Design An Automated Stick For Visually Impaired People For Efficient Road Crossing And Navigation.

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***Abstract*:** Artificial Intelligence is used to make human life safe, easy. It also helps us to reduce human errors in work. Human are replaced with intelligent robots to work in dangerous areas. Similarly it is used to help blind people in day to day life. This system use sensors ,actuators to help blind person for crossing the road. Threshold frequency of vehicles on road is used to indicate whether he can step forward or not. Our paper will provide road crossing feature with efficient strategy with less manual help.

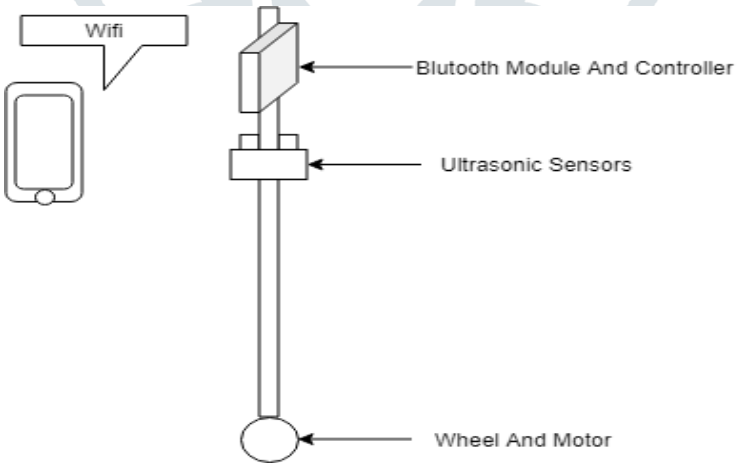
Index Terms: **Threshold frequency, Microcontroller, Sensors, Actuators, Road crossing techniques**

I. INTRODUCTION

Technology has considered boon for human being survival at some extent. Day to Day life activities are mostly dependent on various technological activities. Not only Normal being but physically challenged and visually impaired people are living their life as a normal due to technology at some extent. For an instance various technologies and smart digital components has been arised and being used by visually impaired in day to day activities. The basic tools used previously were like walking cane and guide dogs and kindness of fellow commutators. Moreover, Blind stick is a tool still in use and is being proving a great ease for visually impaired persons for their locomotion. Existing system ha many facilities like, Buzzer help from surrounding ,Android app feedback system, GPS system, Obstacle detection system in which many complex detection object algorithms have been developed and are giving accuracy ranging from 50-90%. But it is not providing efficiency of locomotion to blind people. Blind person is still in fear of crossing road and thus depends on a other person to cross a road. To make a above problem easy to some extent our proposed system is showing road crossing techniques and algorithms.

Our system use sensors for detection of vehicles from all directions and its frequency. The threshold concept is been used for an ease. If frequency of the vehicles is greater than threshold ,person may not step forward to cross a road and vice a versa.

Thus Our objective is a very important and complex feature in a blind stick which will be inexpensive and will prove effortless in navigation of a blind person.



Fig(1): Structure of Smart Stick

II. LITERATURE REVIEW

1. **A Hybrid Approach for identification of Manhole and Staircase to Assist Visually Challenged. (2018)**

A prototype is developed using Arduino kit along with feature detection module based on(BGMM) Bivariate Gaussian Mixture Model and SURF algorithm and helps in efficient obstacle detection (such as manhole and staircase).

2. **Blind Aid Stick : Hurdle Recognition ,Simulated perception ,Android Integrated voice based cooperation via GPS along with Panic Alert System. (2017)**

This paper uses IR sensors along with Ultrasonic range finder circuit for hurdle detection. Bluetooth module along with GPS technology and Android application for Blind ,will provide voice assistance to desired location and in panic situations will send SMS alert to register mobile number.

3. **Intelligent Ultrasonic Detection of Walking Stick for the Blind. (2017)**

This paper uses ultrasonic sensors for obstacle detection and angular sensor and stepper motor is used to adjust direction of this sensors. Bluetooth voice signal is used to call for help if blind person falls down . Also GPS and 4G terminal used to give the regular updates of location to his family.

4. **Arduino based automated stick guide for a visually impaired person. (2017)**

It consists of Global Positioning System(GPS) and a Global System for mobile communication (GSM) modules along with sensors like ultrasonic and infrared sensors. This is smart stick that will make the visually impaired persons guiding their way.

5. **Smart walking stick for visually impaired people using ultrasonic sensors and Arduino (2017)**

It is low cost and light weight system design with microcontroller that processes and alerts the visually impaired person over any obstacle and water or dark areas through beeping sounds.

III. SYSTEM ARCHITECTURE OVERVIEW

A. THRESHOLD FREQUENCY CALCULATION SYSTEM ARCHITECTURE

Every time when blind people wants to cross the road it checks for the frequency of vehicles on the road. Then the observed frequency is compared with threshold frequency to go. This threshold value is calculated using experiments. Using sensors frequency of vehicles from heavy traffic road, medium traffic road, slow traffic road is stored. That data is analyzed and threshold frequency is calculated. This threshold frequency is equal to the minimum safe frequency to go.

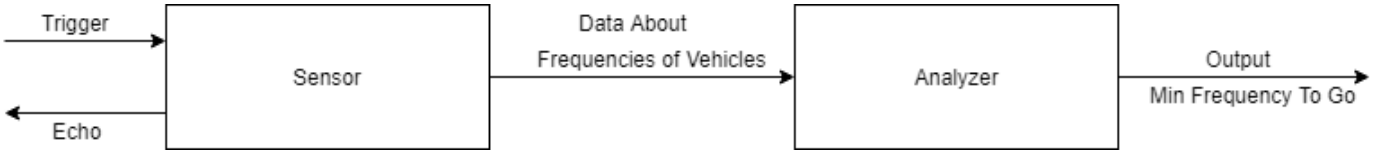


Fig.(2)

B.SMART STICK SYSTEM ARCHITECTURE

This system uses three sensors i.e. front sensor, left sensor, right sensor, microcontroller and actuator. Sensors are used to sense the vehicle frequency on the road. Then data is passed to microcontroller. Microcontroller process the data and that data is compared with the threshold values. If it matches to the criteria then microcontroller passes go signal to actuator and if it does not satisfies the criteria then do not go signal is passed to the actuator. The system architecture is as follow

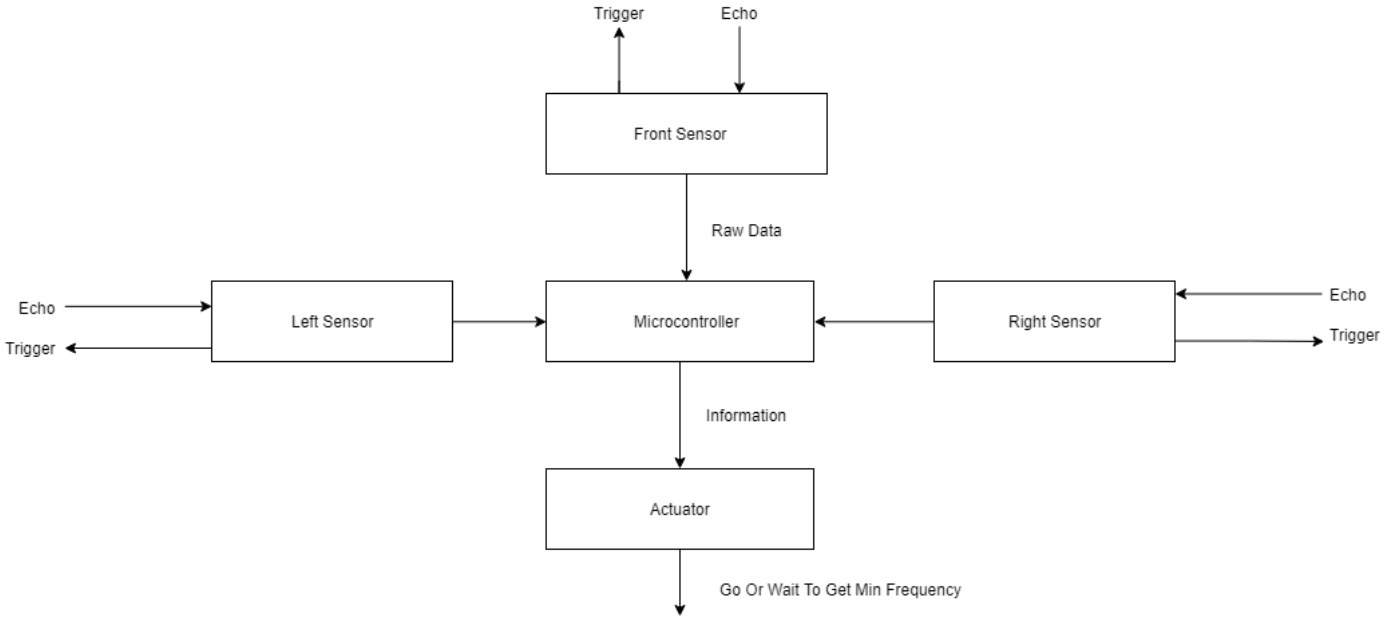


Fig.(3)

IV. SYSTEM ALGORITHM

1. Start.
2. Sense frequency on the road from front sensor. Pass that data to microcontroller.
3. If observed frequency is less than or equal to threshold frequency then
   start walking slowly and start sensing from left and right sensors.
   Else wait for safe frequency signals.
4. From data took from left and right sensor calculate distance of arriving vehicles toward the person.
   If the distance is greater than or equal to one then continue walking
   Else wait till the vehicle goes away from the person.
5. End.

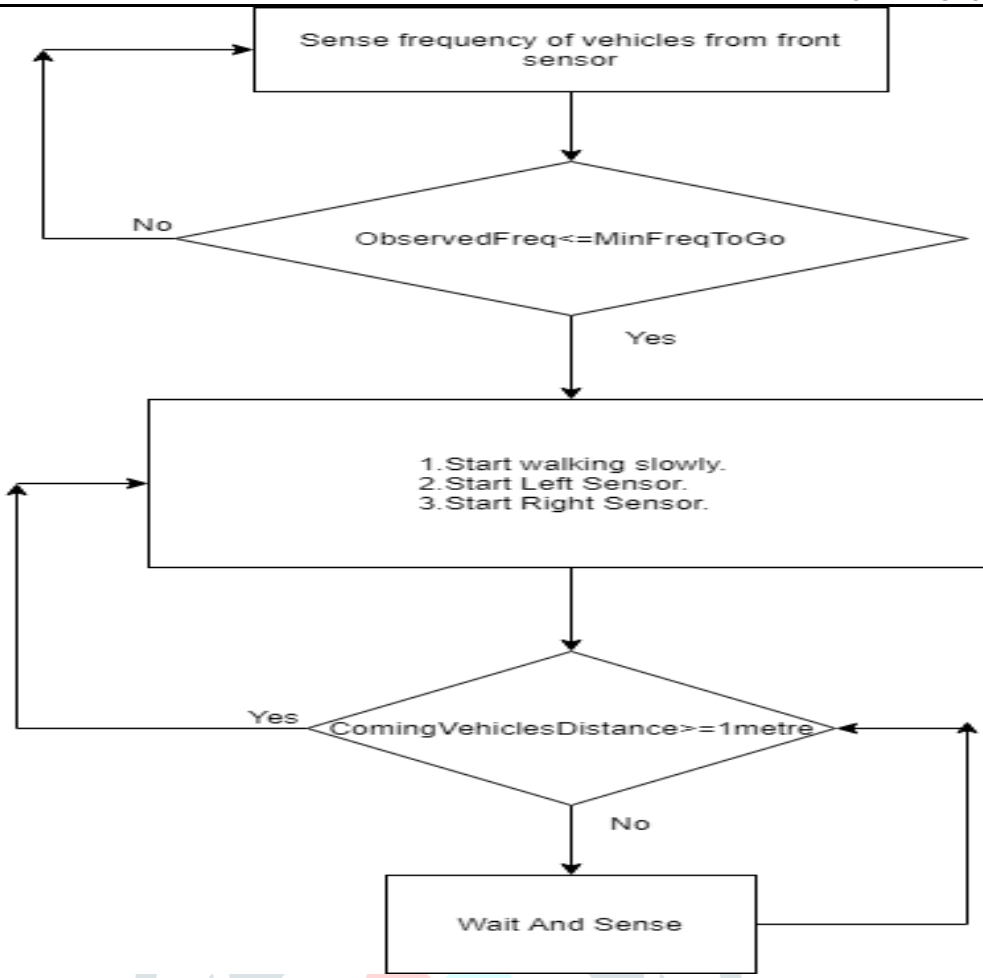


Fig.(4)

V. PROJECT IMPLEMENTATION

1. Tools and Technologies used:

1.1 Arduino IDE

It is used to develop Arduino code and simulate it. It uses C/C++ Libraries.

1.2 MIT APP INVENTOR

It is used for creating android applications.

It uses Graphical user interface and allows user the drag and drop visual objects to create an application that can run on android devices.

1.3 Draw.io and Circuito.io

These online websites are used to simulate and draw circuit diagrams and various case study diagrams.

2. Steps of Implementation :

2.1 Circuit Diagram :

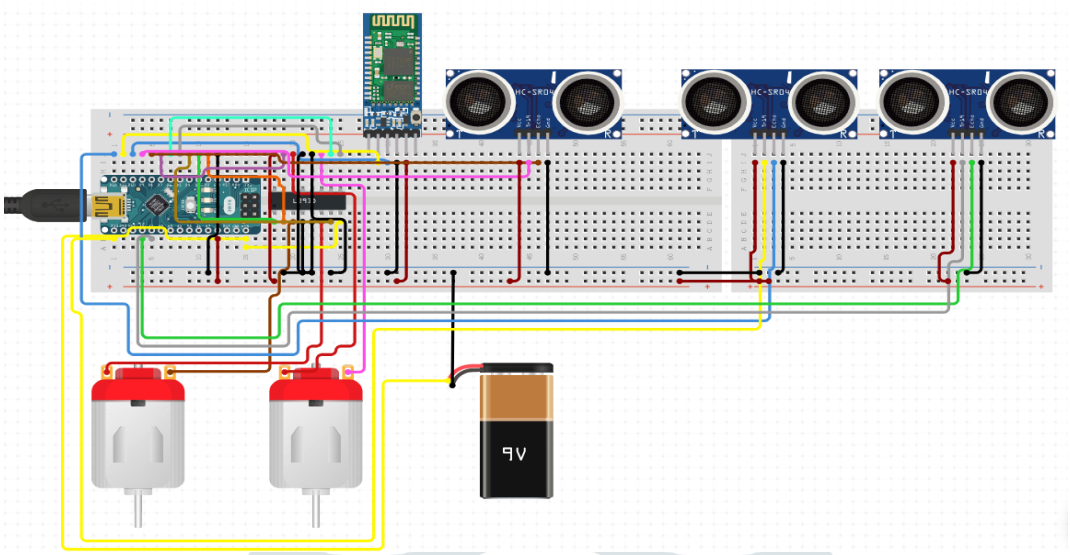


Fig (5)

2.2 Pin Configuration details:

2.2.1 Front Ultrasonic sensors

Device Pin	Arduino Nano Pin
Trigger	D11
Echo	D12
VCC	VCC
GND	GND

2.2.2 Left Ultrasonic sensors

Device Pin	Arduino Nano Pin
Trigger	D08
Echo	D09
VCC	VCC
GND	GND

2.2.3 Right Ultrasonic sensors

Device Pin	Arduino Nano Pin
Trigger	D04
Echo	D07
VCC	VCC
GND	GND

2.2.4 Motor Driver

Device Pin	Arduino Nano Pin
Motor1 Pin 1	D05
Motor1 Pin 2	D06
Motor2 Pin 1	D10
Motor2 Pin 2	D13
VCC	VCC
GND	GND

2.2.5 Bluetooth(HC05)

Device Pin	Arduino Nano Pin
Rx	D03
Tx	D02
VCC	VCC
GND	GND

2.3 Logic to instruct the stick

1.1 Initialization of all Pin configuration of all devices.
1.2 Setup Pin Modes using setup()
1.3 Start looping function for continuously reading data from front sensor.
If there is no continuous obstacle detection, person is instructed to start walking.
1.4 If person is allowed to proceed, left and right sensors start working. They check for safe distance
And instruct to person either stop or continue walking.

2.4 Compile and upload the Arduino code into Arduino Nano.

2.5 Create Android App

6.1 Android logic is build using a MIT App Inventor.

MIT App Inventor is an intuitive, visual programming environment that allows everyone – even children – to build fully functional apps for smartphones and tablets. Those new to MIT App Inventor can have a simple first app up and running in less than 30 minutes. And what's more, our blocks-based tool facilitates the creation of complex, high-impact apps in significantly less time than traditional programming environments. The MIT App Inventor project seeks to democratize software development by empowering all people, especially young people, to move from technology consumption to technology creation.

a. It uses Graphical user interface and allows user the drag and drop visual objects to create an application that can run on android devices.
b. In this MIT APP Inventor, Block platform creating logic of Bluetooth connection and taking readings of data from Arduino and ultrasonic sensors and write on the app screen.

3. Testing :

3.1 Hardware Unit Testing :

Front Sensor connection testing:

1.Connections are established.
2.Input has given to trigger pin.
3.Output is read on Arduino via echo pin.
4. Actual distance and expected distance is verified.

Left Sensor connection testing:

1.Connections are established.
2.Input has given to trigger pin.
3.Output is read on Arduino via echo pin.
4. Actual distance and expected distance is verified.

Right Sensor connection testing:

1.Connections are established.
2.Input has given to trigger pin.
3.Output is read on Arduino via echo pin.
4. Actual distance and expected distance is verified.

Motors connection testing:

1. Connections are established.
2.Input is given to the input pins.
3. Wheels are checked for motion.

Bluetooth connection testing:

1. Bluetooth is connected to Arduino Nano.
2.Successful establishment of Bluetooth to android app is checked.
3. Successful data transferring from Arduino to android app via Bluetooth and vice versa.

3.2 Integrated hardware testing

All unit hardware are assembled and checked whether their performance is retained as pervious unit testing performance
.

3.3 Software Unit testing

1. Android phone and Bluetooth connection accessibility.
2. After successful Bluetooth connection Bluetooth read and write operations are tested.
3. Checking functions used in Arduino IDE executing in efficient manner or not.
4. Checking whether readings of sensors are appropriately displayed on serial monitor or not .
5. Checking whether android phone gives appropriate voice feedback on detecting obstacle.

3.4 System Testing

3.4.1 Heavy Traffic Detection :

In case of heavy traffic, continue obstacle detection will take place. It is checked for whether voice message giving stop message as per the expectation or not.

3.4.2 Safe Distance Detection :

In case of low or medium traffic, person will start walking. In this case obstacles distance from left and right sight are observed. In case of coming vehicle is not in safe distance (not within 1 Km) , expected message is stop and wait. In case of coming vehicle is in safe distance (1 Km) , expected message is continue walking .

4. MATHEMATICAL MODEL

This system's mathematical module can be represented using following information.

Let X is set of heavy traffic frequencies. Y be the set of medium traffic frequencies, Z be the set of low traffic frequencies and O be the set outputs obtain from actuator to blind person.

$X=\{x_1,x_2,x_3,.....,x_n\}$

$Y=\{y_1,y_2,y_3,.....,y_m\}$

$Z=\{z_1,z_2,z_3,.....,z_l\}$

$O=\{Go, Stop\}$

thresholdFrequency= SUM $(y_1,y_2,y_3,.....,y_m)/m$

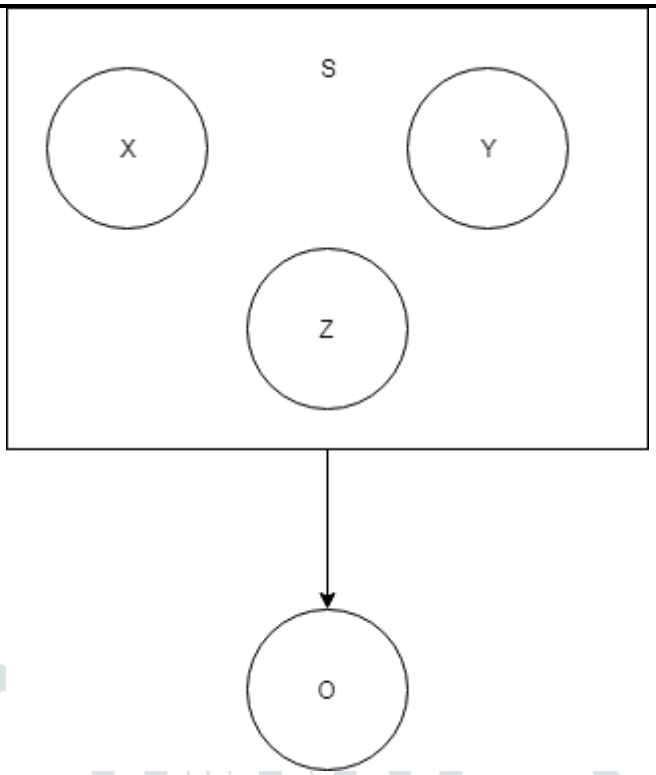
$S=\{a|\ a \in X \text{ or } a \in Y \text{ or } a \in Z\}$

$f(a)=\{r|r \in O\}$

f(a)=Go a<=thresholdFrequency

f(a)=Stop a>thresholdFrequency

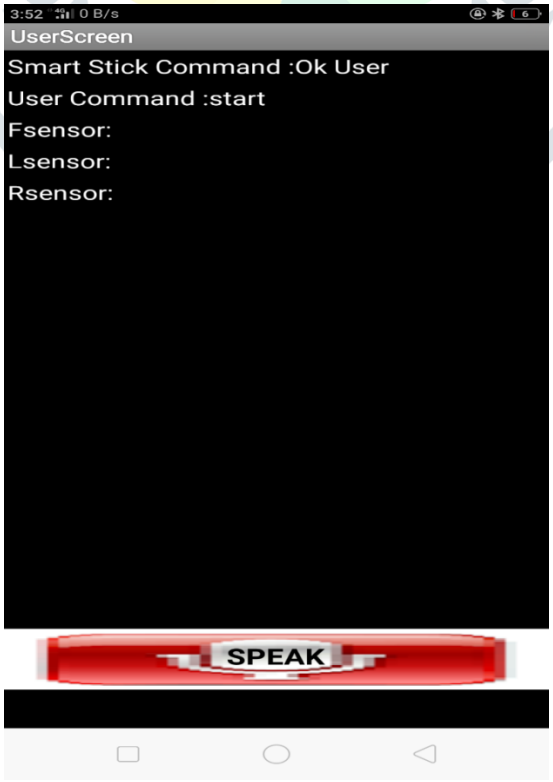
Venn Diagram of the mathematical module is



Fig(6)

5. OUTPUTS AND RESULTS:

5.1 Android Front end user layout.



VI. CONCLUSION

This paper has proposed a blind stick with a new feature. Building a smart stick having a road crossing technique has been achieved. It consists of a sensors and Micro Processing Unit. It works on threshold concept. It first assures the blind person the frequency rate of the vehicles and thus stepping him \her forward for road crossing. Our system has achieved accuracy up to 50-70%.

This can be extended by improving its accuracy. An adequate system can be built without any need of the navigation aid.

VII. ACKNOWLEDEGMENT

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