
}

void khan()
{
noInterrupts();
detachInterrupt(INT0);
while(digitalRead(2)==1);

```

```
mySerial.print("khan\n");  
Serial.print("khan\n");  
delay(500);  
  
}
```