Chapter 1

INTRODUCTION

Blindness is defined as the lack of vision caused due to physiological or neurological factors resulting into visual disability. Blindness can be temporary or permanent and partial or complete blindness causing a person to become dependent on others for help. If the person wants to be independent and do not want to seek help from others, Smart Blind Stick is a device, which is an initiative to help blind people to resolve the problems faced by them in their daily life.

Visually impaired persons have difficulty to interact and feel their environment. They have little contact with surroundings Physical movement is a challenge for visually impaired persons, because it can become tricky to distinguish obstacles appearing in front of them, and they are not able to move from one place to another. They depend on their families for mobility and financial support. Their mobility opposes them from interacting with people and social activities. In the past, different systems are designed with limitations without a solid understanding of the nonvisual perception. Researchers have spent the decades to develop an intelligent and smart stick to assist and alert visually impaired persons from obstacles and give information about their location. Over the last decades, research has been conducted for new devices to design a good and reliable system for visually impaired persons to detect obstacles and warn them at danger places. Smart walking stick is designed to detect obstacles which may help the blind to navigate care-free. The audio signals will keep the user alert and considerably reduce accidents. This system presents a concept to provide a smart electronic aid for blind people, both in public and private space The proposed system contains the ultrasonic sensor, Arduino and buzzer. The Stick measures the distance between the objects and smart walking stick by using an ultrasonic sensor objects or obstacles come in range of an ultrasonic sensor then the speaker guides the direction. The smart walking stick is a simple and purely mechanical device to detect the obstacles on the ground. This device is light in weight and portable. But its range is limited due to its own size. It provides the best travel aid for the person. The blind person can move from one place to another independently without the others help. The main aim of the system is to provide an efficient navigation aid for the blind persons which gives a sense of vision by providing the information about their surroundings and objects around them. Main objective of the device is to help blind people to walk with complete relieve and self-dependency. The blind stick is integrated with ultrasonic sensors and buzzer along

with Arduino UNO. The Smart Blind Stick automatically detects the obstacle in front of the person by use of sensors present in the systems.

1.1 Problem Definition

Physical movement is challenging for visually impaired person. The conventional walking stick used by them is very limited in its range of detection and is used to detect the object which is near to the user.The disadvantage of conventional cane, however, is its failure to detect the obstacles outside of its reach. That is the user has to touch the ground or the object to detect the obstacle. The visually challenged people can avoid the object better if the walking stick can produce sound warning when there is an object in the specified range of distance.

1.2 Motivation

Obstacle detection is one of the major concerns for a blind person. The primary goal of this project is to assist blind people to walk with ease and to alert them whenever their walking path is obstructed by other objects or people. So, this helps them to easily move in this busy world. Our motive is the help them so that many accidents are minimized. In this mini project we are implementing a voice assisted smart blind stick using Arduino Uno and Ultrasonic sensors.

1.3 Objectives

- To simplify the physical movement of visually impaired person
- To replace the conventional walking cane with smart walking stick that detect obstacle.
- To make the blind person safe while they are walking.
- To design smart stick for blind person using Ultrasonic sensor at distance range 2cm to 4m using tinker cad simulation.
- To design a walking stick that detects obstacles using ultrasonic sensor.
- To trigger the buzzer for signaling.

Chapter 2

Literature review

A literature survey is a proof essay of sorts. It is a study of relevant literature materials in relation to a topic we have been given. For thorough development of the device Smart Stick for Blind Using Arduino, we need to go through each and every technical aspect related to it. This chapter provides an introduction to the area of research. A Brief Study and Survey has been Carried out to understand various issues related to the project which involves providing a smart electronic aid for blind people to provide artificial vision and object detection, real time assistance via voice module by using Arduino uno. A survey is made among the Blind people finding difficulties in detecting obstacles during walking in the street .Our project mainly focuses on the visually impaired people who cannot walk independently in unfamiliar environment .The main aim of our project is to develop a system that helps the blind people to move independently. Smart Stick for Blind systems usually consists of three parts to help people travel with a greater degree of psychological comfort and independence: sensing the immediate environment for obstacles and hazards, providing information to move left or right and orientation during travel.

[1] M Narendran, SarmisthaPadhi, Aashita Tiwari, “the third eye for the blind using Arduino and ultrasonic sensor”. Department of Computer Science & Engineering, SRM Institute of Science & Technology Ramapuram, Chennai, Tamil Nadu, India, National Journal of Multidisciplinary Research and Development ISSN: 2455-9040 Volume 3; Issue 1; January 2018; Page No. 752-756 . This was a wearable technology for the blinds. One of the main feature of this device is that it will be affordable. This was equipped with ultrasonic sensors, consisting of module. Using the sensor, visually impaired can detect the objects around them and can travel easily. When the sensor detects any object it will notify the user by beep or vibration. Arduino, wearable band, buzzer, blind, people, ultrasonic.

[2] Sathya, S.Nithyaroopa, P.Betty, G.Santhoshni, S.Sabharinath, M.J.Ahanaa” smart walking stick for blind person”. Department of Computer Science and Engineering, Kumara guru College of Technology Coimbatore. Coimbatore International Journal of Pure and Applied Mathematics Volume 118 No. 20 2018, 4531-4536. The proposed system contains the ultrasonic sensor, water sensor, voice play back board, raspberry pi and speaker. The proposed system detects the obstacle images which are present in outdoor and indoor with the help of a

camera. The Stick measures the distance between the objects and smart walking stick by using an ultrasonic sensor. To provide vision to the user so we need to consider and process the image ahead as well. The image is detected using image sensors (camera walking stick including a USB camera, RF module, Rain sensor, Ultrasonic sensor, Raspberry pi and a head phone attached to it. The raspberry pi is the central controller of the system. The images which were sent from the camera are compared with the images stored in the dataset using the image processing. For image processing, morphology segmentation is used.

[3] Jayakumar, S.Magesh ,K.Prasanth, P.Umamaheswari, R.Senthilkumar,"smart walking stick for visually impaired people". Dept.of EEE, Erode Sengunthar Engineering College. International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST) Vol.3, Special Issue.24, March 2017. The different sensors like object sensors (ultrasonic sensors), humidity sensor, temperature sensor and light sensor are used. Speaker and volume control is used in the form the status to the blind people. GPS is used to track the blind people path and emergency conditions are transmitted to the neighbour through GSM based alarm system. This project is implemented by using the DSPIC30F2010 controller, ARM Processor, DISPIC3OF 2010.

[4] Dada Emmanuel,Gbenga, Arhyel, Ibrahim Shani , Adebimpe Lateef, Adekunle . "Smart walking stick for visually impaired people using ultrasonic sensor and Arduino".Department Of Computer Engineering, University Of Maiduguri, Borno State, Nigeria . International journal of innovative research in electrical, electronics, instrumentation and control engineering vol. 4, issue 3, March 2016. This paper presents the smart walking stick based on ultrasonic sensors and Arduino for visually impaired people the system was designed, programmed using c language and tested for accuracy and checked by the visually impaired person. Our device can detect obstacles within the distance of about 2m from the user. Ultrasonic sensor, Arduino atmega328 microcontroller, mobility aid, visually impaired person, alarm.

[5] D.Sekar, S.Sivakumar, P.Thiyagarajan, R..Premkumar, Vivekkumar," Ultrasonic and voice based smart stick". SriEshwar College of Engineering. International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering Vol. 4, Issue 3, March 2016. In this paper GPS technology is integrated with pre-programmed locations to determine the optimal route to be taken. The user can choose the location from the set of

destinations stored in the memory and will lead in the correct direction of the stick. In this system, ultrasonic sensor, temperature sensor, humidity sensor, GPS receiver, vibrator, voice synthesizer, speaker or headphone, PIC controller and battery are used in this system, ultrasonic sensor, temperature sensor, humidity sensor, GPS receiver, vibrator, voice synthesizer, speaker or headphone, PIC controller and battery are used.

[6] "Smart walking stick - An electronic approach to assist visually disabled persons" by Mohammad Hazzaz Mahmud, RanaSaha, and Sayemul Islam in this paper are the sensor-based circuitry consisting of sensors, Ultrasonic Sensor is used to detect obstacles, A PIC16F690 microcontroller reads these sensors and drives a buzzer, a LED and a motor with PWM. An audio output is designated by a buzzer alarm.

[7] "Arm7 Based Electronic Travel Aid System for Blind People Navigation and Monitoring" V. S. M. Madulika S, M. S. Madhan Mohan, CH.Sridevi, T. V. Janardhana rao.This paper 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 stick of the blind people. When the object is detected near to the blinds' stick it alerts them with the help of vibratory circuit (speakers or head phones). The system consists of ultrasonic sensor, GPS Module, GSM Module and vibratory circuit (speakers or headphones).

[8] "Ultrasonic smart cane indicating a safe free path to blind people", Arun G. Gaikwad 1, H. K. Waghmare2 1ME Embedded system Design, MIT Aurangabad Assistant Professor Department of E&TC, MIT Aurangabad

[9] "A Multidimensional Walking Aid for Visually Impaired Using Ultrasonic Sensors Network with Voice Guidance", lakanmi and Oladayo.

CHAPTER 3:

TECHNICAL CONTENT AND RELEVANCE

This project is build based on a simple concept. Five key components are needed to build this project, these are two ultrasonic Sensors, an Arduino board, Buzzer. Two ultrasonic sensors are used to detects obstacles at different hight. Then these sensors send data to the Arduino board. Now the Arduino calculates the distance between the sensor and the obstacle. Whenever an obstacle comes near these sensors, then the Arduino sends operating voltage to the Buzzer. Then the Buzzer and Led turn on, these are used as indicators. The smart stick for the blind as the name suggests is **a device for the visually impaired to guide the user to respective destination and avoiding to collide with the obstacles**. It uses two ultrasonic sensors HC SR 04 to detect the depth below or the obstacles in between. One of them transmits the ultrasonic waves and serves as the transmitter. The other each serves as a receiver and collects the repeated sound signal (mostly a small microphone). The sensor is adjusted according to air velocity of the echo. With that measured information, the time difference between sound pulse propagation and detection is determined by calculation of the distance to the target. This circuit is powered through a switch by a 9 volt battery. The smaller the obstacle gap, the more frequent the beep buzzer is. We can say the length of the beep is inversely proportional to the size. The ultrasonic sensor is the main feature of this device. The ultrasonic sensor transmits a sound pulse at high frequency, and then measures the period to obtain the sound echo signal to mirror back. There are 2 circles inside the sensor. Arduino microcontroller is the key feature of this computer. The specific blocks connected to this device include an buzzer, vibrator, An ultrasonic sensor for (if any) barriers is used in this system. The ultrasonic sensor can provide an extremely cost-efficient remote measuring device. Vibrator and buzzer run using the sensor data. On discovery of the stream, buzzer is triggered. Even supplying vibrator to show obstacles. The system has one more benefit. The blind person may sometimes lost his stone, or forget where he was put. An Arduino UNO is used to control all the sensors. The complete board is powered by a 9V battery which is regulated to +5V using a 7805 Voltage regulator. The Ultrasonic sensor is powered by 5V and the trigger and Echo pin is connected to Arduino UNO pin 9 and 10 The output of the board is given by the Buzzer which is connected to pin 11 and Motor which is connected to pin 13.

Visually impaired persons have difficulty to interact and feel their environment. They have little contact with surroundings Physical movement is a challenge for visually impaired persons, because it can become tricky to distinguish obstacles appearing in front of them, and they are not able to move from one place to another. They depend on their families for mobility and financial support. Their mobility opposes them from interacting with people and social activities. In the past, different systems are designed with limitations without a solid understanding of the nonvisual perception. Researchers have spent the decades to develop an intelligent and smart stick to assist and alert visually impaired persons from obstacles and give information about their location. Over the last decades, research has been conducted for new devices to design a good and reliable system for visually impaired persons to detect obstacles and warn them at danger places. Smart walking stick is designed to detect obstacles which may help the blind to navigate care-free. The audio signals will keep the user alert and considerably reduce accidents. This system presents a concept to provide a smart electronic aid for blind people, both in public and private space The proposed system contains the ultrasonic sensor, Arduino and buzzer. The Stick measures the distance between the objects and smart walking stick by using an ultrasonic sensor objects or obstacles come in range of an ultrasonic sensor then the speaker guides the direction. The smart walking stick is a simple and purely mechanical device to detect the obstacles on the ground. This device is light in weight and portable. But its range is limited due to its own size. It provides the best travel aid for the person. The blind person can move from one place to another independently without the others help. The main aim of the system is to provide an efficient navigation aid for the blind persons which gives a sense of vision by providing the information about their surroundings and objects around them. Main objective of the device is to help blind people to walk with complete relieve and self-dependency. The blind stick is integrated with ultrasonic sensors and buzzer along with Arduino UNO. The Smart Blind Stick automatically detects the obstacle in front of the person by use of sensors present in the systems.

Chapter 4

Hardware and Software requirements

Hardware requirements:

- **Arduino Uno:** Arduino Nano is one type of microcontroller board, and it is designed by Arduino.cc. It can be built with a microcontroller like Atmega328. This microcontroller is also used in Arduino UNO. It is a small size board and also flexible with a wide variety of applications.

  Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output. Arduino UNO features AVR microcontroller Atmega328, 6 analogue input pins, and 14 digital I/O pins out of which 6 are used as PWM output.

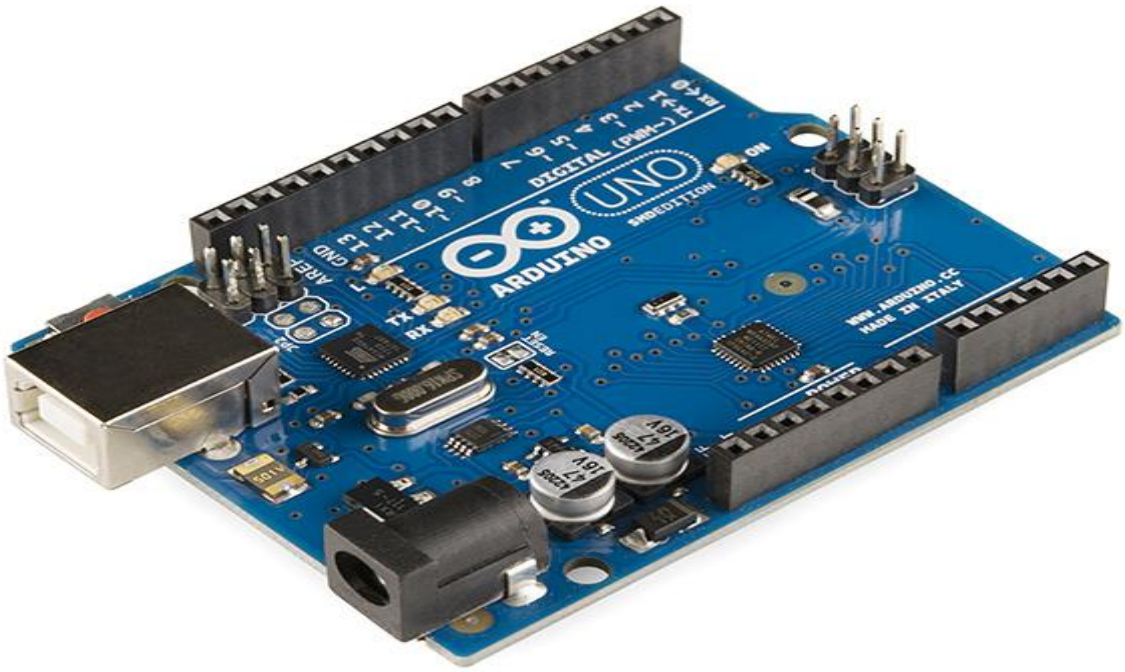


Fig. 4.1

- **Ultrasonic Sensors:** It is an ultrasonic sensor, also known as an ultrasonic transducer, that is based on a transmitter and receiver and is primarily used to determine the distance from a target object with a wavelength ranging from 20kHz to 20 MHz . sensors, like sonar detectors, work by transmitting a pulse of sound outside the range of human hearing. At the speed of sound (340 m/s), this pulse travels away from the range finder in a conical shape. The sound bounces off an object and is reflected in the range finder. This is interpreted as an echo by the sensor, which measures the time between transmitting the signal and receiving the echo. The object's distance is then calculated using this interval by a controller in simple notation

$$distance = \frac{elapsed\ time\ x\ speed\ of\ sound}{2}$$

The ultrasonic sensor is a robust and flexible sensing agent with relatively few limitations. Our ultrasonic sensors are in the air, non-contact object detection and ranging sensors that detect objects within an area. These sensors are not affected by the colour or other visual characteristics of the detected object.
Ultrasonic sensors use high-frequency sound to detect and localize objects in a variety of environments. Ultrasonic sensors measure the time of flight for the sound that has been transmitted to and reflected from nearby objects. Based upon the time of flight, the sensor then outputs a range reading

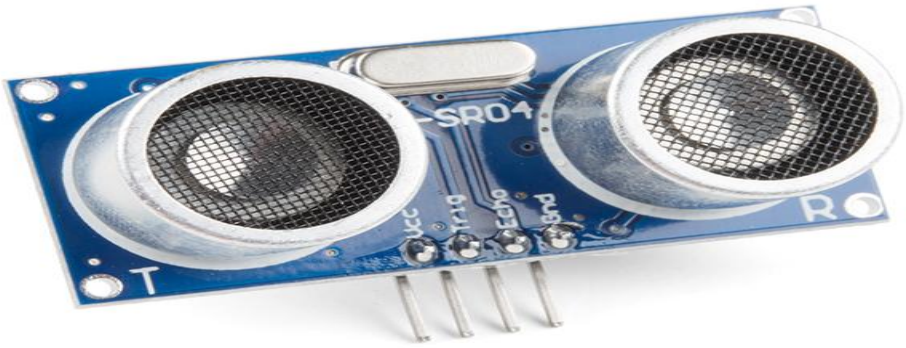


Fig. 4.2

- **Buzzer:** A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, train and confirmation of user input such as a mouse click or keystroke.

Fig. 4.3

- **LED:**LED is Light emitting diode. The main function of Diode is that it allows the current to flow in one direction only.

The LED has two terminals:

1. Positive Terminal: The longer leg of the LED is positive.
2. Negative Terminal: The shorter leg of the LED is negative.

Fig. 4.4

- **Pager Motor(vibrator):**The cylinder shape is also called bar-type vibration motor. This vibrating motor is essentially a motor that is improperly balanced. In other words, there is an off-centered weight attached to the motor's rotational shaft that produces a centrifugal force while rotating. This unbalanced force displaces the motor. Its high speed displacement makes the motor to wobble, which is known as the “vibrating”. The wobble can be changed by the weight mass you attach, the weight's distance to the shaft, and the speed at which the motor spins.Motors work through a process called induction. When you an put electric charge through wire, a magnetic field is created. A coiled wire will create a stronger field, as will increased current

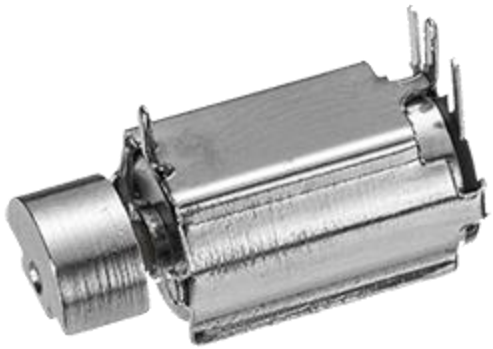


Fig. 4.5

Software requirements:

- **Arduino IDE:** 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.

Fig. 4.6

- **Tinkercad**: Tinkercad is an excellent tool that allows us to simulate Arduino-based systems (and a lot more). We can simulate all exercises and even our own designs before trying them on real hardware. It also allows us to do programming using block

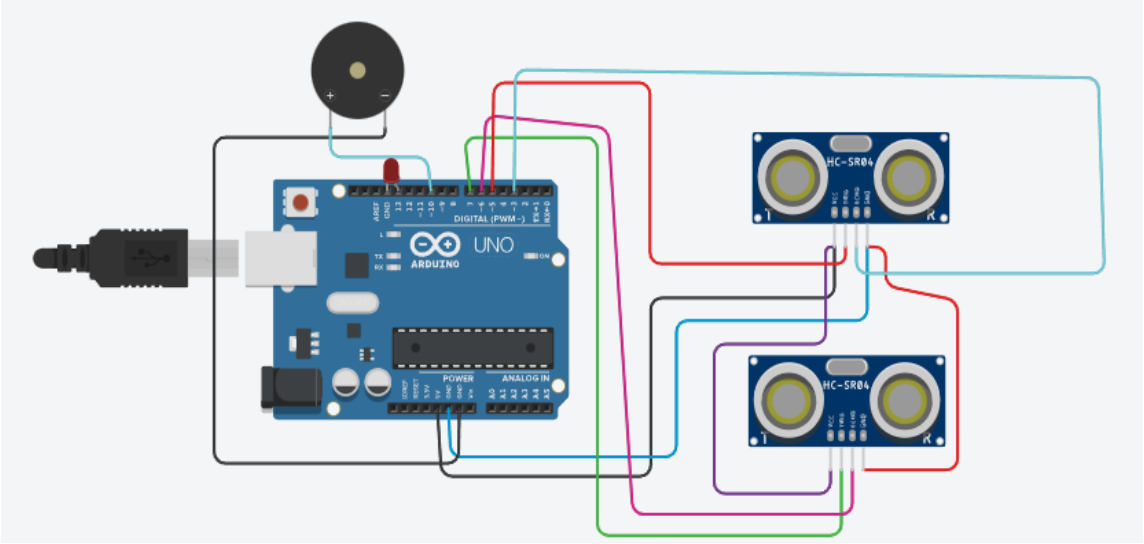


Fig. 4.7

Chapter 5

Block Diagram & Methodology

Block diagram

We here propose an advanced blind stick that allows visually challenged people to navigate with ease using advanced technology. The blind stick is integrated with ultrasonic sensor along with speaker Our proposed project first uses ultrasonic sensors to detect obstacles ahead using ultrasonic waves. On sensing obstacles, the sensor passes this data to the Arduino nano. The Arduino then processes this data and calculates if the obstacle is close enough. If the obstacle is not that close the circuit does nothing. If the obstacle is close the Arduino sends a warning in the form of voice.

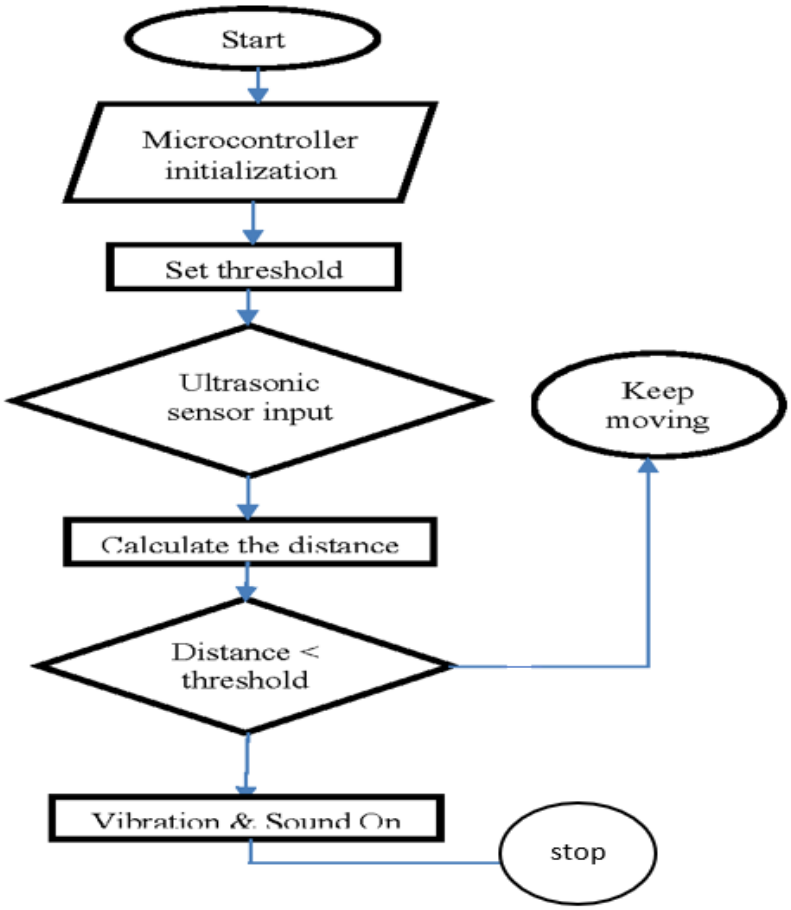


Fig. 5.1

Methodology

- We will try to accomplish and finish the project as per the scheduled time by referring some materials (book, internet) concerned with blindness and its related technology.
- On doing this project to achieve good quality and to get resources reliable, first the availability of equipment's and quality will be cheeked.
- This can be done by measuring the discreet component values and checking they fit for the purpose they will be needed.
- We try to read different books which are related to our project under the section Literature review then design the sensor circuit which is used to senses obstacle object
- We will simulate the circuit using Tinkercad and finally hardware implementation will be performed

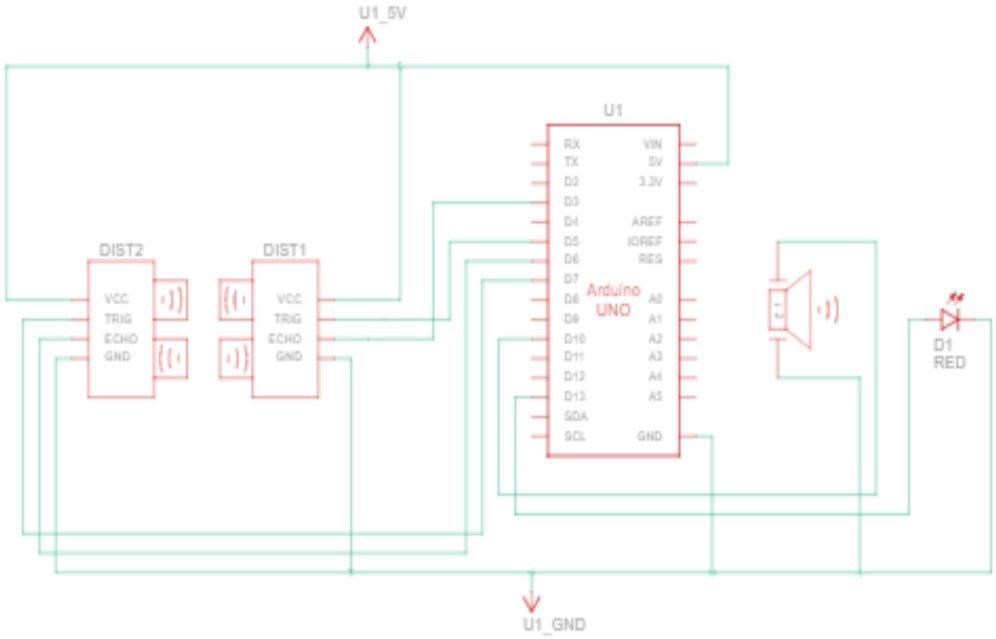
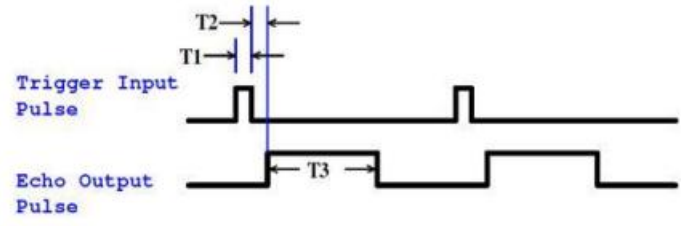


Fig 5.2

Chapter 6

RESULTS AND DISCUSSION

Ultrasonic sensor, arduino are tested individually as well as integrated. As ultrasonic sensors work on principle of echo, studying of its reflection on different obstacle is very important. The measurement cycle starts with transmitting the 10µs high level pulse to the sensor trigger pin to start ranging (T1), then the sensor will send out ultrasonic signal with 40 kHz and 450µs (T2) and then wait to capture the rising edge output by echo port (T3) from 150µs: 25ms, depending on measured distance as shown in Fig. 4. In case of no obstacle (no signal reflected) it waits 38ms before it restarts transmission.



Timing diagram

Fig 6.1

RESULT OF ULTRASONIC SENSOR COMPARISON

Distance (cm)	Analog value calculated (mV)	Analog value measured (mV)	error
5	25	24	1 mv
10	50	48.8	1.8 mv
20	100	97.6	2.4 mv
30	150	146.4	3.6 mv
40	200	195.3	4.7 mv
50	250	244.15	5.85 mv
75	375	366	9 mv
100	500	489	11 mv
150	750	732	16 mv
200	1000	976.6	23.4 mv
250	1250	1220.7	29.3 mv
300	1500	1464.9	35.1 mv
350	1750	1709	41 mv
400	2000	1953.2	46.8 mv

We tested how the ultrasonic sensors performance in lab compared to simulated calculation. TABLE II and Fig. 6 are present comparison of the ultrasonic sensor analog voltage value between the calculation value and measurement value. Thereafter the error is calculated in

small range 5:50 cm error is 1– 6 mv, medium range 75:200 cm error is 9 – 23 mv and far range 250:400 cm error is 30 – 47 mv.

Difference between calculated and measured value

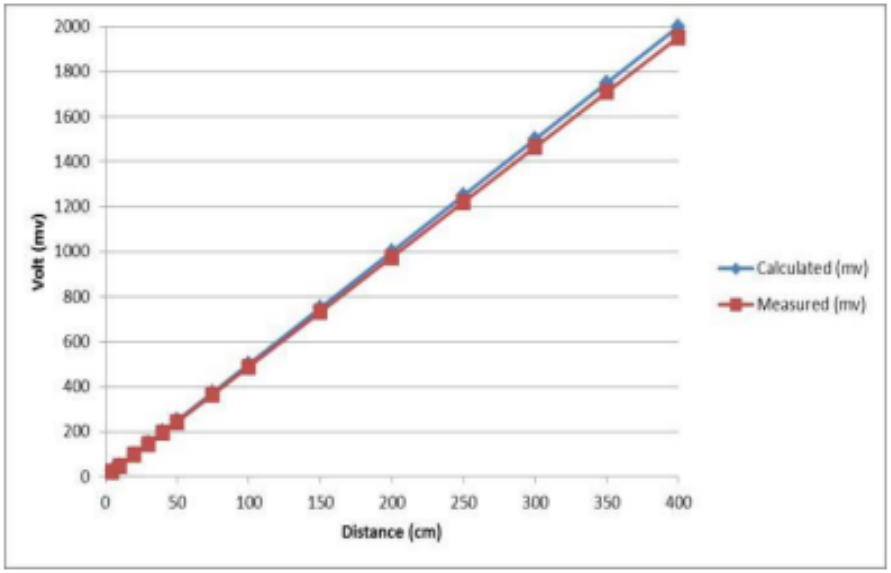


Fig 6.2

EXPECTED OUTCOMES

- The stick is capable of detecting all obstacles in the range 40 centimeter during 39 ms and gives a suitable respect message empowering blind to move twice his normal speed because she/he feels safe. The smart stick is of low cost, fast response, low power consumption, light weight .

APPLICATIONS

- Facilitates the visually-impaired people through various user-friendly features such as **Navigation, Obstacle alert and communication**.

SOCIETAL RELEVANCE

- This proposed idea of **smart stick** for **blind** people is a sincere attempt to upgrade the lifestyle of visually impaired by providing independent mobility to the **blind** person with the help of smart stick and helps in locating the exact location by buzzer sound and in constant contact of their loved ones setting them free into their surroundings.
- A white cane primarily allows its user to scan their surroundings for obstacles, but is also helpful for onlookers in identifying the user as blind or visually impaired and taking appropriate care.

Advantages

- The main advantage of the system is that it helps the blind people in both indoor and outdoor, care-free navigation Discrete distances to moving objects can be detected and measured.
- The devices placed in the stick makes it comfortable and easy to handle.
- The smart stick helps in detecting obstacles placed at a distance in front of the user.
- The system is suitable for both indoor and outdoor environment.

Disadvantages

- They can't detect obstructions that are hidden but very dangerous for the blind such as downward stairs, holes etc. Usually, the feedback information comes out as either vibration or sound signals.
- The battery must be charged.

Chapter 7

CONCLUSION AND FUTURE SCOPE

CONCLUSION

The smart walking stick, constructed with at most accuracy, will help the blind people to move from one place to another without others help. This could also be considered a crude way of giving the blind a sense of vision. This stick reduces the dependency of visually impaired people on other family members, friends and guide dogs while walking around. The proposed combination of various working units makes a real-time system that monitors position of the user and provides dual feedback making navigation more safe and secure. The smart stick detects objects or obstacles in front of users and feeds warning back, in the form of voice messages rather than vibration. Also the incorporation of automatic room equipment switching in the stick will be useful while they are indoor. The advantage of the system lies in the fact that it can prove to be a low cost solution to millions of blind person worldwide. It is worth mentioning at this point that the aim of this study which is the design and implementation of "A smart walking stick for assisting blind peoples" for the blind has been fully achieved. The Smart Stick acts as a basic platform for the coming generation for more aiding devices to help the visually impaired peoples to navigate safely both indoor and outdoor. It is effective and affordable. In a developing country like India, there is a need of cost-effective solution so that most of the people can't have an effective device as proposed in this paper. The device constructed in this work is capable of detecting obstacles, heat flames and water. The system also takes the measure to ensure their safety. This project will operate to help all the blind people in the world to make them easier to walk everywhere they want. It is used to help the people with disabilities that are blind to facilitate the movement and increase safety. Our solution is different from the other is because we are trying to minimize the problems and difficulties of the blind peoples by adding more aiding sensors which is capable for detecting heat flame, water and obstacles. This stick is very affordable in price with lot of features reacting time is too quick, sensor sensing is also fast and the range of detecting the obstacle is adjustable according to the requirement/need of the persons. This stick light in weight, easy to handle, easy to use, and with rechargeable or removeable battery. This is a future gadget/product and project idea for the blind peoples.

FUTURE SCOPE

- It can be further enhanced by using VLSI technology to design the PCB unit. This makes the system further more compact. Also, use of active RFID tags will transmit the location information automatically to the PCB unit, when the intelligent stick is in its range.
- The RFID sensor doesn't have to read it explicitly. The global position of the user is obtained using the global positioning system (GPS), and their current position and guidance to their destination will be given to the user by voice.
- The future scope of the existing smart stick, guides the visually impaired person in his navigation independently in an efficient manner ensuring the person's safety.
- The programmable wheels would steer the stick away from the obstacles and also leading the blind person towards the destination.
- Internet of Things is a trending concept which can increase the benefits of the smart stick by allowing one stick to communicate with another smart stick (or mobile , PCs) nearby to utilize the functionality of the other stick when one stick's functionality breaks down.
- In order to run this integrated set of hardware we can use solar panels as an alternative to the battery. The use of solar panel occurs to be more advantageous as it uses sunlight, the easily available renewable resource of energy, to get recharged.
- Wireless connectivity between components of the device will enhance the additional features of this instrument and increase the range of ultrasound sensors and incorporate technologies to measure the intensity of obstacles approaching. With this approach, our targets in all of the developing countries were particularly addressed towards visually impaired and blind people. In this analysis the machine built can only sense obstacles and humidity.
- No holes can be identified with this device or with the form of barrier. Thus, ultrasonic sensor systems, arduino Uno and other tools can be designed for an approach to warn users about the direction of movement by using audio commands. For easy use and flexibility, a vibrator can also be attached. Further enhancements to boost system performance will be made in future. These include: an international system for locating the individual via the GPS and GSM systems in

order to reach the parent or caregiver venue. It should be flexible and wide range of handling.

- It's safe and affordable. This results in effective obstacle detection within three meters of the user's direction. It offers low cost, reliable, lightweight, low power and efficient navigation with fast, quick response times. The computer is hardwired, but light weight, with sensors and other features.

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