Smart Stick and Shoes for Blind People

Minor Project I

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ABSTRACT

The main objective of this project is to provide assistance to the blind people and also to help 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.One of the biggest problems that the visual impaired ones face is while travelling because when they walk 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 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 shoes will sense the obstacles within a range and send a vibration feedback to alert the blind person.This will be achieved by using ultrasonic sensors and a vibratory circuit.The stick will detect the objects in the path and tell the person regarding the upcoming obstacles via voice feedback.This will be achieved by applying a camera on the stick & raspberry pi which will do object detection and hence send the voice commands through the earphones.The smart shoes and stick work independently.By using them,blind people can achieve a better quality of life and can lead a life of independence.

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CHAPTER 1

INTRODUCTION

According to survey of WHO (World Health Organization) held out in 2011 we come to know that in world about 1% of the human population is visually impaired and amongst them about 10% is fully blind. The main concern for blind people is mobility. They need to depend on others for mobility. This approach presents a tool for visually impaired people that will help them to navigate. The system we have designed consists of sensors and vibrators for sensing the surrounding environment and giving feedback to the blind person of the position of the nearest obstacles in range. The idea is to extend the senses of the user through this after a training period, without any sensible effort.

We propose smart shoes for blind people. Electronic component is fixed in shoes of users. User will wear shoes for easy mobility. Sensors will sense obstacles, vibrators will vibrate for left/right turn through path. Using smart shoe, blind people need not to be depend on others for mobility. In this work, system is designed which is cheap, a simple friendly user, smart blind guidance system. It is implemented to improve the mobility of both blind and visually impaired people in a various area. [1]

We would also like to present smart stick for blinds. It will be different from a traditional stick, with a camera mounted on its top. It will be doing object detection with OPENCV on raspberry pi and giving the voice feedback to the user via earphones. It will tell the user about the object detected and the distance of object from person. It also tells about the speed of the detected object and whether the object is moving towards or away from the person. The main advantage of this stick is that it does not require any internet connection nor anything else to operate. This stick starts working as soon as it is powered up.

1.1 Project Goal

The project 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 project serves as a solution for visual impaired people. [2] 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.

CHAPTER 2
BACKGROUND STUDY

The motivation behind the project is the statistics of the blind people in the world and to create an independent life form for them.

2.1 Traditional System

Presently a large population of the visually impaired people use a normal cane for walking, which is not so safe in conditions like crossing the road or detecting obstacles in the path beforehand. Blind people use conventional white cane as their supporting aid for movement. Information gathered using white cane was not adequate to guide the blind.

2.2 Literature Survey

A Radio Frequency Identification Technology (RFIT) based smart cane project was proposed by Willie Martin. It used a passive Radio Frequency Identification Detector (RFID) and an obstacle detection system consisting of a single ultrasonic sensor.

Jayant, Pratik and Mita proposed a smart cane assisted mobility for the visually impaired. The system was based on normal ultrasonic sensors and ATMEL microcontroller. Once obstacles were detected, vibration and buzzer get activated in order to warn the user. However, this system had only one direction detection coverage and it was inaccurate in detecting the obstacles.

Somnath and Ravi used voice playback navigation system for visually impaired people. The stick incorporated ultrasonic sensors, GPS and audio output system.

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 as 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”.

2.3 Proposed System

Smart stick and shoes are meant to provide a smart electronic aid for blind people.This project aims to help the blind people to make them aware of the obstacles in their path.The shoes will sense the obstacles within a range and send a vibration feedback to alert the blind person whenever the person gets too close to the obstacle.The sensors and the vibration motors will be located in such positions that the person can identify if the obstacle is on the right,on the left or in the front.The stick will detect the objects in the path and tell the person regarding the upcoming obstacles via voice feedback.The stick will also give information regarding the distance and speed of the object and hence the visually impaired people can have a collision free walk.

CHAPTER 3
HARDWARE COMPONENTS

3.1 Shoe Module

The hardware components used are:

- **Arduino UNO**: The Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.

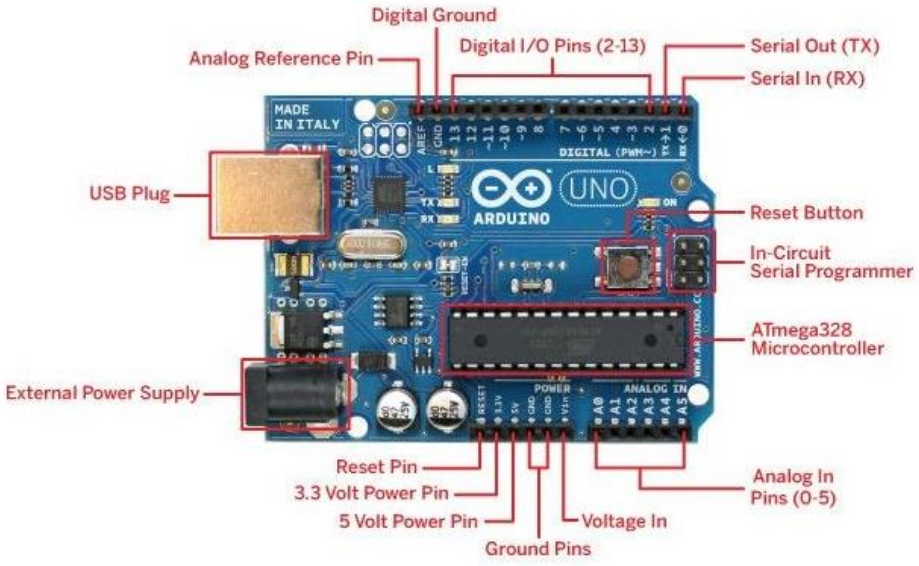


Figure 3.1:Description of Arduino UNO[3]

- **IC 7805**: 7805 is a voltage regulator integrated circuit. It is a member of 78xx series of fixed linear voltage regulator ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage output. The voltage regulator IC maintains the output voltage at a constant value i.e 5V.

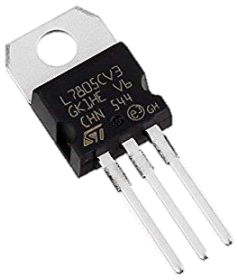


Figure 3.2: IC 7805[4]

- **IC 7809**: 7809 is a voltage regulator integrated circuit. It is a member of 78xx series of fixed linear voltage regulator ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage output. The voltage regulator IC maintains the output voltage at a constant value i.e 9V.

Figure 3.3: IC 7809[5]

- **Ultrasonic Sensors(SR-04)**: It measures distance by using ultrasonic waves. The transmitter head emits an ultrasonic wave and receiver receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception.

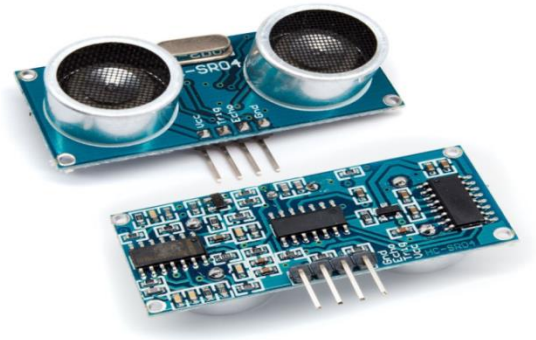
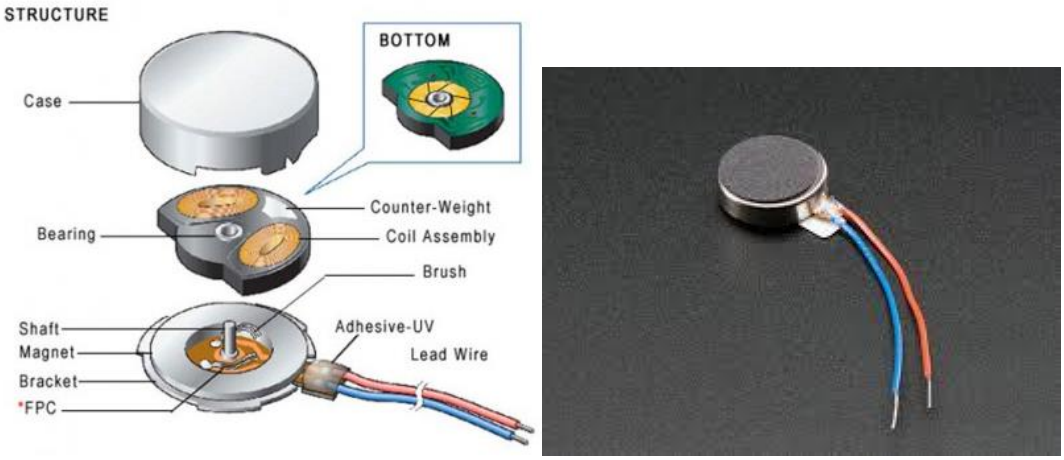


Figure 3.4: Ultrasonic sensor(SR-04)[6]

- **Vibration Motors**: Vibration motors give a vibration feedback.



(a)Vibration motor pin diagram (b)Vibartion motor
Figure 3.5: Description of Vibration motor[7]

3.2 Stick Module

The hardware components used are:

- **Raspberry pi 3 B**: It is a single computer board with credit card size, that can be used for many tasks that your computer does, like games, word processing, spreadsheets and also to play HD video.It consists of Broadcom BCM2387 chipset ,1.2GHz Quad-Core ARM Cortex-A53,802.11 bgn Wireless LAN and Bluetooth 4.1 (Bluetooth Classic and LE),1GB RAM,64 Bit CPU,4 x USB ports,Full size HDMI,Micro SD port for loading your operating system and storing data,Micro USB power source.

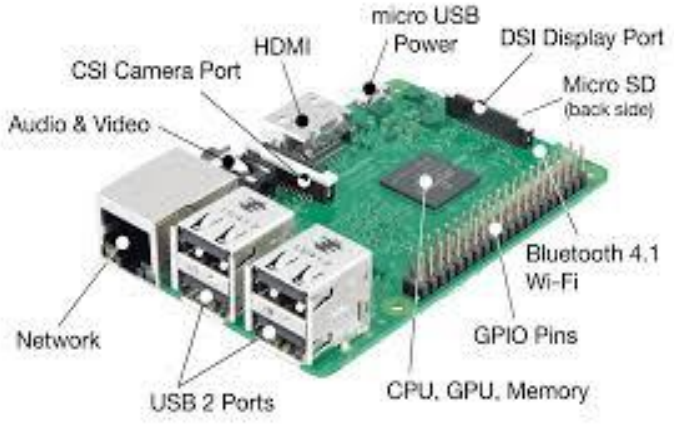


Figure 3.6:Description of Raspberry pi 3 B[8]

- **USB Webcam**: It is a video camera that feeds or _streams its image in real time to or through a computer to a computer network. When "captured" by the computer, the video stream may be saved, viewed or sent on to other networks travelling through systems such as the internet, and emailed as an attachment. When sent to a remote location, the video stream may be saved, viewed or on sent there.

Figure 3.7:USB Webcam and 12V DC Fan[9]

- **12V DC Fan**: Dc axial cooling fan axial fans blow air along the axis of the fan, or parallel to the track of the blade axis. Dc axial fans are found in a variety of applications, including computing, servers, telecommunication cabinets, and any type of equipment where the need for thermal control is necessary for the improved reliability and life extension of the components that are included in the system.
- The other hardware components used are jumper wires, power bank and a battery.

CHAPTER 4
DETAILED DESIGN

The principal aim of the project is to provide an electronic aid to the visually impaired population so as to ease their lives. The smart shoes detect the obstacles via ultrasonic sensors and give a vibration feedback to alert the person regarding the obstacle. The smart stick detects cars and human beings and informs the blind person at what distance the obstacle is and at what speed it is moving via voice feedback. It also tells whether the object is coming towards or away from the user.

4.1 Shoe Module

The shoe module detects the ground level hurdles and alerts the visually impaired via vibration feedback. The obstacle detection is achieved via ultrasonic sensors. Ultrasonic sensors come along with many advantages. They can be used in dark environments and are hence preferred over IR sensors. Ultrasonic sensors are also not affected by the color or transparency of objects. They are also budget friendly thus making the cost of the shoes affordable.

4.1.1 Assembling the hardware

The required connections are made using the arduino and ICs. The ultrasonic sensors are connected according to their pin description.The vibration motor connections are simple; one wire is connected to a 3V supply and other is grounded.

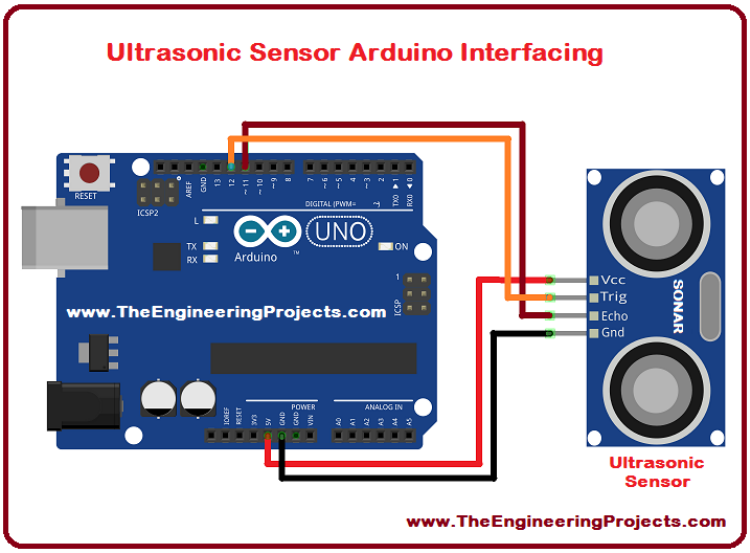


Figure 4.1:Circuit Diagram of ultrasonic sensor[10]

4.1.2 Arduino UNO Coding

The coding is done on the Arduino IDE software.A specific range is set for the ultrasonic sensors within which if it detects an obstacle,the vibration motor will do it's work and alert the visually impaired person.

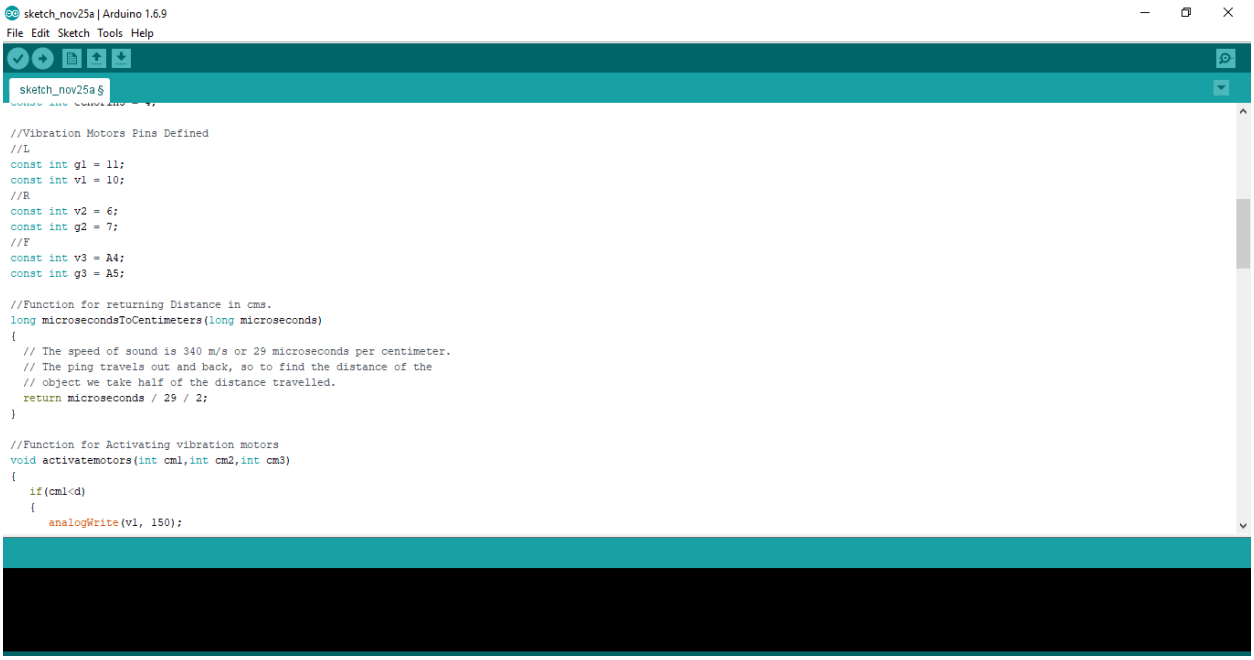


Figure 4.2: Arduino Genuino Software[11]

4.2 Stick Module

The stick module detects the human beings and cars and alerts the visually impaired regarding the obstacle via voice feedback and also gives information about the distance and speed of that object. This is achieved by using raspberry pi and a web camera. Raspberry pi has a lot of advantages. There are three main benefits to the Raspberry Pi 3 are: It has Bluetooth; it has Wi-Fi; and it has a more powerful CPU/GPU pair. The voice feedback is heard using earphones.

4.2.1 Assembling the hardware

The required connections are made on the raspberry pi;the LAN cable, web camera and the earphones are connected to it.The setup is attached to the stick so as to obtain the proposed system.

4.2.2 Python coding

- **OPENCV:** OpenCV (Open Source Computer Vision Library) is released under a BSD license and hence it's free for both academic and commercial use. It has C++, Python and Java interfaces and supports Windows, Linux, Mac OS, iOS and Android. OpenCV was designed for computational efficiency and with a strong focus on real-time applications. Written in optimized C/C++, the library can take advantage of multi-core processing. Adopted all around the world, OpenCV has more than 47 thousand people of user community and estimated number of downloads exceeding 14 million. Usage ranges from interactive art, to mines inspection, stitching maps on the web or through advanced robotics.

- **HAAR CASCADES:** A Haar Cascade is basically a classifier which is used to detect the object for which it has been trained for, from the source. The Haar Cascade is by superimposing the positive image over a set of negative images. The training is generally done on a server and in various stages. Better results are obtained by using high quality images and increasing the amount of stages for which the classifier is trained.
- **eSpeak Library**: eSpeak is a compact open source software speech synthesizer for English and other languages, for Linux and Windows. eSpeak uses a "formant synthesis" method. This allows many languages to be provided in a small size. The speech is clear, and can be used at high speeds, but is not as natural or smooth as larger synthesizers which are based on human speech recordings.

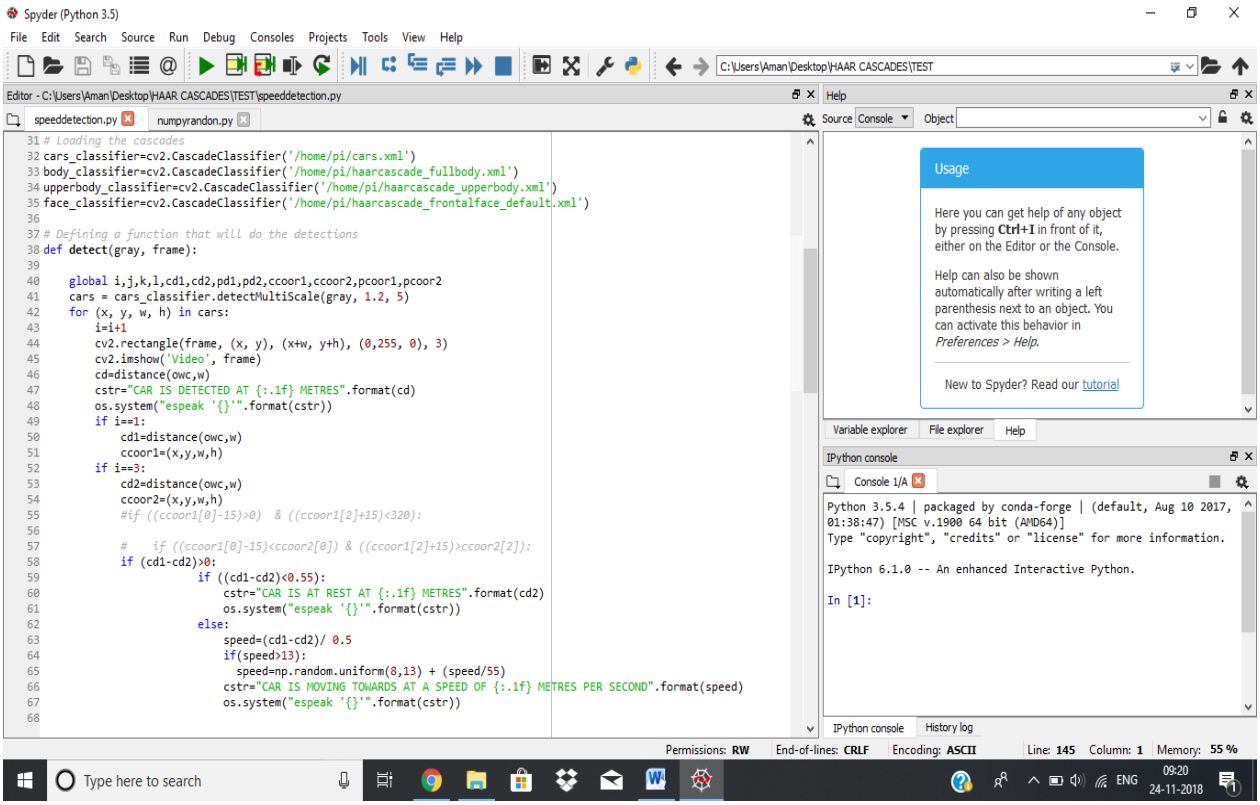


Figure 4.3:Spyder Software[12]

CHAPTER 5

IMPLEMENTATION

This chapter explains how the system has been implemented, and the decisions that were made during the process. It also shows any difficulties that were encountered, and how they were dealt with.

5.1 Working

The project is intended to be developed as tool or aid that will help blind people in moving or travelling. The dependency on others is reduced and these people can become more self-reliant. The project is built around ARDUINO UNO and Raspberry Pi 3B controller. The smart shoes has features to detect obstacles using ultrasonic sensors and alerting the blind person via vibration feedback. If the obstacle is detected on the right side, the vibration motor on the right side will vibrate; hence alerting the blind person that the obstacle is on the right.The same function is performed if the obstacle is on the front or on the left, enabling the vibration motor on the front and left respectively.

The web camera is mounted on the stick and the raspberry pi setup is also attached to it.The cars and human beings are detected and a voice feedback is sent via earphones to the blind person so as to alert them regarding the obstacle.It also measures the distance and speed of the object.It also tells whether the detected object is moving towards or away from the user.

5.2 Shoe Module Realization

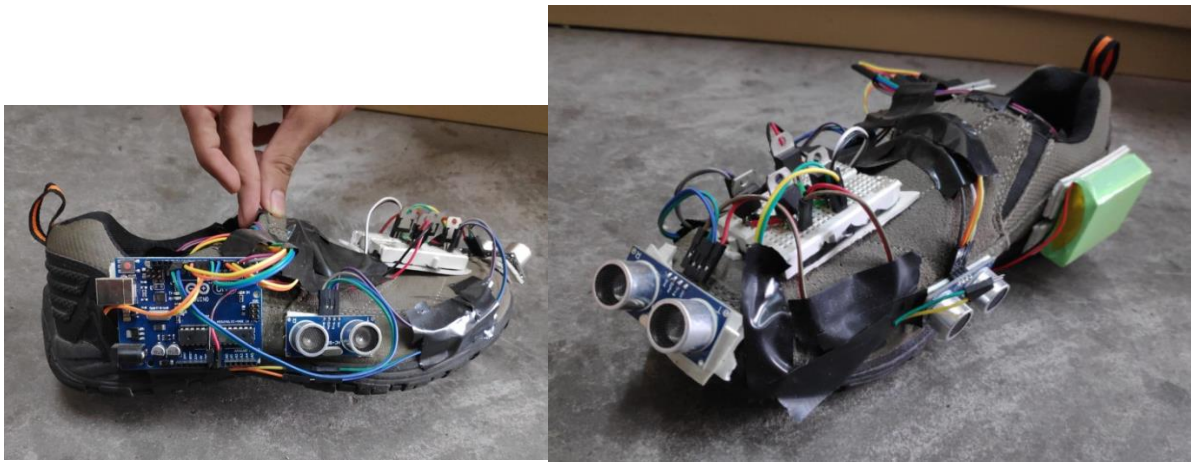


Figure 5.1: Hardware realization of shoe module

5.3 Stick Module Realization

Figure 5.2: Hardware realization of stick module

5.4 Advantages

- Offering independency to the subject so he can be able to walk on streets without the need of an external assistance.
- Navigation Assistance while travelling.
- Distraction-free travel.
- Improved sensing range than the conventional technologies offering a haptic feedback upon sensing.
- User friendly system

CHAPTER 6
CONCLUSION

The main aim of the project is to make the lives of visually impaired people easier. With the help of these shoes and stick they do not have to depend on anyone thus they can live an independent life. The proposed system uses ultrasonic sensor based shoes to detect obstacles for ground level. This device is light in weight wearable device, which makes the system easy to carry. The main adavantage of these devices is that neither of require any internet connection nor anything else to operate.Also, the proposed system is low cost, which is a significant factor because 90% of the visually impaired in the world lead their life in low income. This system modifies the quality of visually impairer's life and decrease dependency on others for their social life.

CHAPTER 7
FUTURE SCOPE

The project has a lot of scope for future advancements.

- Both these products have great future scopes and can enter real world market after some minor changes.
- Machine Learning & Deep Learning can be incorporated in the Smart Stick for it to become more trained for the real world .
- A GPS connection can help people navigate to the designated location by overcoming the obstacles in the path.
- The stick can help the blinds to walk safely on the roads and even to cross at the zebra-crossings.

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