NORTH SOUTH UNIVERSITY

Center of Excellence in Higher Education

The first private university in Bangladesh

Department of Electrical and Computer Engineering

Major : Computer Science and Engineering

Course : CSE- 498R Directed Research

Research Report

Title : Arduino Based Smart Stick for the Blind and Visually Impaired People .

Supervisor Name : Dr. Mohammad Ashrafuzzaman Khan (AZK)

Section : 11

Semester : Summer-19

Group Members :

NAME	ID NO
1. MD. HAFIZUR RAHMAN	1512027042
2. ESHAN BARUA	1512058042
3. MD. MAMUN HOSSAIN	1430590042

Abstract :

In this research we work with blind walking stick by using of Arduino. According to WHO, worldwide about 285 million individuals are visually impaired, out of which 39 million people are permanently blind. Experts at a discussion have said that about [1]750,000 people in Bangladesh are suffering from blindness. This large number of people can't walk without the help of other. They need guidance to reach their destination. They have to face more problems in their daily life. Using this blind stick, a person can walk more confidently. This stick detects the object in front of the person and give response to the user either by vibrating, alert sound with LED or through command. So, the person can walk or move without any fear. This device will be best solution to overcome their difficulties and make their life easier.

1. Introduction :

Blind persons have great trouble while interacting with other people. Most of these people face so many problems when they are walking on roads and so many accident occurs. It's not only a problem of the whole worlds blind people but also in our country it creates a big problem in their social life. Director of National Eye Care Line and National Institute of Ophthalmology and Hospital (NIOH), Dr. Golam Mostafa said in a discussion: "Around 1.5 million children in Bangladesh are suffering from low vision." So from this and [1] we can see the number of blind and visually impaired people in Bangladesh is big and these people need a capable device so that they can move around independently. Now a days, we can see, there are so many techniques, and devices have been developed, which help these people to move freely. We develop a device called blind stick for the blind and visually impaired people which can help the people of Bangladesh and also the whole world. This device or walking stick is an alternative to the traditional walking stick. Arduino Nano, ultrasonic sensor, buzzer, vibrator, push button, LEDs are used. Arduino is a microcontroller which can do all the calculations very quickly with great accuracy. Ultrasonic sensor is used to detect the object in the front of the person by measuring the distance between the object and the stick. Buzzer is used to make some alert sound. Vibrator vibrates when there is any trouble or object in front of the person. Push button help the person
if the person need to alert the people in front of him to get some space. We talked about the other instruments in the other part of this paper briefly. Our main aim to work on this project is to focus the blind population of the world and to assist them in every walk of life through the aid of technology. We found that the main aids that blind people use are trained dogs, but such dogs are very expensive and not very

reliable. Some other products available in the market are the smart belt, smart ring, smart cane etc. But these devices have very limited usability and lack approach due to more cost. So blind people are not interested in buying such products. So this smart blind stick will be more helpful than other devices or products for the blind people.

2. Circuit Diagram :

A circuit diagram is given below what is scratched in a software called Fritzing.

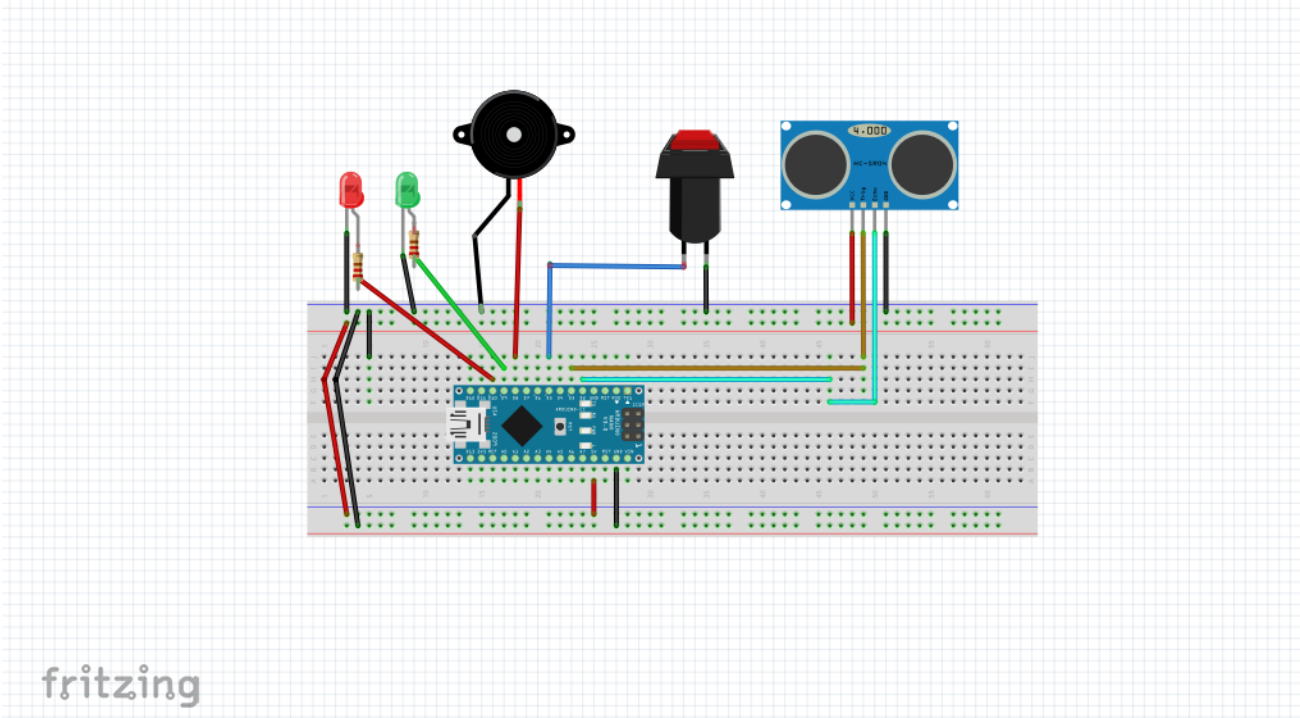


Figure 1 : Circuit diagram of smart blind stick

3. Equipments :

3.1 Arduino Nano :

Arduino Nano is a microcontroller board designed by Arduino.cc. The microcontroller used in the Arduino Nano is Atmega328. It has a wide range of applications and is a major microcontroller board because of its small size and flexibility. So, now let's have a look at its basic features.

Basic Features of Arduino Nano :
Here are few of its basic features which you must know if you are thinking to work on this great microcontroller board:

- It has 22 input/output pins in total.
- 14 of these pins are digital pins.
- Arduino Nano has 8 analogue pins.
- It has 6 PWM pins among the digital pins.
- It has a crystal oscillator of 16MHz.
- It's operating voltage varies from 5V to 12V.
- It also supports different ways of communication, which are:
    - Serial Protocol.
    - I2C Protocol.
    - SPI Protocol.

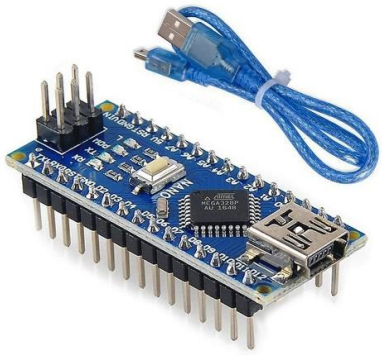


Figure 2 : Diagram of Arduino Nano.

- It also has a mini USB Pin which is used to upload code.

- It also has a Reset button on it.

Memory in Arduino Nano :

It has below memories embedded in it which are used for different purposes and are as follows:

- Flash memory of Arduino Nano is 32Kb.
- It has preinstalled bootloader on it, which takes a flash memory of 2kb.
- SRAM memory of this Microcontroller board is 8kb.
- It has an EEPROM memory of 1kb.

Applications of Arduino Nano

Here are few of its application but it has an extensive range which we can't discuss here. So here's the tip of the iceberg:

- Embedded Systems.
- Automation.

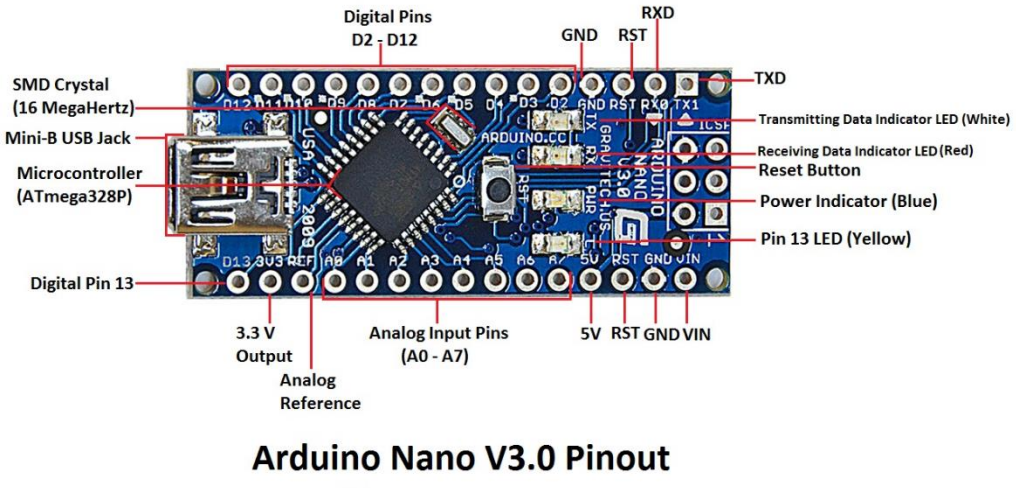


Figure 3 : Diagram of Arduino Nano with pin details.

- Robotics.
- Control Systems.
- Instrumentation.

As a microcontroller here for this research we used Arduino Nano what controlled the whole device. All other equipment's are attached with Arduino Nano and so that those equipment's works according to the given command.

3.2 HC-SR04 Ultrasonic Sensor :

Ultrasonic sensor is used to detect the object in front of the person . HC-SRC04 ultrasonic sensor has 4 pins-ground, Vcc , trigger and Echo . It ranging from 2cm to 400cm. Mainly it has two opening – one is transmitter which is used to transmit the signal and another one is receiver which is used to receive the signal. It sends ultrasound waves at high frequency and receive back the signal. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required.

Figure 4 : Diagram of Ultrasonic Sensor.

For this Project we use Ultrasonic Sensor. This Sensor sends out a high-frequency sound pulse and then times how long it takes for the echo of the sound to reflect back. The sensor has 2 openings on its front. One opening transmits ultrasonic waves, (like a tiny speaker), the other receives them, (like a tiny microphone).The speed of sound is approximately 340 meters per second in air. The ultrasonic sensor uses this information along with the time difference between sending and receiving the sound pulse to determine the distance to an object. It uses the following mathematical equation:

Distance = (Time x Speed of Sound) / 2

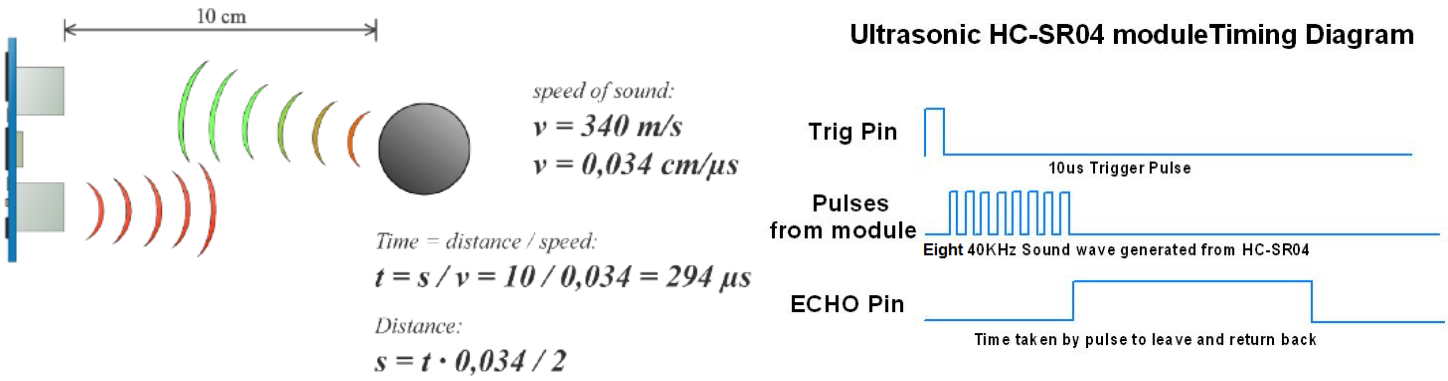


Figure 5 : Functioning of Ultrasonic Sensor.

When there is any object in front of the people or stick then this sensor can detect this by using the methods what was described in the above.

3.3 Buzzer :

3V to 5V to piezo buzzer module makes a loud 2KHz BEEP. Unlike a plain piezo, this buzzer does not need an AC signal. Inside is a piezo element plus the driver circuitry that makes it oscillate at 2KHz. The piezo buzzer is 5V TTL logic compatible and Breadboard friendly pin spacing.
This buzzer is ideal when you need to fit a buzzer in a small place. It has its own built-in drive circuit. It offers low current consumption. Used in manufacturing applications such as laptops, alarms, pagers, etc. The piezo buzzer is polarized, meaning that power must be applied to the correct pins. On the top of the case, there is a plus (+) sign to indicate the anode connection pin.

Figure 6: Diagram of a Buzzer.

Here in this research we used this to make sound as an alert. In the methodology part we describe about this more.

3.4 Vibrator :

These motors are often used for silent alert functions in mobile phones and are also used in applications within tools, robotics, control sticks and various alert functions in hand held equipment.
For generating the alert signal we have used this
which generate different pattern of vibration depending upon the type of obstacle.

Figure 7: Diagram of a Vibration Motor.

3.5 Push Button :

A Push button switch is used in case the blind person wants to alert the people when that person need a space for his walk. It makes an alert with a LED signal. So that people can understand that the blind person need some space or help. This button don't have any negative or positive pole.

Figure 8 : Push Button.

3.6 LED (Red , Green) :

LED means Light-emitting diode. A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. We used LED for different signal. If there is no obstacle near to the blind people, then the Green LED is on with blinking. When there is obstacle near to the blind people then Red LED turns on.

Figure 9 : LEDs.

3.7 Resistor :

Resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. For this project we use some resistors for our LED's and Buzzer because LED's and buzzer don't need high voltage. If we provide more voltage that equipment will be destroyed. So we use Resistors to control the voltage.

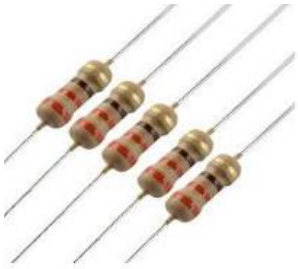


Figure 10 : Resistors.

3.8 Jumper Wires :

A jump wire (also known as jumper wire, or jumper) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or

components, without soldering. There will be different types of jumper wires but here we only use the Male – Male jumper wires.

Figure 11 : Jumper Wires.

3.9 Breadboard :

A breadboard is a solderless device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate. The breadboard has strips of metal underneath the board and connect the holes on the top of the board. The metal strips are laid out as shown below. Note that the top and bottom rows of holes are connected horizontally and split in the middle while the remaining holes are connected vertically.
We connected all our equipment will Arduino Nano through the breadboard.

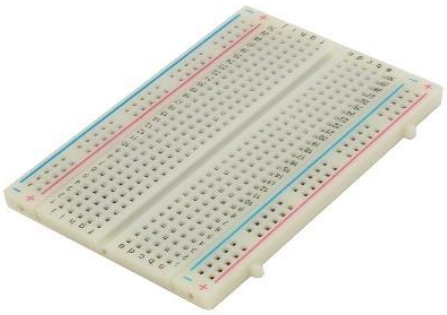


Figure 12 : Breadboard.

3.10 Battery :

Batteries are a collection of one or more cells whose chemical reactions create a flow of electrons in a circuit. All batteries are made up of three basic components: an anode (the '-' side), a cathode (the '+' side), and some kind of electrolyte (a substance that chemically reacts with the anode and cathode).
A 9V rechargeable battery is used for this research to supply the power to the Arduino Nano and other components.

Figure 13 : Battery.

4. Methodology :

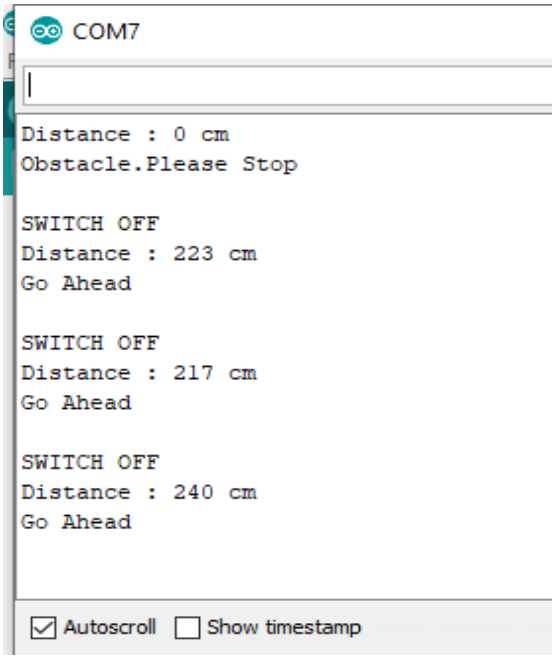
The working behind this blind stick is that it is used for special purpose as a sensing device for the blind people. The circuit provides 5V power supply for the circuit and maintains its output of the power supply at constant level. It is used widely to detect objects using ultrasonic sensor. If any object is present, the ultrasonic sensor detects the object by measuring the distance between the object and the user and sends the data to the Arduino Nano.
To determine the distance of an object, calculate the distance between sending the signal and receiving back the signal. That was described in the above. If any object is found nearer, it sends the command to the user through buzzer. For a different range of distance, it gives different alert sound by Buzzer with different LED signals. Like when there is no object found and the distance range is greater than 100 cm then the Green LED on and there is no sound and it shows there is no

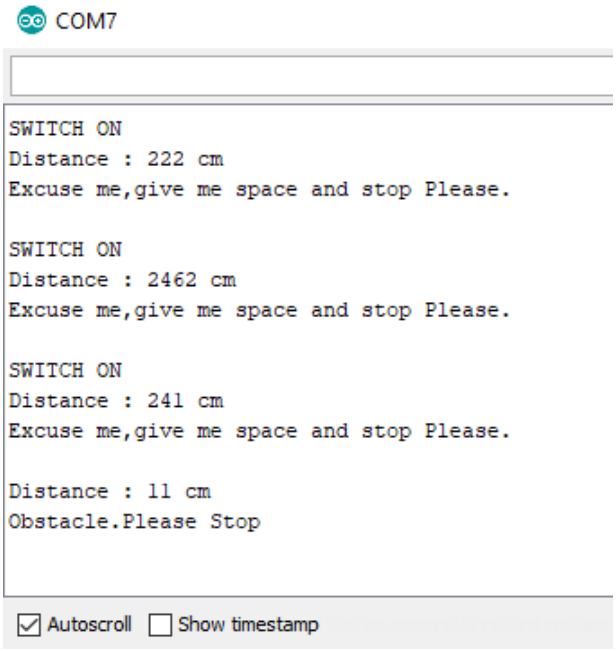
object so you can go. When there is any object between 100 cm range then there will be an alarm in Buzzer and the Red LED turns on. It gives the blind people an alert that there is an object and don't go (Please stop).
The command is already stored in the Arduino Nano alert message to the user about the object.
So The command condition is as follows :

[1] If the distance between the objects and the person is 0 - 100 cm, it will send the command as the obstacle is nearer to the person and Red LED blink with alert sound.

[2] For the other cases there is no alert sound and Green Led is on.

[3] When the person press the push button it makes an alert sound with Red LED that inform the people the blind person need some space to move.





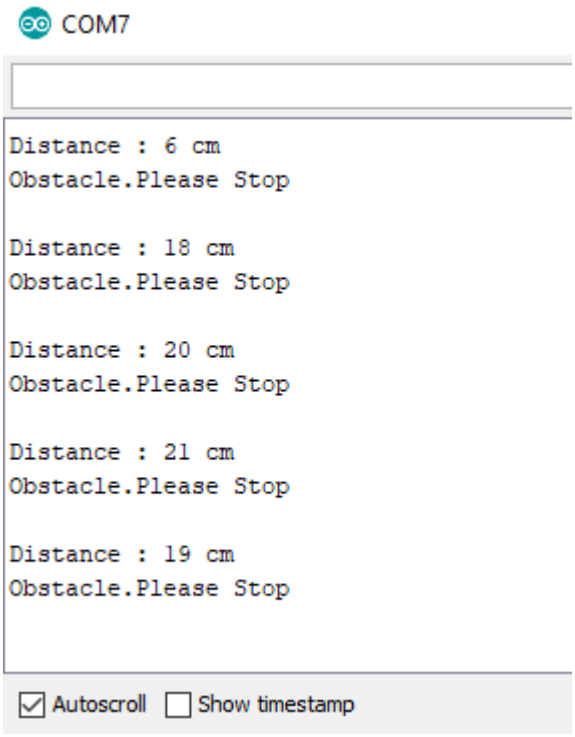


Figure 14 : Obstacle Detected.

5. Code :

Arduino code for this research is given below :

```
#define RED 10          // Define Digital Pin Number 10 as RED of Nano for Red Alert (stop) LED
#define GREEN 9      // Define Digital Pin Number 9 as GREEN of Nano for Green Alert (go/move) LED
#define BUZZER 8           // Define Digital Pin Number 8 as BUZZER of Nano for Sound (Alert)


const int trigPin = 3;              // Fixed Digital Pin Number 3 for sonar trig
const int echoPin = 2 ;             // Fixed Digital Pin Number 2 for sonar echo
const int ButtonPin = 5;          // Fixed Digital Pin Number 5 as a pushbutton pin

long duration;       // time duration for sonar
int distance;        // distance calculation for sonar
int sound =1000;    // sound level
```

```
// variables will change
int ButtonState = 0;  // variable for reading the pushbutton status


 void setup()
{

  pinMode(trigPin, OUTPUT);      // Sets the trigPinas an Output
  pinMode(echoPin, INPUT);       // Sets the echoPinas an Input
  pinMode(RED,OUTPUT);           // sets the digital pin as output
  pinMode(GREEN,OUTPUT);         // sets the digital pin as output

  pinMode(BUZZER, OUTPUT);

  pinMode(ButtonPin, INPUT);     // Read the state of the pushbutton value


  Serial.begin(9600);              // Begins Serial Communication


}


 void loop()
{

  digitalWrite(trigPin, LOW);    // Clears the trigPin
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);   // sets the trigPin On HIGH state for 10 micro seconds
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  duration = pulseIn(echoPin, HIGH);       // Reads the echoPin, returns the sound wave travel time in microseconds
  distance = duration*0.034/2;           // Calculating the distance

  ButtonState = digitalRead(ButtonPin);



    if (distance >= 0 &&  distance <=100 )
    {

      digitalWrite(RED, HIGH); // Sets the RED LED on
      digitalWrite(GREEN, LOW); // Sets the GREEN LED off
      sound = 1000 ;

      tone(BUZZER, sound);

      Serial.print("Distance : ");
      Serial.print(distance);
```

```
   Serial.println(" cm");
   Serial.println("Obstacle.Please Stop\n");

   delay(150);
   noTone(BUZZER);

  }


 else
{

   digitalWrite(RED, LOW);           // Sets the RED LED Off
   noTone(BUZZER);


     if (ButtonState == HIGH)
    {
       digitalWrite(RED, HIGH);             // Turn RED LED On
       digitalWrite(GREEN, LOW);        // Sets the GREEN LED Off

       sound = 1500 ;

       tone(BUZZER, sound);
       delay(120);

       Serial.println("SWITCH ON");

       Serial.print("Distance : ");
       Serial.print(distance);
       Serial.println(" cm");
       Serial.println("Excuse me,give me space and stop Please.\n");

       noTone(BUZZER);

     }

      else
     {

        digitalWrite(GREEN, HIGH);    // Sets the GREEN LED On
        digitalWrite(RED, LOW);         // Sets the RED LED Off
        delay(500);

        sound = 200 ;
        tone(BUZZER, sound);

        digitalWrite(GREEN, LOW);    // Sets the GREEN LED Off

        Serial.println("SWITCH OFF");
```

```
            Serial.print("Distance : ");
            Serial.print(distance);
            Serial.println(" cm");
            Serial.println("Go Ahead\n");

            noTone(BUZZER);

          }

    }

    delay(1000);


}
```

6. Impact :

We hope that this research has greatly impact the lives of blind people. We still can vastly improve their daily lives by utilizing advanced technology. This shows a new start in developing devices which can aid not only people with disabilities but even normal people in their day to day lives. Allowing humans to become much more efficient in their work.

7. Conclusions :

The Blind Walking Stick has been finally made into prototype which can be used to guide the blind. Its aims to solve the problems faced by the blind people in their daily life. This gadget is a very practical creation which helps blind users by acting as his auxiliary senses. The system also takes the measure to ensure their safety . This research will help all the blind people in the world to make them easier to walk everywhere they want. It is used to help the people with disabilities that are blind to facilitate the movement and increase safety.

Based on the above facts we can now conclude that:

1. The smart stick is a simple, cheap, easy to handle for blind and visually impaired persons.
2. The device is efficient and unique in its capability in specifying the source and distance of the objects that may be encountered by the blind .
3. It’s a user-friendly device.

Acknowledgement :

We would like to express our deepest appreciation to all those who provided us the possibility to complete this report. A special gratitude we give to our final year research project supervisor, **Dr. Mohammad Ashrafuzzaman Khan**, whose contribution in stimulating suggestions and encouragement, helped us to coordinate our project especially in writing this report.

References :

[1] Smart Cane Assisted Mobility for the Visually Impaired, World Academy of Science, Engineering and technology International Journal and Information Engineering Vol:6 No:10,2012

[2] G. Prasanthi and P. Tejaswidho Sensor assisted Stick for the Blind People- Transmission on Engineering and Sciences, vol:3, number 1, pp-, 12-16,2015.

[3] I .Ulrich, J. Borenstein, The GuideCane –Applying Mobile Robot Technologies to Assist the visually impaired, IEEE Tr.SMC, Vol:31, No.2, March 2001.

[4] S. Shovel, J. Borenstein, Y. Koren, Auditory guidance with the Navbelt-a computerized travel aid for the blind, IEEE Tr. SMC, Vol.28, August 1998.

[5] Ayat A. Nada, Mahmoud A. Fakhr and Ahmed F. Seddik "Assistive Infrared Sensor Based Smart Stick for Blind People", Science and Information Conference (SAI), 2015, 10.1109/SAI.2015.7237289

[6] http://www.who.int/mediacentre/factsheets/fs282/en/

[7] https://www.iapb.org/vision-2020/who-facts/

[8] https://timesofindia.indiatimes.com/india/India-has-largest-blindpopulation

[9] http://www.myeyeworld.com/files/eyebanks

[10] http://education.rec.ri.cmu.edu/content/electronics/boe/ultrasonicsensor

[11] https://en.wikipedia.org/wiki/Lithium-ion_battery

[12] https://www.dhakatribune.com/