ISSN XXXX XXXX © 2018 IJESC

Research Article Volume 8 Issue No.4

Smart Assistive Shoes and Cane: Solemates for the Blind People

S.D. Asha Mahesh[1], K..Raj Supriya[2], M.V.S.S.N.K.Pushpa Latha[3], P.Gowri[4], T.Sonia[5], B. Nani[6]
Assistant Professor[1], B.Tech Student[2, 3,4,5,6]
Department of EEE
Chaitanya Engineering College, Andhra Pradesh, India

Abstract:
The main objective of this project is to provide an acoustic assistance to the blind people and also to deal with the problems faced by them to walk like the normal human beings. Thus, the project aims to develop a device that would serve as a guiding assistance to them. The paper focuses on designing a device for visual impaired (or blind) people that would help them to travel independently and also with more ease. One of the biggest problems that the visual impaired ones face is while travelling because when they walk in the indoors and outdoors they are not well aware of information about their location and orientation with respect to traffic and obstacles on their way unlike the normal beings. The technology proposed in the paper serves as a solution for visual impaired people. The project consists of the smart shoes and the smart cane (stick) that alerts visually-impaired people over obstacles coming between their ways and could help them in walking with less collision. The main aim of this paper is to address a reliable solution encompassing of a cane and a shoe that could communicate with the users through voice alert and pre-recorded messages

Keywords: Arduino Nano, Vibrating motor, IR Sensors, Ultrasonic Sensors, Buzzer.

1. INTRODUCTION

Blindness, low vision, visual impairment and vision loss have dramatic impacts on individuals experiencing such disabilities. These carry with them physiological, psychological, social, and economic outcomes, hence impacting the quality of life and depriving such individuals from performing many of the Activities of Daily Living (ADL), the most crucial of which is navigation and mobility. Blindness is a qualitative term that describes the clinical condition whereby individuals have no light perception as a result of total vision loss. Blindness also refers to those who have so little vision that they have to rely predominantly on other senses as vision substitution skills. On the other hand, visual impairments is a qualitative term used when the condition of vision loss is characterized by a loss of visual functions at the organ level, such as the loss of visual acuity or the loss of visual field. This project presents a prototype model and a system concept to provide a smart electronic aid for blind people.

This system is intended to provide overall measures object detection, and send information related to blind people. The system consists of microcontroller, ultrasonic sensor, and a vibratory circuit. This project aims at the development of an Electronic Travelling Aid (ETA) kit to help the blind people to find obstacle free path. This ETA is fixed to the shoe. When the object is detected near to the shoe alerts them with the help of vibratory circuit and also in advancement with help of speakers or head phones that is voice command with the help of android application. Here the power supply is main criteria the shoe is integrated with self-power generation unit such that there is no power backup problem

II. LITERATURE SURVEY

In 2001, Gemperle F, et al proposed that "Most of the assistive devices for the blind that exploit touch as the substitution sense are tactile displays for the fingertips and palms. Typical tactile displays involve arrays of vibrators or upward/downward moveable pins nas skin indentation mechanisms. The bandage-sized tactile display is an innovative touch stimulation device based on EAP soft actuator technology. It is soft and flexible and can to be wrapped around the finger like a band-aid. This new wearable display could be used as a Braille display or as a multi-purpose tactile display to convey visual information to the blind". [3]

In 2006 Shinohara said "Smart cane is one of the creations which was the origination of the technique required to help blind people equipped with some sensors." This comprises of ultrasonic sensors and servo motors to navigate visually impaired people. [4]

In July, 2011,Mohd Helmy and Abd Wahab proposed, "The technology can help in reducing many barriers that people with disabilities face. These kinds of technologies are referred to as assistive technology (AT). Different kind of disabilities can be cured by an AT such as hearing aid or blindness however their major limitation is their highly expensive rates.

The main problem with the blind people is the loss of their physical integrity. They do not have confidence in themselves. This statement has been proven in which an experiment name "Project Prakash" has been carried out. It was intended attesting the visually-impaired to utilize their brain to identify set of objects. This can also be applied to different situation". [5]

In 2013, Harshad Girish Lele, et al, said that technology can remove the barriers between the humans and their illness. There are various methods to measure the distance between the obstacles and overcome the problem of blind people. One of the methods is the use of ultrasonic sensors in the shoe implemented in the form of an array around the sole. [6]

In 2012, M. Nassih, quoted thatthe smart stick for the blind people can also use the technique of RFID (RadioFrequency Identification)to detect the objects or the obstacles in front of user.

This invention is just like a simple stick used by blind people but equipped with a bag also. This bag provides electricity supply and indicates user by the speaker. However there were some limitations. [7]

In 2013 Alshbatat and Abdel Ilah Nour cited "As per this paper, it gives importance to the stick used by the blind people. The guide cane is designed to navigate visually impaired ones. This guide cane is somewhat heavier than the white cane." [8]

In 2012 Muhsin Asaad H., et al, under this paper, the technology upgraded to one step more. The cane is able to detect above the knee level upto the 2 or 3 feet. When an obstacle is detected, this stick vibrates or makes a sound. [9]

In 2015 Syed Tehzeeb Alam said that related to the guide cane there was also a smart cane invented with almost same configurations. This cane uses ultrasonic sensors and the servomotors to detect the obstacles.

There is a microcontroller inside the cane which will work on the received instructions like right, left, straight etc. However this system also has some limitations like it not easy to handle and requires large area or space to be placed because they cannot be folded. Additionally this cane, due to the large number of ultrasonic sensors and servomotors, is very expensive. So every blind person cannot afford it. [10] From the above survey it was depicted that following were the loopholes in the conventional technologies invented for the blind persons:

- There are many models that already have been made and have been implemented for helping the visual impaired people that help them in walking on the roads approximately equal tothat of normal one.

- The existing technology does consists of the smart shoes and the smart stick. These technologies have been built up but are implemented separately i.e. shoes and stick separately [11]. Yet they fail to serve the basic purpose of providing them the tools they can carry with ease and without absolute no embarrassment.

- One of the major limitations of these existing technologies is that these technologies are expensive. And also causes implementation problems when acquired in the real world [12].

III. CIRCUIT OPERATION:

AIM: The project consists of the smart shoes and the smart cane (stick) that alerts visually-impaired people over obstacles coming between their ways and could help them in walking with less collision.

The main aim of this paper is to address a reliable solution encompassing of a cane and a shoe that could communicate with the users through voice alert and pre-recorded messages .

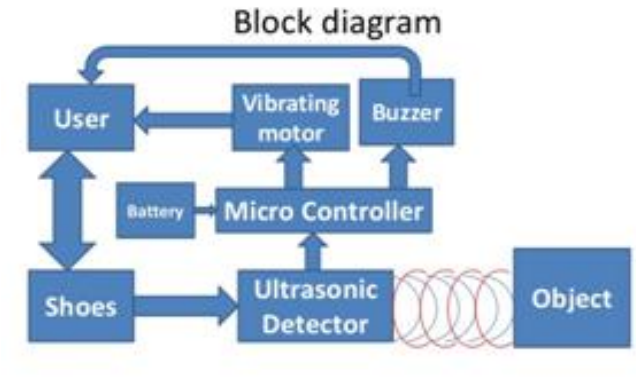


Figure.1.Block diagram Smart Assistive Shoe for Blind people

WORKING:
It is the primary part of the whole system . It consists of 2 IR sensors, one for right direction and other for the front direction. It measures the ground level. The IR sensors continuously works or we can say they results in IR wave continuously. When any obstacle comes in front of these IR sensors then the IR waves gets reflected back from the obstacle and come back to the sensor again which result in some different action in the sensor or we may say any obstacle is front of it. The analog signal reflected back is converted in to digital one by sensor which is then compiled by the processor of shoe to check from which direction it came. After compiling, the processor sends it to the stick via Bluetooth which is further processed by the processor. According to it the pre-recorded voice message is buzzed through the speaker.

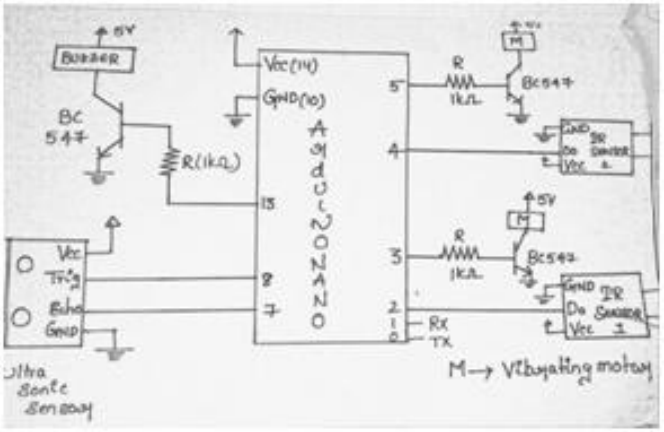


Figure.2. Circuit Diagram for Shoe

IV. PROPOSED IDEA

 To overcome the above defined limitation of the existing technology for the visual impaired people, we have modified the usage of this technology and results in the integration of both shoes and stick resulting in single unit or as a single equipment known as "Smart Assistive Shoes and Cane".

 Under this technology, we have combined both shoes and cane and are connected with each other via Bluetooth technology to act as a single system and enhanced the existing technology. This technology solves the minor problems that were arising due to the usage of the single module only. [13]

The proposed idea consists of two modules:
 Shoe Module (Auxiliary Module)
 Cane Module (Primary Module)

The above stated process is done for each and every IR sensor connected to the module and the voltage levels depending upon the status ofthe IR sensor are transmitted to the micro-controller and as per the data collected an appropriate acoustic feedback signals is generated thus, alertingthe blind person about the surroundings. This whole process also takes some delay to confirm that accuracy of polling of sensors and after that small delay period provides the acoustic feedback.

The acoustic feedback can be:

- "Front IR detected" if the obstacle is in the front of the user
- "Right IR detected" if the obstacle is on the right side of the user

We are not using left IR sensor in shoe because right leg of user will work as obstacle for it. So we will use left IR sensor on cane. There would a rechargeable battery connected to the shoe module for the proper functioning of the modules

V. HARDWARE COMPONENTS

The proposed idea for the integration of two modules into a single unit comprises of following hardware components:

- Arduino Nano (ATMEGA328)
- Arduino Lily (ATMEGA328)
- IR sensors (IR323/H0-A)
- Ultrasonic sensors (HC-SR04)
- Bluetooth voice recorder
- Bluetooth module (HC-05)
- Rechargeable Battery (4000mAh)
- Battery Charger (TP4056)
- Voltage convertor (XL6009)

VI. Detailed Description of the Proposed Idea

The proposed idea comprises of 2 modules which are integrated together to form as a single device or unit. The detailed description of both modules is as follows:-

a) Shoe Module

The shoe module is the secondary module which measures the ground level hurdles and indicates about the presence of objects by sending commands to the cane module. The block diagram of the shoe module is shown in the figure 3.

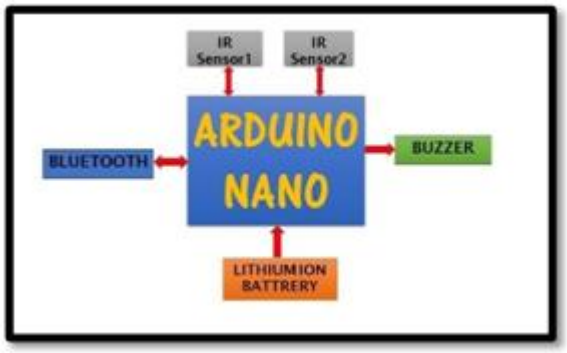


Figure.3. Block diagram of Shoe Module

The block diagram comprises of following blocks:

a) **IR Sensor1:** This is the first sensor which detects the presence of the obstacles in the front direction and sends the command to the controller for the detection of object in the front direction.

b) **IR Sensor2:** This is the first sensor which detects the presence of the obstacles in the
right direction and sends the command to the controller for the detection of object in the right direction.

c) **Arduino Nano:** This is the main controller of the shoe module which receives the command from both the sensorsand gives command to the speaker as per signal received.

d) **Bluetooth Module**: This device is used to interconnect both the modules via Bluetooth wireless technology. Due to this interconnection, both have communication of signals to execute commands.

e) **Voltage Convertor:** This electronic device is used to convert the voltage obtained from the battery (3.7 V) to the voltage required to run the device (5.0 V).

f) **Rechargeable battery:** It is a battery used in the protocol so that continuous power can be delivered to the controller to be in active state. It can be recharged again and again by the simple mobile charger.

Working

- It is the primary part of the whole system or protocol. It consists of 2 IR sensors, one for right direction and other for the front direction. It measures the ground level.
- The IR sensors continuously works or we can say they results in IR
wavecontinuously. When any obstacle comes in front of these IR sensors then the IR waves gets reflected back from the obstacle and come back to the sensor again which result in some different action in the sensor or we may say any obstacle is front of it.
- The analog signal reflected back is converted in to digital one by sensor
which is then compiled by the processor of shoe to check from which direction it came. After compiling, the processor sends it to the stick via Bluetooth which is further processed by the processor. According to it the pre-recorded voice message is buzzed through the speaker

Module realization

Figure .5. Hardware realization of Shoe Module

The above Figure 5 shows the practical realization of the shoe module that comprises of the various electronic modules inter-connected with each other as per block diagram and the circuit diagram.

Hardware Verification

For the physical or the hardware verification of the circuit proposed the whole shoe module was implemented on a bread board and the result of the obstacle detection was taken on an android app. The idea of the hardware verification can be easily understood by the following flowchart shown in the figure

DESCRIPTION FOR CANE:

The above figure (Figure 8) i.e., cane module, is the primary unit as compared with the shoe part

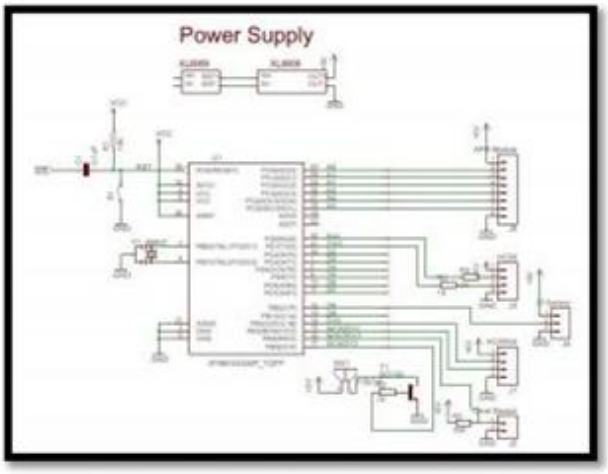


Figure.6. Circuit diagram of Cane Module

and primarily function for detecting obstacles above the knee level and collecting the information from an IR sensor along with an ultrasonic sensor connected and transferring the information gathered so that the primary objective of the design can be fulfilled i.e., the blind person or the visually impaired person gets to know about the obstacle through a speech output.

1.4 Working :

The working of this cane module is divided into 2 phases:

Phase 1:After receiving the input from the shoe module ultrasonic, the Arduino nano receives the input, decodes it and selects the appropriate signals (front and right direction) and commands to the speaker which give the indication to the user of the obstacle in the respective direction with help of buzzer.

Phase 2: The other phase of the input reception is by the left sensor and the ultrasonic sensor above the knee level. The Arduino nano controller receives the input from the above sensors, executes and decode it and again select the appropriate saved voice messages (left and above the knee) and commands to the speaker which give the indication to the user of the obstacle in the respective direction. The other function of the cane module is to prevent the shoe module from water. For this, a water prevention circuit has been implemented at the bottom of the cane module. The water prevention circuit gets completed when it comes in contact with water and thus sends a command to the Arduino Lily which executes it and select the command for the water prevention.

ARDUINO

Arduino is common term for a software company, project, and user community, that designs and manufactures computer open-source hardware, open-source and microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can interface to various expansion boards (termed shields) and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a languages C and C++. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits. The hardware design specifications are openly available, allowing the Arduino boards to be produced by anyone. Adafruit Industries estimated in mid-2011 that over 300,000 official Arduinos had been commercially produced, and in 2013 that 700,000 official boards were in users' hands.

Figure.7. Arduino Nano

ARDUINO NANO:

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x) or ATmega168 (Arduino Nano 2.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.The Arduino Nano can be powered via the Mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). The power source is automatically selected to the highest voltage source.

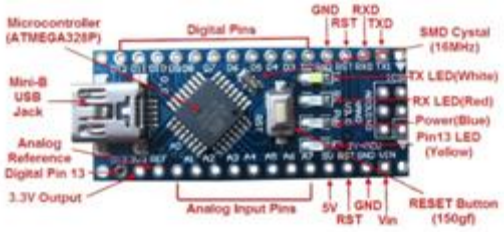


Figure.8. Parts of Arduino Nano

Difference between uno and nano

As its name, Arduino Nano is a compact and breadboard-friendly version board based on ATmega328 processor. It is more or less same functionality as the Arduino UNO but in different package. Instead of using the standard USB to connect to the computer, it uses the mini usb but without the power plug for external power source that built on Arduino UNO. The dimension of Arduino Nano is only 43mm x 18mm, it comes with 6 PWM I/O from the total of 14 digitals I/O, 8 analog inputs, 16Mhz clock speed and 32kB of flash memory

3. APPLICATIONS

- Arduboy, a handheld game console based on Arduino
- Arduino Motion Control Rig
- Arduinome, a MIDI controller device that mimics the Monome
- ArduinoPhone, a do-it-yourself cell phone
- Ardupilot, drone software and hardware
- ArduSat, a cubesat based on Arduino.
- Automatic titration system based on Arduino and stepper motor
- C-STEM Studio, a platform for hands-on integrated learning of
- computing, science, technology, engineering, and mathematics (C-STEM) with robotics.
- DC motor control using Arduino and H-Bridge

- Data loggers for scientific research
- Gameduino, an Arduino shield to create retro 2D video games
- Homemade CNC using Arduino and DC motors with close loop control by Homofaciens
- Impedance sensor system to detect bovine milk adulteration
- Low cost data glove for virtual reality applications
- OBDuino, a trip computer that uses the on-board diagnostics interface found in most modern cars
- Water quality testing platform
- Xoscillo, an open-source oscilloscope

Through this application software the Bluetooth client communication tools (i.e.: Bluetooth slave mode), Bluetooth serial communication can be tested, Can connect a Bluetooth MCU and PC serial port. Software features includes:

Search for Bluetooth devices, and displays the class and RSSI (signal strength)

The use of serial communication, receiving and sending data.

Can be set to ASCII and HEX input and output mode.

The data results can be saved to the SD card.

Can search for Bluetooth low energy devices (nothing more).

This tool has three modules:

Byte stream mode: the basic input-output model

Keyboard mode: Can customize the output value of 12 buttons, each button has three states (respectively: Down Long-press| Up), each state can send commands event.

Command Line: Set the command terminator for communication debugging. the whole device. It measures the presence of the obstacles above the knee level. It has dual function, firstly it takes the commands from the shoe module to detect the objects and secondly it also continuously detects above the knee level.

Block Diagram

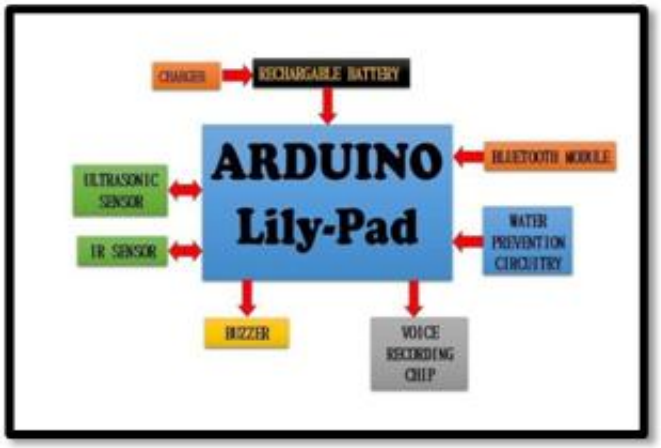


Figure.9. Block Diagram of Cane Module

The above figure (Figure 8) i.e., cane module, is the primary unit as compared with the shoe part and primarily function for detecting obstacles above the knee level and collecting the information from an IR sensor along with an ultrasonic sensor connected and transferring the information gathered so that the primary objective of the design can be fulfilled i.e., the blind person or the visually impaired person gets to know about the obstacle through a speech output.

INFRARED IN ELECTRONICS

Infra-Red is interesting, because it is easily generated and doesn't suffer electromagnetic interference, so it is nicely used to communication and control, but it is not perfect, some other light emissions could contains infrared as well, and that can interfere in this communication. The sun is an example, since it emits a wide spectrum or radiation.The adventure of using lots of infra-red in TV/VCR remote controls and other applications, brought infra-red diodes (emitter and receivers) at very low cost at the market. From now on you should think as infrared as just a "red" light. This light can means something to the receiver, the "on or off" radiation can transmit different meanings. Lots of things can generate infrared, anything that radiate heat do it, including out body, lamps, stove, oven, friction your hands together, even the hot water at the faucet.

The block diagram consists of following blocks:

a) **IR Sensor1:** This is the first sensor which detects the presence of the obstacles in the left direction and sends the command to the controller for the detection of object in the left direction.

b) **Arduino Lily:** This is the main controller of the protocol which receives the command from all the sensors and the shoe module and gives command to the speaker as per signal received.

c) **Voltage Convertor**: This electronic device is used to convert the voltage obtained from the battery (3.7 V) to the voltage required to run the device (5.0 V).

d) **Bluetooth Module:** This device is used to interconnect both the modules via Bluetooth wireless technology. Due to this interconnection, both have communication of signals to execute commands.

e) **Voice Recording Chip:** This is a Bluetooth device that comprises of recorded voice commands to alert the person about the obstacle direction.

f) **Water prevention circuit:** This is an open circuit that becomes close when comes in contact with the water. It is used to prevent the circuit from getting damage from water on the road.

g) **Rechargable battery:** It is a battery used in the protocol so that continuous power can be delivered to the controller tobe in active state. It can be recharged again and again by the simple mobile charger.

Working

The working of this cane module is divided into 2 phases:

Phase 1: After receiving the input form the shoe module via Bluetooth module, the Arduino Lily receives the input, decodes it and selects the appropriate saved voice messages (front and right direction) and commands to the speaker which give the indication to the user of the obstacle in the respective direction.

Phase 2:

The other phase of the input reception is by the left sensor and the ultrasonic sensor above the knee level.

The Arduino lily controller receives the input from the above sensors, executes and decode it and again select the appropriate saved voice messages (left and above the knee) and commands to the speaker which give the indication to the user of the obstacle in the respective direction.

The other function of the cane module is to prevent the shoe module from water.

For this, a water prevention circuit has been implemented at the bottom of the cane module. The water prevention circuit gets completed when it comes in contact with water and thus sends a command to the Arduino Lily which executes it and select the command for the water prevention.

Circuit Diagram

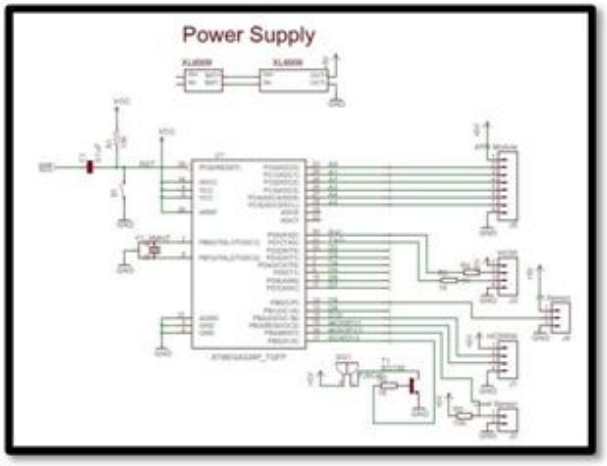


Figure .10. Circuit diagram of Cane Module

The above Figure 9 represents the circuit diagram of the cane module that comprises all the inter connections of the modules that helps in the complete practical realization of the respective protocol.

Module Realization

Figure.11. Hardware realization of Cane

Modul Advantages

- A reliable assistive technology providing a voice feedback as per the surrounding.
- An ease to carry the project without any embarrassment.
- Improved sensing range than the conventional technologies offering a haptic feedback upon sensing.
- Offering independency to the subject so he can be able to walk on streets without the need of an external assistance.
- Provide the best assistance through a switch and a buzzer in case the subject lost the cane.

Vibrating motor

In electronics before the development of switch-mode power supplies and the introduction of semiconductor devices operating off low voltage, there was a requirement to generate voltages of about 50 to 250V DC from vehicle batteries. Electromechanical components known as vibrators were used in a circuit similar to modern solid state inverter circuits to provide a pulsating DC which could be converted to a higher voltage with a transformer, rectified, and filtered to create higher-voltage DC. This "vibrator" is essentially a relay using normally closed contacts to supply power to the relay coil, thus immediately breaking the connection, only to be reconnected very quickly through the normally closed contacts. It happens so rapidly it vibrates, and sounds like a buzzer. This same rapidly pulsing contact applies the rising and falling DC voltage to the transformer which can step it up to a higher voltage.

Figure.12. Vibrating motor

VII. CONCLUSION

The above proposed idea depicting the integration of the both modules of the protocol into a single unit overcomes almost all the limitations that were in the previous versions of the technology. Thus this technology becomes a reliable partner for the visually impaired people in every situation. This system will detect the presence of the obstacles coming in the front of the blind person and then alert them about the direction of the obstacles so that they can walk with ease. The system comprises of the sensors that receives signals and then send commands to the controller which executes it further about the direction. Thus, allowing the blind person to walk independently among obstacles. **This project offers a numerous applications in the medical field to provide a better responsive mate to the visually impaired. For the NGO's working for the visually impaired to provide such assistive technology.**

VIII. REFERENCES

[1] Parth Dhall, et al, "A REVIEW PAPER ON ASSISTIVE SHOE & CANE FOR VISUALLY IMPAIRED PEOPLE", International Journal of Scientific Research and Management Studies (IJSRMS), Volume 3 Issue 2, pp: 113-117.

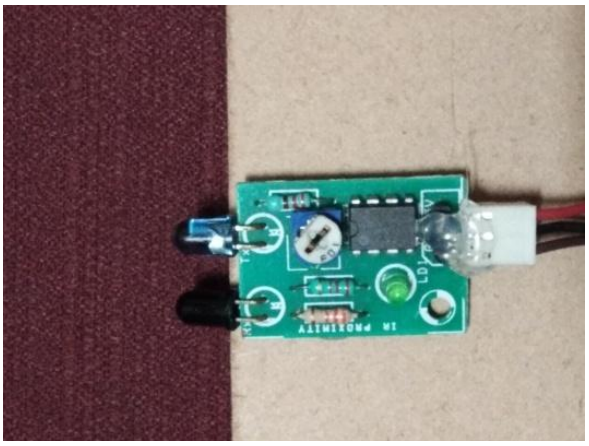
[2] Shristhi Thakur, et al, "Smart Assistive Shoes for the Blind People", International Journal on Recent and Innovation Trends in Computing and Communication (IJRITCC), Volume: 4 Issue: 9, pp: 44-49.

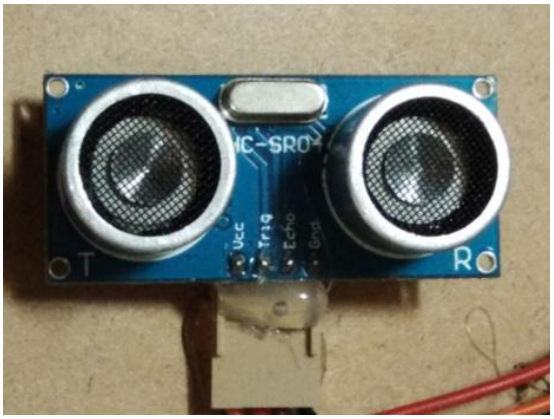
[3] Gemperle F, Ota N, and Siewiorek D (2001) Design of a wearable tactile display. In: Proc. of. 5th International Symposium on Wearable Computers, Zu.

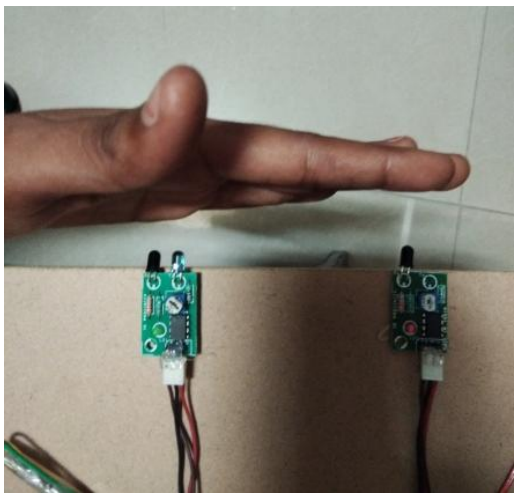
[4] Shinohara, K. “Designing assistive technology for blind users.” In Proceedings of the 8th international ACM SIGACCESS conference on Computers and accessibility, ACM (2006), pp- 293–294.

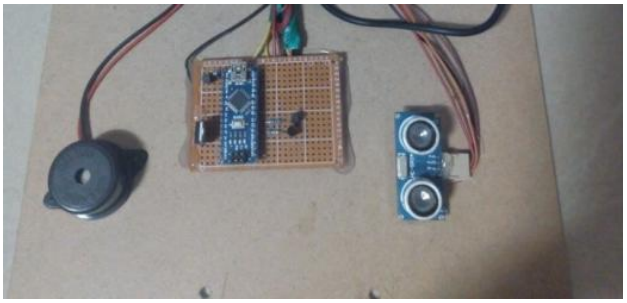
[5] Mohd Helmy Abd Wahab, Amirul A. Talib, Herdawatie A. Kadir, “Smart Cane: Assistive Cane for Visually-impaired People”, Journal : IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 4, No 2, July 2011.

[6] Harshad Girish Lele, Viten Vilas Lonkar, Varun Vasant Marathe, Mrunmayi Mohan Modak. "Electronic path guidance for visually impaired people." The International Journal of Engineering and Science (IJES), 09-14, 201









Author’s Profile

Sri S.D. Asha Mahesh **Mtech,mba,**
Email id :ashamahi.cec@gmail.com, PHN NO:8332896990

k.raj supriya, email id :kurmanasupriya@gmail.com
pho no 8179025675

M.V.S.S.N.K.PUSHPA LATHA.
Email id : omsairamlucky123@gmail.com
Phn no: 9581157237

P.GOWRI, email id :pottigowri2016@gmail.com
phn no:7330836798

T.Sonia, Email id : tamarpallisonia92@gmail.com
Phon no 7337252538

B.Nani, Email id:nanibudda14@gmail.com
Phnno:8790529432