RESEARCH ARTICLE OPEN ACCESS

IoT Based Smart Stick for Visually Impaired

Prof. Sonali K. Pawar[1], Prof. Anuradha Nigade[2], Kajal Kumari[3], Shivani[4], Prof. Sharada Tondare[5], Prof. Aparna Patil[6]

1(Department of Electronics and Communication Engineering, Bharati Vidyapeeth (Deemed to be University), Pune Email: sdsuryawanshi@bvucoep.edu.in)

2 (Department of Electronics and Communication Engineering, Bharati Vidyapeeth (Deemed to be University), Pune Email: asnigade@bvucoep.edu.in)

3(Department of Electronics and Communication Engineering, Bharati Vidyapeeth (Deemed to be University), Pune Email: kajal.kumari-coep@bvucoep.edu.in)

4(Department of Electronics and Communication Engineering, Bharati Vidyapeeth (Deemed to be University), Pune Email: shivani.-coep@bvucoep.edu.in)

5(Department of Electronics and Communication Engineering, Bharati Vidyapeeth (Deemed to be University), Pune Email: sptondare@bvucoep.edu.in)

6(Department of Electronics and Communication Engineering, Bharati Vidyapeeth (Deemed to be University), Pune Email: aspatil1@bvucoep.edu.in)

Abstract:

The smart walking stick makes navigating and work easier and more comfortable for blind persons. The barrier is not detected in regular sticks, and a basic cane is ineffective for visually challenged people. Because the sight-challenged individual has no idea what sort of things lies in his path. The individual has no idea about the scale of the obstacle or how far away he or she is from it. It is tough for a sight-challenged person to get through. The presence of an obstacle is identified through the use of Ultrasonic Sensors which are used to calculate the distance between the obstacle and the person in a smart walking stick. If a blind person encounters an impediment, the sound emitted by the Buzzer will alert him or her to the presence of the barrier. The technique is extremely beneficial to visually impaired persons who frequently require assistance from others. The GPS and GSM Module is used to provide location information and message alert from the user.

Keywords — **Smart Stick, Arduino Uno, Ultrasonic Sensors LDR Sensor, Buzzer, GPS, and GSM**

I. INTRODUCTION

This People with visual impairments find it difficult to interact with and experience their situations. They have little interaction with their environment. Visually impaired people have difficulty moving because it is difficult to distinguish the barriers in front of them and they cannot walk from one place to another. Her movement and financial support depend on her family. Their agility prevents them from engaging in social activities or meeting other people. Due to a lack of knowledge and visual experience, various limited systems have been built in the past. Researchers have spent decades developing clever and intelligent sticks that help visually impaired people avoid obstacles and provide location information. Over the past few decades, scientists have been working on new devices to create superior and reliable systems for visually impaired people to detect obstacles and notify them when they are at risk. The smart stick is designed to detect obstacles and helps the visually impaired to move safely. Alarms continue to inform users and significantly reduce accidents. This technology presents the idea of intelligent electronic support for the visually impaired in public and private spaces. Ultrasonic sensors, LDRs, raindrop sensors, and buzzers are all part of the proposed system. The stick uses an ultrasonic sensor to measure the distance between an object and an intelligent cane. If an object or obstacle is within range of the ultrasonic sensor, a buzzer will sound to alert the user. A smart stick is a simple and pure mechanical device that detects obstacles on the ground. This device is lightweight and portable. Blind people can move independently from one place to another without outside help.

The system's main aim is to provide the best environment for blind persons, which gives a sense of vision by providing information about their surroundings and objects around them. Our proposed venture makes use of 3 ultrasonic sensors to locate limitations without touching them the usage of ultrasonic waves. On sensing limitations, the sensors by skip these facts to the microcontroller. The microcontroller then strategies these facts and calculates if the impediment is near enough. If the impediment is some distance the circuit does not do anything however If the impediment is near the microcontroller sends a sign to sound a buzzer. Ultrasonic sensors are used to locate any impediment in front of the blind individual. It has a Detection Distance of 2cm-40cm so every time there are a few impediments to this variety it's going to alert the blind individual. One extra function is that it permits the blind individual to locate if there's mild or darkness withinside the room or out of doors world. The darkness and mildness may be detected through the usage of the LDR sensor. An LDR or mild-based resistor is likewise called a photoresistor, photocell, or photoconductor. It is one sort of resistor whose resistance varies relying on the quantity of mild falling on its surface. The raindrop sensor is used to locate the presence of water at some point of the journey while water comes in touch with the raining board.

II. LITERATURE REVIEW

An The smart blind stick is based on sensors and a microcontroller, according to the paper [1]. The Arduino Mega 2560, ultrasonic sensors, IR sensors, and a buzzer are used to detect obstacles near the stick and alert them back. It is designed to be a low-cost, simple, and lightweight solution. Sensors sense the distance between obstacles and the blind stick using these sensors and microcontrollers, and then alarm with the buzzer, with the frequency of vibration representing the proximity of hazards.

The design and execution of a smart blind walking stick are described in paper [2], which uses an Arduino UNO, an ultrasonic sensor, an IR sensor, and a speech playback module. This stick detects any obstructions in front of the user and notifies them using a voice playback module that recognizes the user’s spoken word via a microphone. A person can walk more comfortably and confidently using this blind stick. This device will be the most effective way for them to conquer their problems.

According to paper [3], the smart walking stick makes it easier for blind persons to navigate and complete their tasks. Arduino nano, ultrasonic sensors, IR sensors, and buzzers make up this smart blind stick. The ultrasonic sensors detect the distance between the obstacles and the user, and the IR sensor detects the front hole while the stick is roughly 21.5cm away from the hole. If a blind person encounters an impediment, the sound emitted by the BUZZER will alert them to the presence of the obstruction.

In this paper [4], the blind stick is designed to assist visually impaired folks to navigate extra easily. This stick consists of an ultrasonic sensor in addition to a water sensor. The ultrasonic sensor detects limitations in advance of the use of ultrasonic waves and sends the records to the microcontroller. The distance between the impediment and the stick is calculated through this microcontroller. The microcontroller gives a sign to a speaker if the impediment is close. It additionally senses the presence of water and emits a wonderful sound. Using a wi-fi based far flung additionally aids the consumer in locating the stick if they neglect in which they placed it.

In this paper [5], the clever blind stick is designed with an infrared sensor to discover stairs and ultrasonic sensors, the primary of which detects every other limitation in the front of the consumer inside some meters and the second one that is placed at the lowest of the keep on with keep away from puddles. When an obstruction is recognized, the vibration motor and spoken alarm messages are engaged.

III. SYSTEM OVERVIEW, SPECIFICATIONS AND ARCHITECTURE

The smart stick is essentially a system that integrates the following elements: three ultrasonic sensors to detect obstacles in front of the eaves from ground height to clubhead height within 40 cm at front, a water sensor for puddle detection, and an LDR sensor for day and night detection. The sensors collect data in real time and send it to the microcontroller for processing. After treatment, the. The microcontroller activates a buzzer or a vibrating motor to alert the person to an obstacle or time of day. The system is powered by a rechargeable battery. GPS and GSM modules are used to detect the user's current location and send it to the respective receiver when requested.

A. *Block Diagram*

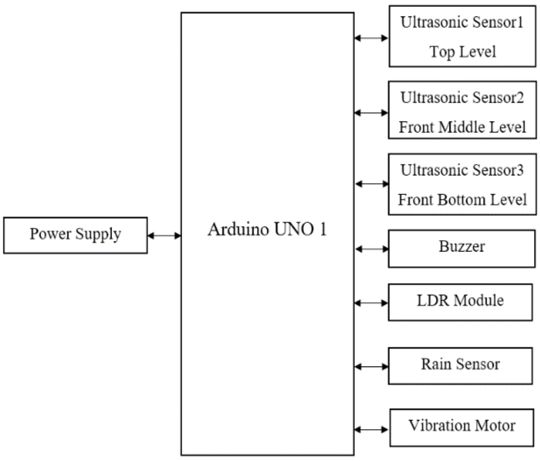

Fig.. 1 Block Diagram of Arduino UNO 1

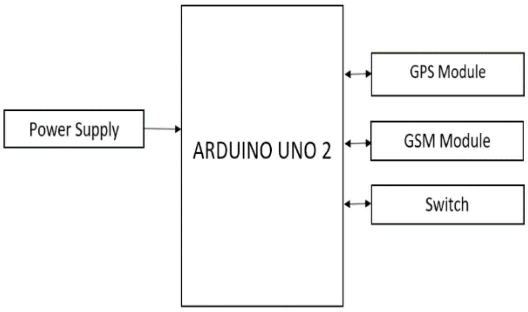

Fig.. 2 Block Diagram of Arduino UNO 2

B. *Hardware Specifications*

1) ***ARDUINO UNO:*** The Arduino Uno microcontroller board is based on the ATmega328P microcontroller. The board has 14 digital I / O pins (6 of which can be used as PWM outputs), 6 analog inputs, a 16MHz crystal, a USB connector, a power jack, an ICSP header, and a reset button. It contains everything you need to get started with the microcontroller. Connect it to your computer with a USB cable, or turn it on with an AC-DC adapter or battery.

Fig. 3 Arduino UNO Hardware

2) ***Ultrasonic Sensor:*** An ultrasonic sensor, also known as an ultrasonic transducer, consists of a transmitter and receiver and is mostly used to calculate the distance to a target object with a wavelength of 20kHz to 20 MHz Speed and direction measurement, wireless charging, humidifiers, medical ultrasonography, sonar, burglar alarms, and non-destructive testing are all applications for this sensor, which has a range of 2cm to 400cm. It uses non-contact technology, which means there is no physical touch between the sensor and the thing being measured. The transmitter and receiver are the sensor's two major components, with the former converting electrical impulses to ultrasonic waves and the latter converting ultrasonic waves back to electrical signals. It provides exact measurement details and has a resolution of roughly 3mm, implying that the computed distance from the item and the real distance may differ somewhat. The HC-SR04 has a total of four pins.

Fig. 4 Ultrasonic Sensor HC-SR04

3) ***LDR***: The resistance of light dependent resistor (LDR) depends on the intensity of the light. At

night, the resistance of the LDR is high and no current flows. Instead, an LED mounted parallel to it lights up and acts as a flashlight that is visible to others. A type of resistor depends on the amount of light that hits the surface. When the resistor is exposed to light, the resistance value changes. These resistors are often used in many circuits that need to detect the presence of light. These resistors have various functions and resistances. For example, if the LDR is in the dark, you can use it to turn the light on or turn it off when the light is on. It warns others of the existence of blind people and tells them to get off the road so they can pass by.

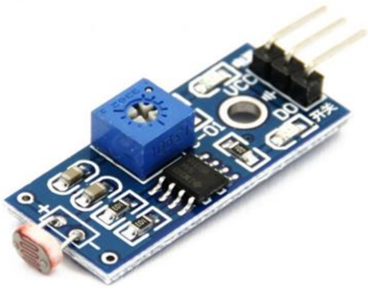

Fig. 5 Light Dependent Resistor

4) ***Raindrop Sensor***: A raindrop sensor is a circuit board coated with nickel linearly. It works on the principle of resistance. The rain sensor module allows you to measure humidity via analog output pins and provides a digital output when the humidity threshold is exceeded. The module contains a separate rain panel and control panel for your convenience. It has adjustable sensitivity with a power indicator LED and potentiometer. The rain sensor detects water that completes the lead circuit printed on the sensor board. The sensor board acts as a variable resistor, changing from 100 ohms when wet to 2M ohms when dry. In short, the wetter the board, the more current will flow.

Fig. 6 Raindrop Sensor Module

5) ***GPS Module:*** The GPS NEO-6M is a one-of-a-kind GPS Module from the GPS UBLOX Series. It can monitor up to 22 satellites on 50 channels and reaches the highest level of sensitivity in the industry, -161 dB tracking while drawing only 45 milliamps from the power source. Unlike other GPS modules, it can update its location up to 5 times per second, with a horizontal position precision of 2.5 meters. In addition, the u-blox 6 positioning engine has a Time-To-First-Fix (TTFF) of less than one second. The chip's Power Save Mode is one of its best features (PSM). Selectively switching parts of the receiver ON and OFF provide for a reduction in system power usage.

Fig. 7 GPS Module

6) ***GSM Module:*** The. A GSM Module is a GSM Modem (like SIM800A) connected to a PCB with different types of output taken from the board – say TTL Output (for Arduino, 8051, and other microcontrollers) and RS232 Output to interface directly with a PC (personal computer). The board will also have pins or provisions to attach the mic and speaker, to take out +5V or other values of power and ground connections. These types of provisions vary with different modules. The SIM800A Quadband GSM/GPRS Module with RS232 Interface is a complete Quad-band GSM/GPRS solution in an LGA (Land grid array) type that can be embedded in the customer applications. SIM800A supports Quad-band 850/900/1800/1900 MHz, it can transmit Voice, SMS, and data information with low power consumption. Featuring an Embedded AT, it allows total cost savings and fast time-to-market for customer applications. The SIM800A modem has a SIM800A GSM chip and RS232 interface while enabling easy connection with the computer or

laptop using the USB to the Serial connector or the microcontroller using the RS232 to TTL converter. Once you connect the SIM800A modem using the USB to RS232 connector, you need to find the correct COM port from the Device Manager of the USB to Serial Adapter.

Fig.ure 8. GSM Module

7) ***Buzzer:*** A transducer is a device that transfers electrical energy into mechanical energy. The audible frequency band of 20 Hz to 20 kHz is where a buzzer is located. This is achieved by translating an audible electric oscillating signal into mechanical energy in the form of audio waves. In this study, a buzzer is utilized to alert a blind person of impediments by producing sound proportionate to the distance between the obstacle and the blind person.

8) ***Vibration Motor:*** A vibration motor is a compact size coreless DC motor used to inform the users of receiving the signal by vibrating, with no sound. Vibration motors are widely used in a variety of applications including cell phones, handsets, pagers, and so on. The main feature of a vibration motor is the magnet coreless DC motor is permanent, which means it will always have its magnetic properties (unlike an electromagnet, which only behaves like a magnet when an electric current runs through it); another main feature is the size of the motor itself is small, and thus lightweight. Moreover, the noise and the power consumption that the motor produces while using are low. Based on those features, the performance of the motor is highly reliable.

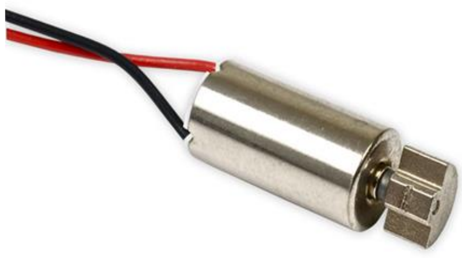

Fig. 9 Vibration Motor

C. *Software Specifications*

1) ***ARDUINO IDE:*** The Arduino IDE (Integrated Development Environment) is the program used to write code, and comes in the form of a downloadable file on the Arduino website. The Arduino board is the physical board that stores and performs the code uploaded to it. Both the software package and the board are referred to as "Arduino." The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

D. *System Architecture*

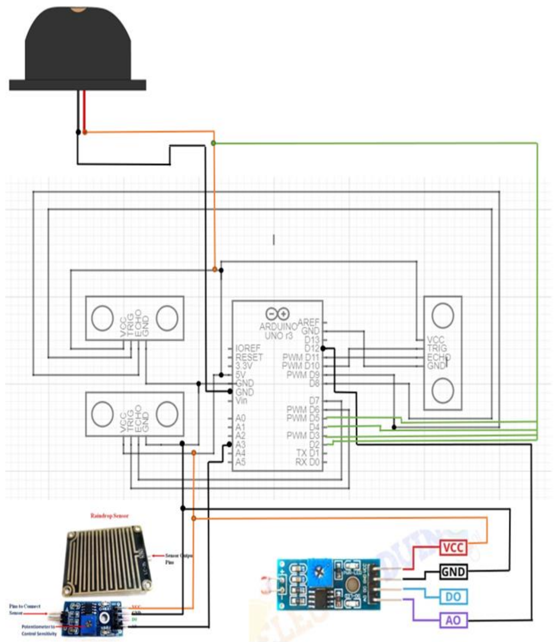

Fig. 10 Connection Diagram for Arduino UNO 1

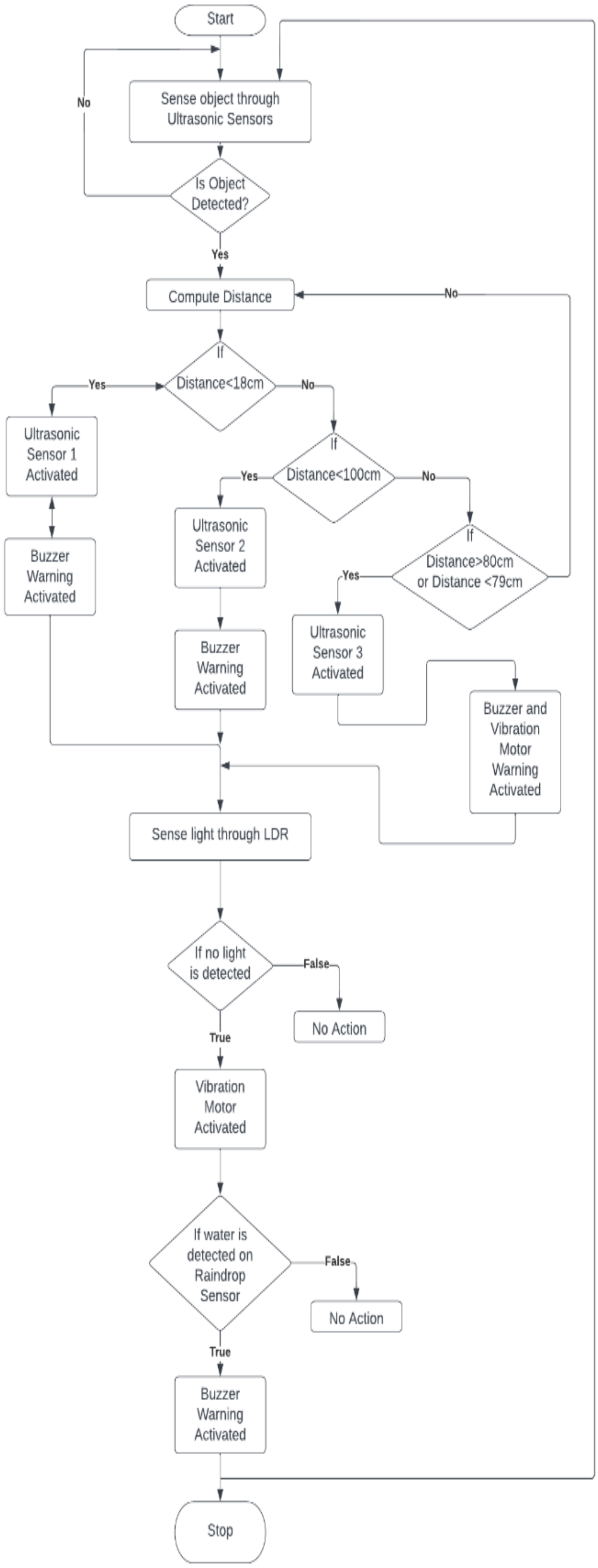

Fig. 11 Flowchart indicating sensor operations

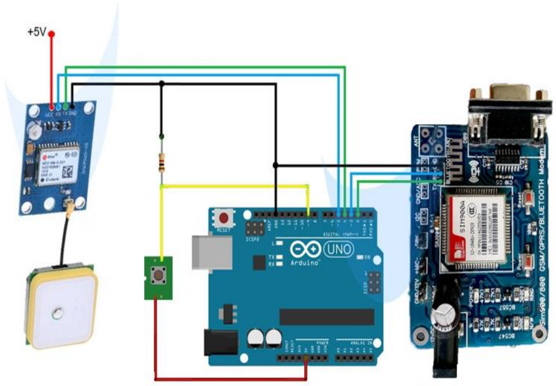

Fig. 12 Connection Diagram for Arduino UNO 2

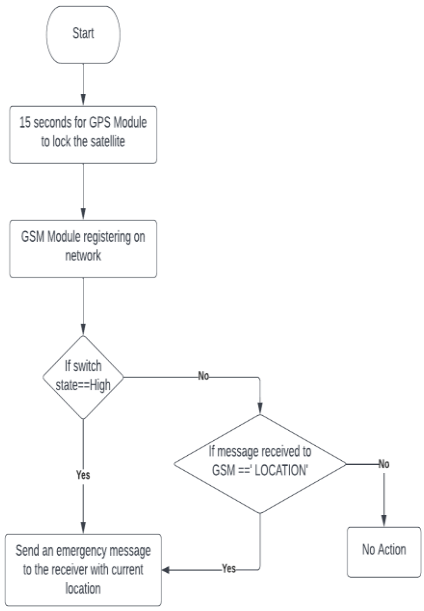

Fig. 13 Flowchart to send an emergency message to the saved number.

E. Result and Analysis

The three ultrasonic sensors used work simultaneously by identifying whether an obstacle is present in the path or not. Table 1 provides the necessary justification for the detection made by ultrasonic sensors.

TABLE I
OBSTACLE DETECTION JUSTIFICATION

Ultrasonic Sensor1	**Ultrasonic Sensor2**	**Ultrasonic Sensor3**	**Case**
Detected	Not Detected	Not Detected	The obstacle at 15cm height
Detected	Detected	Not Detected	The obstacle at 40cm height

Not Detected	Not Detected	Detected	Elevated or Sunken Surface
Detected	Detected	Detected	Continuous elevated surface probably a staircase

Fig. 14 Distance Sensor Values for a different position

Fig. 15 Distance Sensor Values for a different position

Fig. 16 Readings from GPS Module

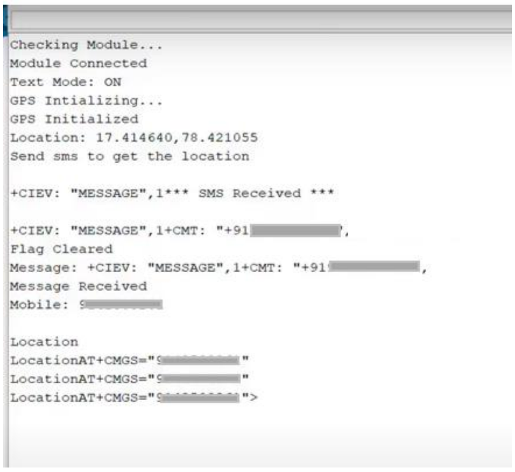

Fig. 17 Readings from GSM Module

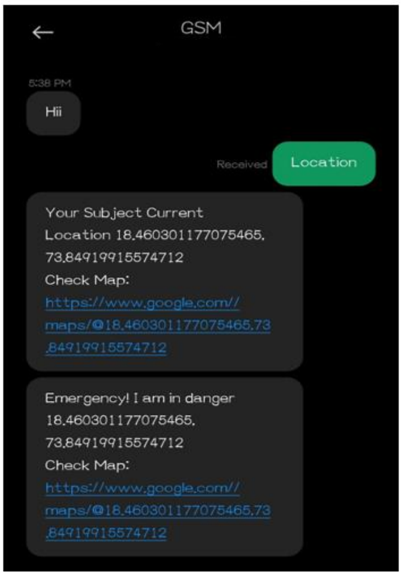

Fig. 18 Message Received by Receiver

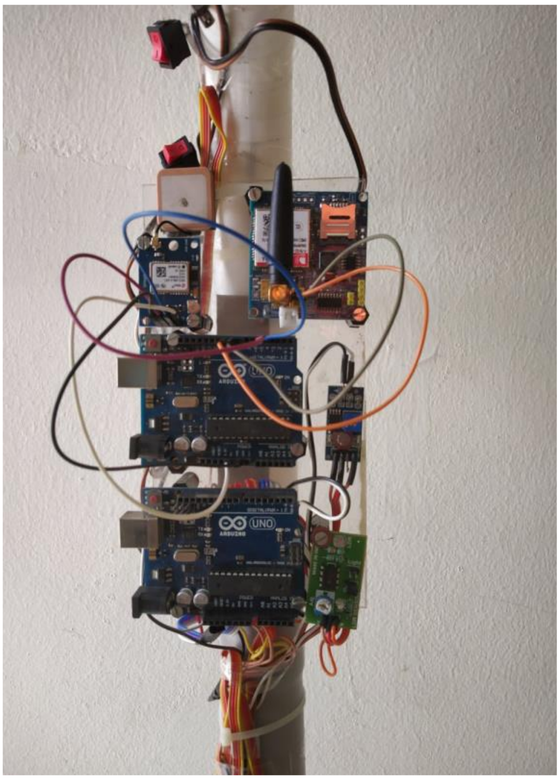

Fig. 19 Connection for Sensors in the Prototype

Fig. 20 Complete Prototype

IV. CONCLUSION

The Smart Blind Stick gives the result for all 360° from the position of the smart walking stick. So, this system provides overall support for the blind society in guiding. The broad beam angle ultrasonic sensors help in a wide range of obstacle detection. The main aim of this system is to act as a security guard and helps the blind to be aware of their surroundings. Future work includes the addition of a GPS along with designing an application and face recognition to find out the people before them. The addition of a GPS helps in locating the exact position of the blind person which helps their guardians to find them and provides a great guide. It will act as a basic platform for the generation of more such devices for the visually impaired and it will be a real boon for the blind. The developed system gives good results in detecting obstacles in front of the user. In this system, the sensors play an important key role to detect the objects in front of the blind to make them free to walk for the blind people. Due to these features, it is the best equipment for blind and visually impaired people for walking on the road. Hence the system can solve the problems faced by the blind in their daily life. The system also takes measures to ensure their safety.

REFERENCES

1. *S. M. T. Ma Naing, NweNweOo, May ThweOo, Smart Blind Walking Stick using Arduino, International Journal of Trend in Scientific Research and Development (IJTSRD)Volume 3 Issue 5, August 2019.*
2. *R Dhanuja, F Farhana, G Savitha, Smart Blind Stick Using Arduino, International Research Journal of Engineering and Technology (IRJET), Volume: 05 Issue:03 | Mar-2018.*
3. *G Srinivas, G M Raju, D Ramesh, S Srinivas, Smart Blind Stick Connected System Using Arduino, IJRAR International Journal of Research and Analytical Reviews, Volume 6 Issue 2 I April – June 2019.*
4. *Vipul V Nahar, Jaya L Nikam, Poonam K Deore, Smart blind walking stick, International Journal of Modern Trends in Engineering and Research (IJMTER), Volume 3, Issue 4, April 2016.*

5. *Ayat Nada, Samia Mashelly, Mahmoud A Fakhr, Ahmed F Seddik, Effective Fast Response Smart Stick, second international conference on advances in bioinformatics and environmental engineering-ICABEE, April 2015.*

6. *G. Prasanthi, P. Tejaswitha "Sensor assisted stick for the blind people" Transactions on Engineering and Sciences*

7. *A. Sangami, M. Kavithra, K. Rubina, S. Sivaprakasam "Obstacle Detection and Location Finding for Blind People"*

8. *Ankita R. Pawar, M. M. Mahajan "Multitasking Stick for Indicating Safe Path to Visually Disabled People"*

9. *"Smart walking stick -an electronic approach to assist visually disabled persons", Mohammad Hazzaz Mahmud, Rana Saha, Sayemul Islam.*

10. *Smart Stick for Blind People: S. Divya, Shubham Raj, M. Praveen Shai, A. Jawahar Akash, V. Nisha, INCOS(IEEE)*

11. *Manoj Kumar, Rohit Verma, Mukesh Kumar, Shekhar Singh4, Er. Thakurendra Singh," Ultrasonic Based Smart Blind Stick For Visually Impaired Persons" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 2017*

12. *Ashraf Anwar, Sultan Aljahdali ." A Smart Stick for Assisting Blind People". IOSR Journal of Computer Engineering (IOSR-JCE), Volume 19, Issue 3, Ver. II www.iosrjournals.org 86, 2017*

13. *'Smart Blind Stick' Sameer Grover, Aeysha Hassan, Kumar Yashaswi, Prof. Namita Kalyan Shinde. SSRG International Journal of Electronics and Communication Engineering (SSRG-IJECE) – Volume 7 Issue – 5 May 2020*

14. *Smart Blind Stick Design and Implementation Amira. A. Elsonbaty. International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249-8958, Volume-10 Issue-5, June 2021*

15. *M. S. Nowak and J. Smigielski (2015). The Prevalence and Causes of Visual Impairment and Blindness among Older Adults in the City of Lodz, Poland, Medicine, 94(5), 505, doi:10.1097/MD.0000000000000505*