Smart Blind Stick

ELECTRONICS AND COMMUNICATION ENGINEERING

By

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JUNE – 2022

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1. INTRODUCTION:

People who are visually impaired can't identify the smallest detail with their healthy eyes. The people who are considered as blind have visual acuity of 6/60 or the horizontal extent of the visual field with both eyes open is less than or equal to 20 degrees. Worldwide 37 million (approx.) people who are blind where over 15 million people are from India. People with visual disabilities are need of aiding about external assistance which may be provided by humans, trained dogs, or special electronic devices as support systems for higher cognitive process to move on their own independently and safely depending on their other remaining senses.

To enhance the mobility of blind people many techniques have been developed depending on signal processing and senor technology which are classified into two major aspects: infrared signals or ultrasonic signals. Like as radar system, ultrasonic sonar detects the fixed or moving obstacles and the measures the distance between the person and the obstacles using the time of the wave travel. Existing devices are able to detect and recognize objects that emerge on the ground, but a substantial risk is additionally includes the objects that are at a sudden depth, or obstacles above waist level or stairs. Thus we were motivated to develop a **Smart Blind Stick** to beat these limitations.

We decided to change and enhance the walking stick, since blind are only able to detect objects by touch or by stick. When the stick hits an object or falls off of the sting of a stair, the user then becomes alert to the obstacle – sometimes too late. So, to avoid the time gap we added an ultrasonic sensor at specific positions to the stick which will be provided information about the path to the user using vibrator.

a. Literature Review

First, we see and then realize after we recognize the entire situation. Human nature and behaviour most effective rely upon that. But for a seen impaired individual it is performed via his memorising ability. When the character moves into a few new regions in the beginning he attempts to ask approximately every element and get that realisation and maintain that memory. If any element from that locality get out of place it ends up not being possible to discover that. further if the character actions into a few new regions he calls for some resources to direct him to transport ahead through obstacles in his way.

From the literature overview we get there is an avoidance wearable transportable laptop which may be used only for indoor navigation .this may translate the data into special sounds, one sound for free travel and any other for blocking, which became quite hard to distinguish the exceptional sounds. Using an infrared sensor the stick became developed to degree the space which could be very a great deal complicated. Also, the stick has exceptional vibration modes for variety which is hard for a blind character to distinguish the variety easily.

In this documentation we tried to give a solution by designing a prototype hardware.

2. PROBLEM ANALYSIS:

Blindness or visual impairment is a condition of lack of visual perception, which leads to inability to see objects, including light. The person cannot recognise rge size or the distance of the object. They have very little contact with the surroundings. Any physical movement for them is a challenge in itself, it can be difficult for them to distinguish obstacles appearing in front of them. Resulting a social isolation and lack of mobility for these physically challenged people.

3. Implementation of Problem / Methodology :

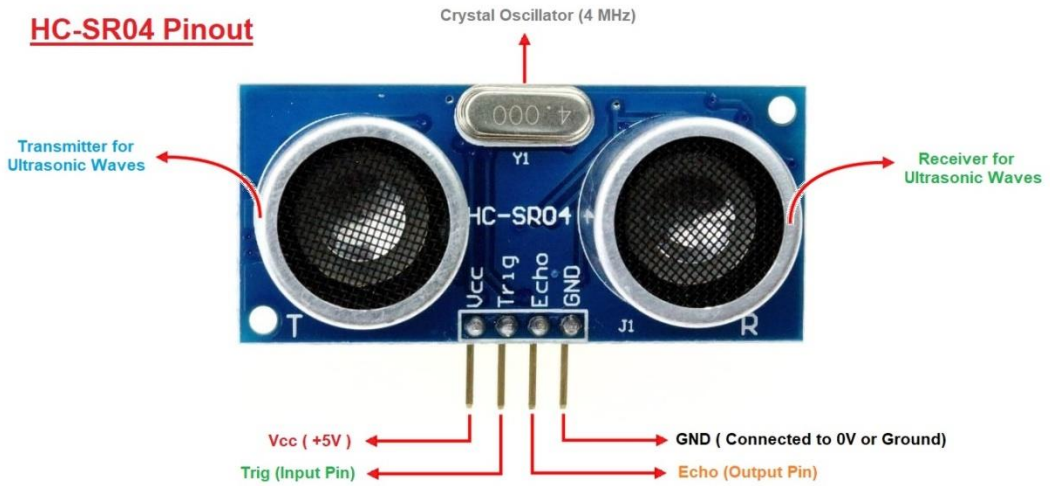
For our project the information about the visually impaired people has been collected throughout every source that leads to our project. All of this information has been used to do our project which is Smart Blind Stick.

In order to conquer the problems withinside the present approach and to offer a cost-effective and user-pleasant device for blind navigation, the subsequent layout is proposed.

a. List of components

- **Ultrasonic Sensor :**

The distance of an object is determined by the HC-SR04 Ultrasonic Sensor using SONAR just like the bats do. It can measure range from 2 cm to 400 cm or 1" to 13 feet with high accuracy .The readings are always stable as we can use it for many applications like Wireless charging, medical ultra sonography, burglar alarms, humidifiers ,non-destructive testing. The only problem is it can find difficulty in detecting cloth, because it is a soft material. But it is not affected by black material or sunlight .The Two main parts of the sensor is Transmitter and receiver where former converts an electric signal to ultrasonic waves while later converts that ultrasonic signals back to electrical signals.it comes with a 4 pin interface and the name of the pins are Vcc, Trigger, Echo, Ground. It mainly works on the sound waves and the distance measurement is very accurate.

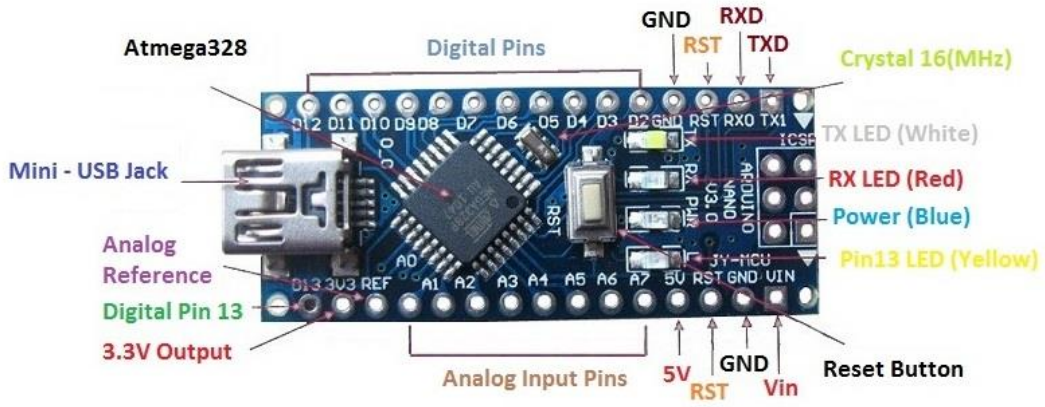


Specifications:

Power Supply	+5V DC
Quiescent Current	<2mA
Working Current	15mA
Effectual Angle	<15°
Ranging Distance	2cm – 400 cm/1″ – 13ft
Resolution	0.3 cm
Measuring Angle	30 degree
Trigger Input Pulse width	10uS
Dimension	45mm x 20mm x 15mm
Accuracy	3mm

- **Arduino NANO :**

For a small, flexible, complete and breadboard friendly Microcontroller Board, then Arduino Nano is the key. It is based on ATmega328p.It contains 30 male I/O headers and is configured by DIP30 style. The pin out of Arduino Nano contains 14 digital pins,8 analog pins,6 power pins and 2 Reset pins.Nano is programmed using Arduino IDE which is an Integrated Development Environment that runs both online and offline. Arduino UNO and Arduino Nano have almost same functionalities because Nano is simply a smaller version of UNO. Arduino Boards are widely used in automation, Internet of things (IoT), robotics, embedded systems and electronics projects.



Arduino Nano

Specifications:

Microcontroller	Atmega328/Atmega168
Operating Voltage	5V
Input Voltage	7-12V
Digital I/O Pins	14
PMW	6 Out of 14 Digital Pins
Max. Current Rating	40mA
USB	Mini
Analog Pins	8
Flash Memory	16KB or 32KB
SRAM	1KB or 2KB
Crystal Oscillator	16 MHz
EEPROM	512byte or 1KB
USART	Yes

- **Buzzer :**

A Buzzer or Piezo Speaker is an audio signalling device which is used to produce sound and you can connect it directly to an Arduino. It is very small and compact 2 pin structure which makes it easy to use on breadboard. It produces sound based on the reverse principle of the piezoelectric effect. It is also less costly and light weighted electronic device that's why it is used in computers, microwave oven, alarm devices, refrigerators, security devices and many more. It can be used by powering it using a DC power supply using a range of 4V to 9V. A 9V simple battery can also be used but the recommended one in a regulated +5V or +6v DC supply.

Specifications:

Rated Voltage	6V DC
Operating Voltage	4-9V DC
Rated current	<30mA
Sound Type	Continuous Beep
Resonant Frequency	~2300 Hz

- **Vibrator motor :**

Vibrator Motors are small devices which are used to develop vibrations. This electric motor having an inequitable mass on its driveshaft changed the generation of vibration. This mini sized DC motor lets the user know sound through its vibrations. The main feature of this motor is its magnet coreless DC motor which is permanent where it means that is possesses its magnetic properties (it performs like magnet when electric current is passed through the device).

Specifications:

Voltage Supply	2.7 - 3.3 V
Rated Speed	12000 rpm
Rated Current	100 mA
Vibration amplitude	0.4 G
Weight	0.7 g
Dimension	8mm (Diameter) & 3.4mm (Length)

- **<u>Connection wire</u> :**

A jump wire (also called jumper, jumper wire, DuPont wire) is an electrical wire with a connector or pin at every finish that interconnects the parts of a breadboard. Jumper wires come in three versions:

1. male-to-male
2. male-to-female
3. female-to-female

The difference between them is at the end point of the wire. The male ends have a pin protruding and can plug into things, while the female ends do not and are used to plug things into. The mostly used Jumper wires are Male-to-male jumper wires for connecting two ports on a breadboard.

Specifications :

Current	4-20 mA
Voltage	12 V
Rated Pressure	25 kPA
Pitch	2.54 mm
Cable Length	20 cm - 8 Inch
Weight	30 gm

- **Battery :**

The 9V battery is a common size of battery. The first time it was introduced is for early transistor radios. The shape of this batter is a rectangular prism with rounded edges and a polarized snap connector at the top. It is commonly used in clocks, smoke detectors, electric guitars, gas detectors, walkie-talkies and effects units. The 9V battery format is commonly available in primary lithium iron disulfide, in rechargeable form in nickel-cadmium, primary carbon-zinc and alkaline chemistry, in primary carbon-zinc and alkaline chemistry and nickel-metal hydride and lithium-ion. Mercury-oxide batteries of this format have not been manufactured in many years because of their mercury content. Designations for this format include NEDA IEC 6F22 or MN1604 6LR61 and 1604. The size, regardless of chemistry, is commonly designated PP3—a designation originally reserved solely for carbon-zinc, or in some countries, E-Block or E.Most 9V alkaline batteries are built with six individual 1.5 V LR61 cells enclosed in a wrapper. These cells are smaller than LR8D425 AAAA cells and can be used in their place for some other devices, even though they are 3.5 mm shorter.

Specifications :

9V Battery Nominal Voltage:	9 Volts
Capacity (Alkaline) ≈	550 mAh
Capacity (Carbon-Zinc) ≈	400 mAh
Capacity (Lithium Primary) ≈	1200 mAh
Capacity (NiMH) ≈	175-300mAh
Operating Temperature:	0°C – 60°C
Length:	17.5 mm
Height:	48.5 mm
Width:	26.5 mm
Chemistry:	Alkaline, Lithium, Carbon-Zinc, NiCd, NiMH, Lithium-Ion

- **Slide switch :**

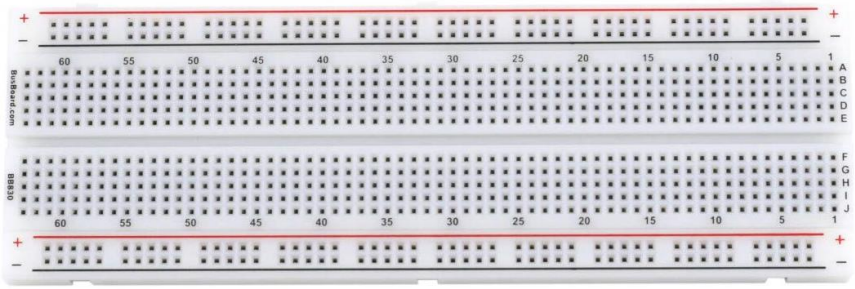
A slide switch is a mechanical switch that slides from open position to closed position and allows control of a circuit's current flow without having to manually cut wire or splice**.** It is a maintained-contact switch in which the switch stays in one state until it's actuated into a new state, where it remains until it's actuated again. Its sizes are miniature, sub miniature, and standard. It is best used to control current flow in small projects. There are many terminal types for slide switches, including wire leads, feed-through style, screw terminals, solder terminals, quick connect or blade terminals, panel mount switches and surface mount technology. The handle of the switch is either flushed or raised, depending on the actuator type. Whether to choose a raised or flush switch depends on the intended application of the switch. Slide switch features include illuminated switches, time delays and pilot lights and wiping contacts.

Specifications :

Contact rating	12 V DC, 200 mA
Contact resistance	<50 mOhms
Insulation resistance	> 100 MOhms at 500 V DC
Dielectric strength	500 V, 50 Hz for the duration of 1 minute
Operating temperature	-10 Degree Celsius to + 60 Degree Celsius
Mechanical life	minimum 5000 operations
Contacts	phosphor bronze, silver-plated
Terminals	brass silver-plated
Contact timing	non-shorting

- **Breadboard :**

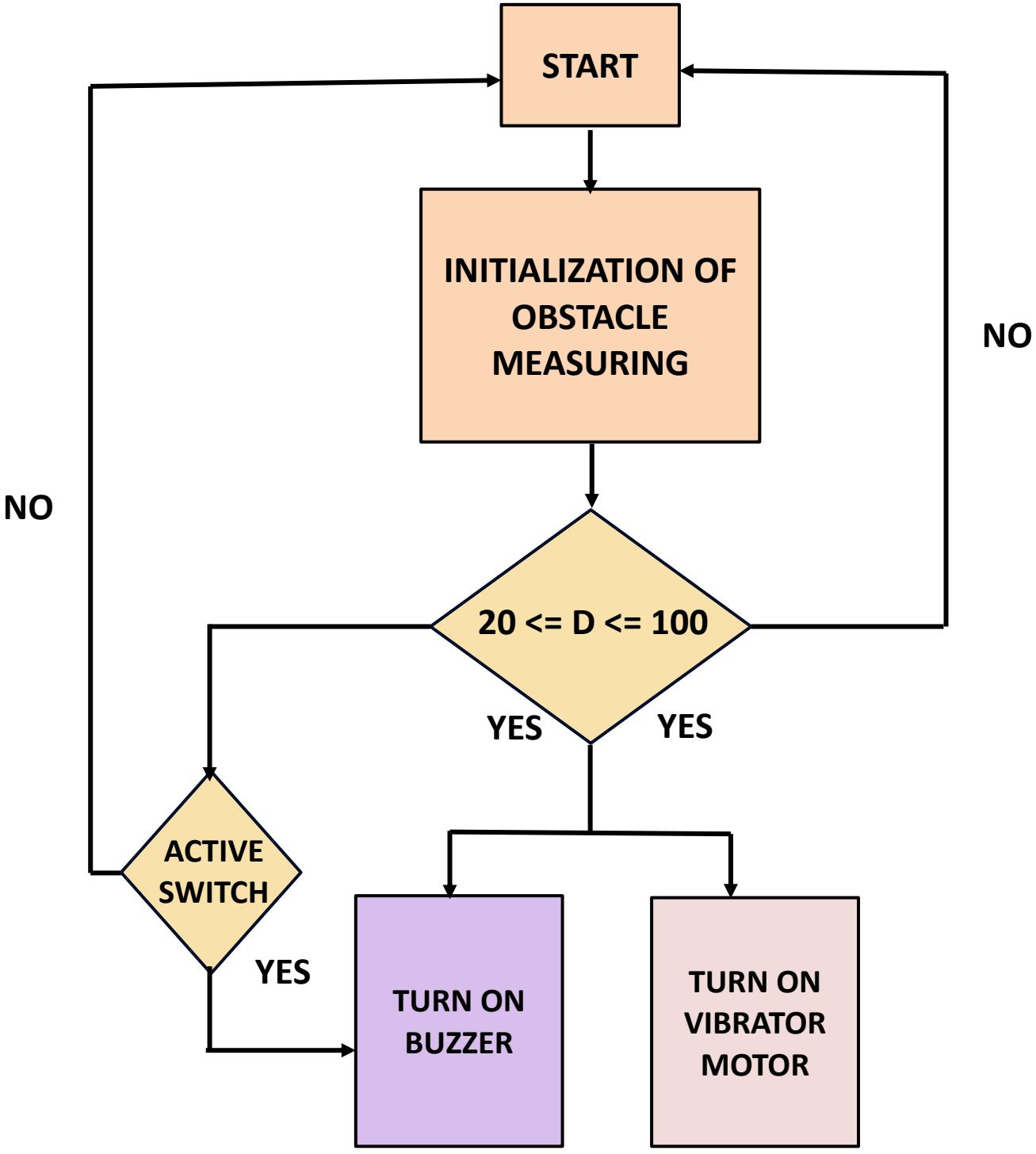
As the name suggests, the term bread-board can be derived from 2 terms specifically bread & board. Initially, this was accustomed to cutting the bread into pieces. Further, it was known as a breadboard & it was employed in physical science and electronic devices within the year 1970. A bread board is additionally referred to as a solder less board as a result of the element used on the breadboard doesn't want any soldering to connect to the board, thus it will be reused. The arrangement of various components on a breadboard can be done by inserting their terminals into the breadboard , therefore it is frequently called a plugboard. Breadboard definition is a plastic board in rectangular form that has tons of little holes in it to permit you to put totally different components to build an electronic circuit called a breadboard. The connection on the breadboard isn't permanent however they can be connected without soldering the components. The material used to create the bread board is white plastic. At present, most of the breadboards are solderless varieties; therefore we will directly enter the components and connect them through an outside power source.



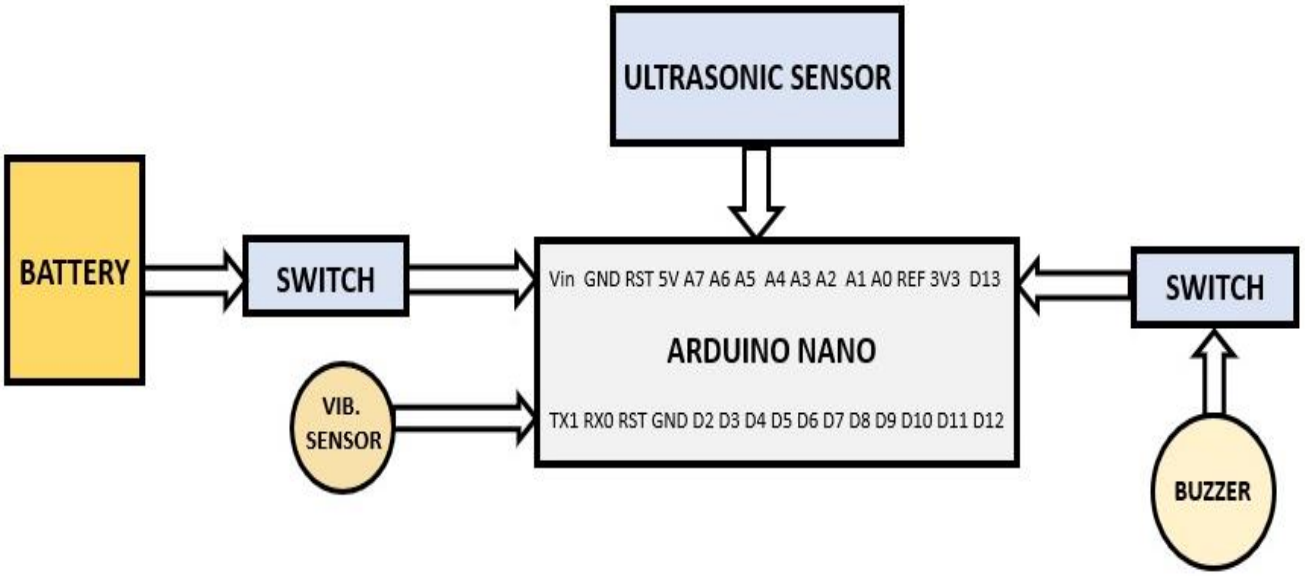
Specifications :

Wire size	21 to 26 AWG wire
Tie Points	Two hundred
Withstanding Voltage	1,000V AC
Tie points within IC	630
Insulation Resistance	DC500V or 500MΩ
Rating	5 Amps

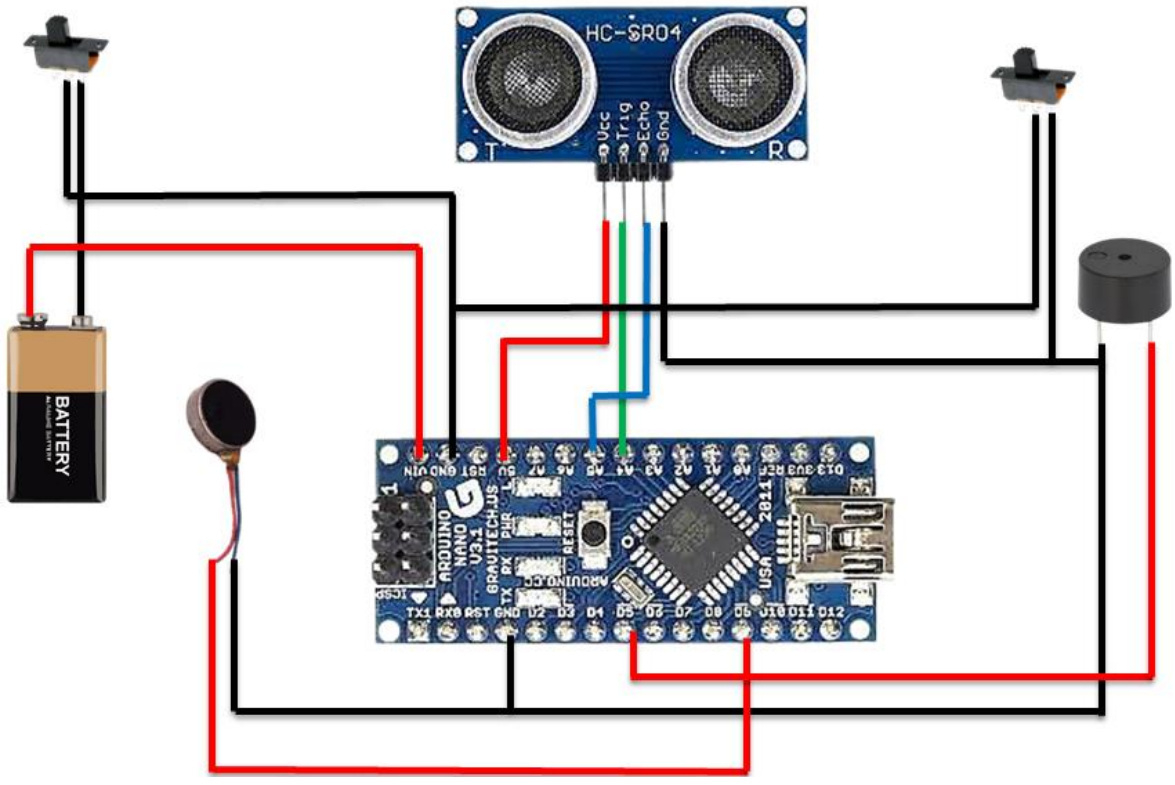
b. Flow chart


START
INITIALIZATION OF OBSTACLE MEASURING
20 <= D <= 100
NO
NO
YES
YES
ACTIVE SWITCH
YES
TURN ON BUZZER
TURN ON VIBRATOR MOTOR

c. Block Diagram

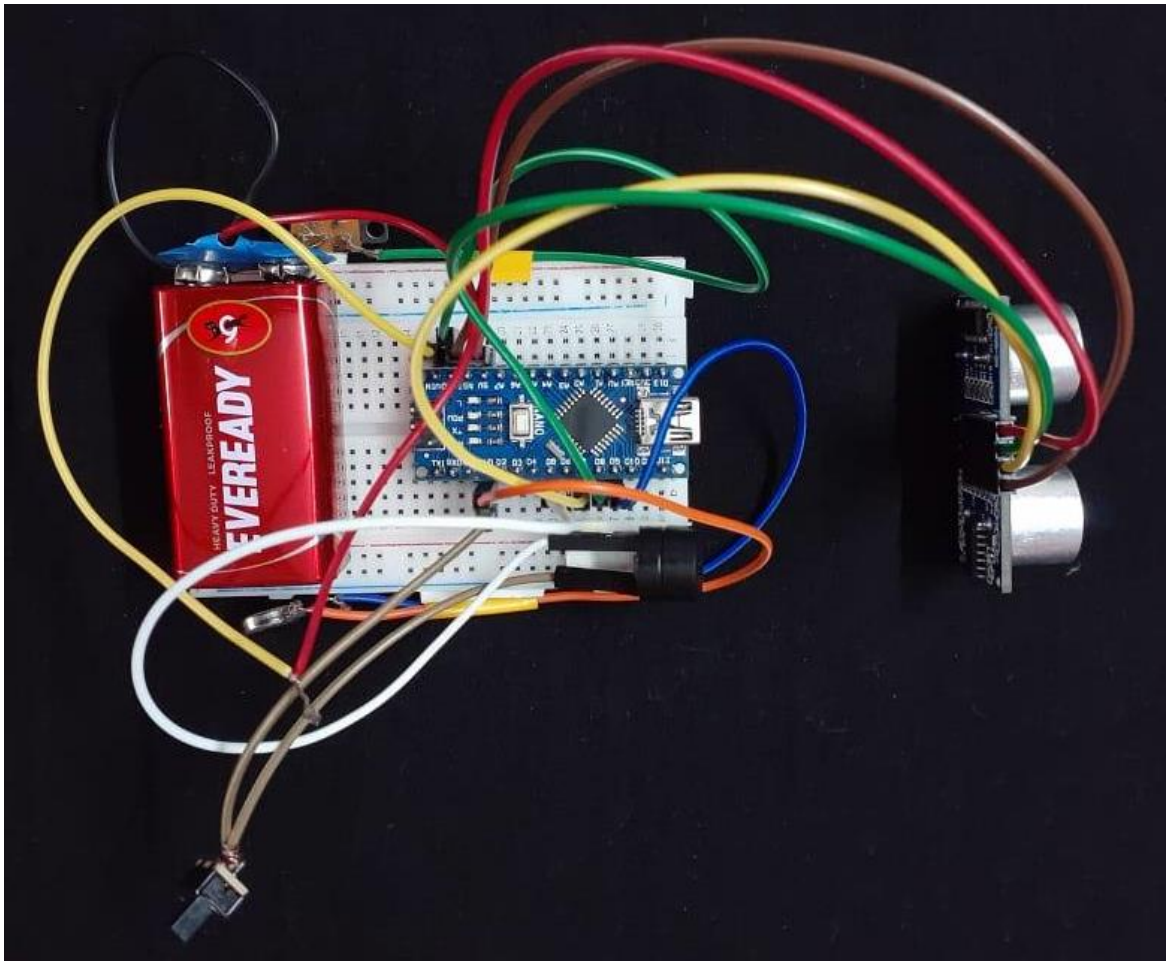


d. Circuit Diagram



e. Final Layout

Hardware Prototype Of Our Project



f. Working Principle

For getting output we have to follow the steps:

step 1. Source code was uploaded to the Arduino NANO microprocessor
step 2. The main switch of the circuit was turned on
step 3. Bring obstacles in front of the Ultrasonic sensor
step 4. Vibrator and buzzer both were activated
step 5. Then turned off the buzzer switch to get only vibrator motor activated. This is an optional switch for the user.
step 6. Finally turned off the main switch of the system

g. Source Code for Arduino NANO

```
// C++ code
#define button1 2 // this button use for only Alarm mode
#define button2 3 // this button use for Alarm & Vibrator mode
#define button3 4 // this button use for only Vibrator mode

#define buzzer 5 // this pin use for Alarm
#define motor  9 // this pin use for Vibrator Motor

#define echopin 7 // echo pin
#define trigpin 8 // Trigger pin

int Alarm=1, Vibrator=1;
int cm; // Duration used to calculate distance

void setup(){ // put your setup code here, to run once
Serial.begin(9600);// initialize serial communication at 9600 bits per second:

pinMode(button1, INPUT_PULLUP);
pinMode(button2, INPUT_PULLUP);
pinMode(button3, INPUT_PULLUP);

pinMode(buzzer, OUTPUT); //declare buzzer as output
pinMode(motor, OUTPUT); //declare vibrator Motor as output

pinMode(trigpin, OUTPUT); // declare ultrasonic sensor Echo pin as input
pinMode(echopin, INPUT);  // declare ultrasonic sensor Trigger pin as Output

delay(100);
}

void loop(){

long duration;

if(digitalRead(button1)==0) Alarm=1, Vibrator=0; //only Alarm mode
if(digitalRead(button2)==0) Alarm=1, Vibrator=1; //Alarm & Vibrator mode
if(digitalRead(button3)==0) Alarm=0, Vibrator=1; //only Vibrator mode

// Write a pulse to the HC-SR04 Trigger Pin
digitalWrite(trigpin, LOW);
delayMicroseconds(2);
```

```
digitalWrite(trigpin, HIGH);
delayMicroseconds(10);
digitalWrite(trigpin, LOW);

// Measure the response from the HC-SR04 Echo Pin
duration = pulseIn (echopin, HIGH);
  // Determine distance from duration
  // Use 343 metres per second as speed of sound
cm = microsecondsToCentimeters(duration);

Serial.print("cm:");Serial.println(cm);

if(cm<=100 && cm>0){
int d = map(cm, 1, 300, 10, 1000);
if(Alarm==1)digitalWrite(buzzer, HIGH);   // Turn on Buzzer
if(Vibrator==1)digitalWrite(motor, HIGH); // Turn on Vibrator
delay(50);
digitalWrite(buzzer, LOW); // Turn off Buzzer
digitalWrite(motor, LOW);  // Turn off Vibrator
delay(d);
}
}
long microsecondsToCentimeters(long microseconds) {
return microseconds / 29 / 2;
}
```

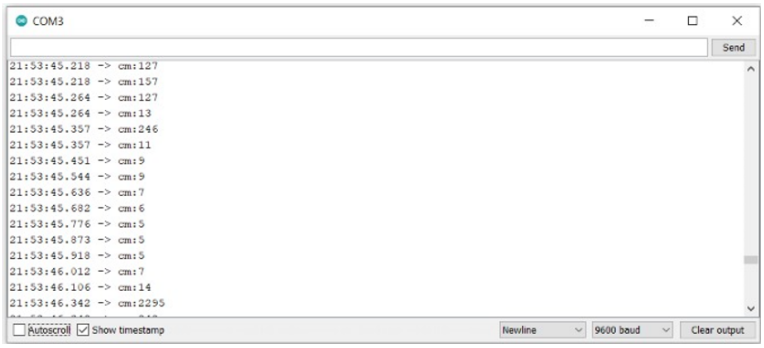
4. SAMPLE OUTPUT :

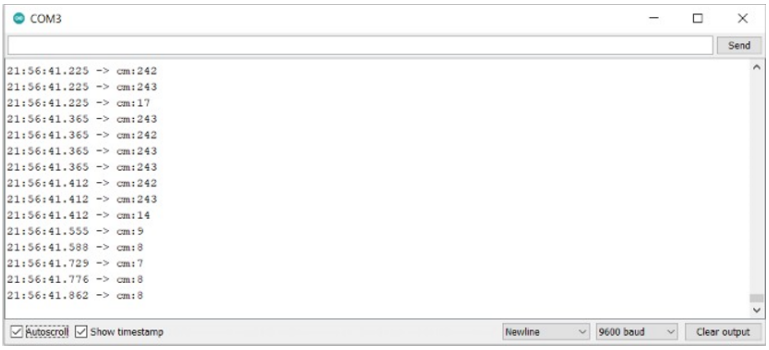
Having designed and programmed the Smart Blind Stick to the required standard, this innovative product worked well. We tested the prototype with certain obstacles, hazard , range and distance and it work successfully as we programed. Analysis about the point of view about the visually impaired person walk at the public.

For getting output we have to follow the step:

1. source code was uploaded to the arduino NANO microprocessor
2. switching on the circuit
3. bring obstacles in front of the Ultrasonic sensor
4. vibrator and buzzer both were activated
5. then switched off the buzzer switch to get only sensor sound
6. finally switched off the main switch to off the system

To know the distance between sensor and obstacles we have to connect the system with laptop or computer using cable. Result outputs (distance) are shown below:





To see the full working demo of Smart Blind Stick please click the link:

https://drive.google.com/file/d/1cX8H32Ch8UYdghRrutozmrWf-65Zv41E/view?usp=sharing

5. FUTURE SCOPE :

1) Low design time.
2) Low production cost.
3) This system is applicable for both the outdoor and indoor environment.
4) Less space.
5) Low power consumption.
6) Easy to use

Future work is going to be centered on enhancing the performance of the system and reducing the load on the user by adding the camera to guide the blind specifically. Pictures acquired by NI-smart cameras and web cameras helps in identification of objects further as scans the complete instances for the presence of a variety of objects within the path of the blind man. It also can detect the shape and material of the object. Matching percentage has got to be nearly all the time correct as there's no probability for correction for a blind man if it is to be reliable and trusty. The principles of the mono pulse radar can be used for finding long range target objects. Another scope may include a new concept of optimum and safe path detection based on neural networks for a blind person.

6. CONCLUSION :

A simple, configurable, cheap, straightforward to handle electronic system is projected to produce constructive assistance and support for blind and visually impaired persons. We have successfully designed, implemented, tested, and verified the system. The results of the system are encouraging; the accuracy in detecting the distance is almost perfect. The results show that the system is unique and efficient in its capability in specifying the distance and source of the objects that may encounter the blind. It is able to scan areas ahead, back, right and left of the blind man no matter its height or depth. The ultrasonic sensor has been fully utilized to advance the mobility of the blind and visually impaired people in safe and independent way. This method doesn't need a large device to be held for an extended distance, and it additionally doesn't need any special coaching. This method also resolves limitations that are associated with most of the movement problems that may influence the blind people in their environment.

7. REFERENCES :

- Software used:

  i. *TinkerCad - online Arduino uno simulator*
  ii. *Arduino IDE*

- Link and books:

  i. *Pooja Sharma, Mrs. Shimi S. L. "Design and Development of Virtual Eye for the Blind", IJIREEICE, Vol. 3, Issue 3, March 2015*
  ii. *https://www.theengineeringprojects.com/2018/10/introduction-to-hc-sr04-ultrasonic-sensor.html*
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8. ACKNOWLEDEMENT :

We would like to express our gratitude to our teacher Saraswati Saha ma'am for mentoring us through this project. Along with that, we would also like to thank our college for constant help and support throughout the project.