Blind Navigation

Submitted in partial fulfilment of the requirements

of the degree of

Bachelor of Engineering

by

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CERTIFICATE

This is to certify that the project entitled **“Blind Navigation”** is a bonafide work of

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Project Report Approval for B. E.

This project report entitled ***Blind Navigation System*** by ***Adwait Sanjeev, Mansi Suhas Raut, Arindam Alok Samanta*** is approved for the degree of ***Bachelor of Engineering*** in ***Computer Engineering*** from ***University of Mumbai***.

Examiners

1.--

2.--

Date:

Place:

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

The proposed project presents a system for those people of our society who are suffering from visually challenging situations. For a number of years, scientists have been trying to develop aids that can make visually impaired people more independent and aware of their surroundings. This project will benefit them and help them in many ways. The main need of this project is to expand the electronic travel aid for the visually impaired pedestrians by emerging into the ultrasonic technology. This system is safe, reliable and cost-effective. Objective of this project is to provide an electronic aid as guidance to overcome the lacking of their visualization power by proposing a simple, effective, configurable electronic guidance system for visually impaired pedestrians. Their condition becomes worse when the travel to unfamiliar location with no personal assistance.

To overcome this type of situation the proposed system is developed. The system is able to understand obstacles around the surroundings in the range of 2 cm - 400 cm. This is done using ultrasonic sensor. Sensor is placed on the stick. It calculates the distance of the detected obstacle from the user and gives feedback in the form of voice output. The proposed system uses Arduino Uno based system. The Aurdino Uno processes real time data collected from the surroundings using ultrasonic sensor network. Based on the detected signal from the obstacle, appropriate voice output is given to the user. The output is the distance from the sensor to the obstacle. The output is given through Bluetooth module to the user’s smart phone. The output is given to the user via ear-phones. Thus, the user gets alert about the obstacle and is informed about the same well in advance.

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Chapter 1

Introduction

According to survey conducted in 2009 by World Health Organization on disability, there are 269 million visually impaired and 45 million blind people worldwide [1]. Ageing population and lifestyle changes leads to chronic blinding conditions such as diabetic retinopathy which is projected to rise exponentially. Without effective major intervention, the number of blind people worldwide has been projected to increase to 76 million by 2020 if current trends continue [2]. Many traditional and advanced navigational aids are available for visually impaired and blind people.

Usage of all these travel aids for detecting obstacles for smooth navigation requires a good training. Presently several electronic travel aids (ETA) are available for visually impaired and blind people. These aids are designed using recent technological developments in automation. Although many advanced electronic navigation aids are available these days for visually impaired and blind people, very few of them are in use. Therefore, user acceptability assessment of such systems is very important.

The most influencing parameters in this regard are size, portability, reliability, useful functionalities, simple user interface, training time, system robustness and affordability in terms of cost. Considering all these user expectations and requirements, a tailor-made low cost and reliable navigation system is proposed for visually impaired and blind people.

1.1 Motivation

Blind person has a difficult time walking down a busy street. Blind people always need someone to guide them. They have to be dependent on someone or the other. People are very busy with their own life and they are hardly bothered about anyone else. This makes the life of such blind people very difficult. To help them in such a way that they won't be a burden to anyone again is the need of the hour. There needs to be a system to help them navigate through their surroundings without having to depend on other people. So, the proposed system is designed to come up with this idea of smart stick for the blinds which will help them find the way on their own without the help of anyone.

The proposed system will help them to be independent and they won't need help from anyone while moving from place to place. This system will help them navigate through obstacles without the guidance of another person. They can be self-dependent with the help of this system.

1.2 Problem Statement

Helping the blind in navigation outdoors as well as indoors is an important issue. Being self-dependent is the most important trait in an individual living in the modern world. The existing systems help the visually impaired people but they are not effective enough. These systems could not detect the obstacles they would encounter while moving forward. They are mostly for the obstacles just lying around. The proposed system will aim to solve all these issues and help make their lives easy and simple.

1.3 Objectives

- To design a system to detect obstacles the user would encounter.
- To make the visually impaired people self-dependent.
- To make the life of visually impaired people simple and easy.
- To implement the system as cost efficient.
- To help the visually impaired people navigate through their surroundings using self-reliable system.

Chapter 2

Review of Literature

Literature Review acts as the basis of research and study of the various concepts required for a particular domain. It describes the theories and other methodologies that can be adopted in order to implement modules of the proposed system. This chapter includes literature survey of technical papers along with the advantages and disadvantage of each system.

2.1 3D Ultrasonic Stick for Blind [3]:

Today technology is improving daily in different aspects in order to provide flexible and safe movement for the people. In this technology driven world, where people strive to live independently, this paper propose a low-cost 3D ultrasonic stick for blind people to gain personal independence, so that they can move from one place to another easily and safety. A portable stick is design and developed that detects the obstacles in the path of the blind using ultrasonic sensors. It consists of these sensors to scan three different directions, a microcontroller, buzzer and DC vibration motor.

The main part in the system is the microcontroller that control the other components of the system. When the ultrasonic sensors detect any objects or obstacles in 180 degree horizontal and 60 degree vertical, it will activate the buzzer and the vibration motor automatically. In addition, the stick is equipped with GPS and SMS message system. When GSM modem receive a message, the microcontroller will process the message with the keyword saved in it. Then, it will get the location of the stick from the GPS modem and transmit the location to the GSM modem in order to respond to the sender. In case of an emergency, the user of the stick can press the emergency button. The microcontroller access the location from the GPS modem and transmit the location to the GSM modem which will send a SMS messages to the all saved numbers in the microcontroller. The GPS will update the location of the stick and automatically save the location in PIC18F45K22 EEPROM memory. If the microcontroller receive the word "OSAMA" from the GSM modem, the microcontroller will track the last location from the EPROM and transmit it to the GSM modem which will send an SMS message that states the location for the person to the required number. Addition to that, if the emergency button is pressed the directly the microcontroller will transmit the last location saved in the EEPROM to the GSM modem to send it to all saved number in the microcontroller.

The programming of GPS modem, GSM modem, buzzer and vibration motor has been successfully done for this system. Computer simulation is done to essence the performance of the system using Proteus software and Easy pic kit. The block diagram of the system is given in Figure 2.1

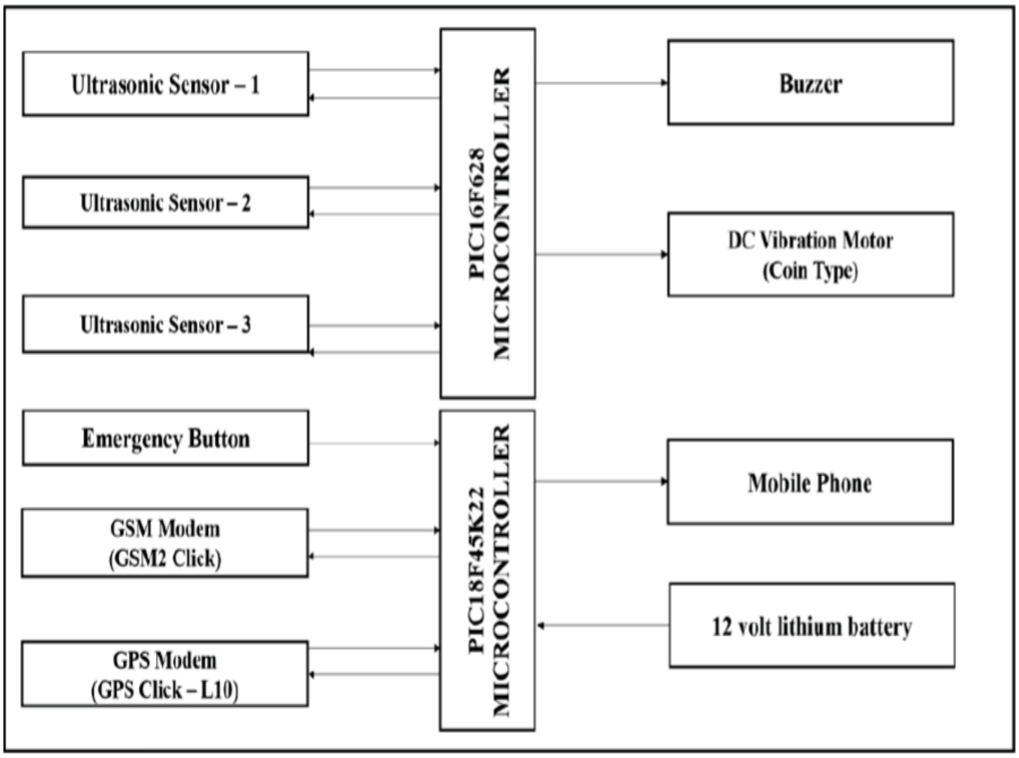

Figure 2.1: Block Diagram for 3D Ultrasonic Stick for Blind

Advantage

The proposed system was economical and efficient in comparison with the similar systems developed. The buzzer provided the required output according to the input signal to the microcontroller.

Disadvantages

However, the proposed system had delay while detecting the obstacles between 2 to 4 second. The delay for the GPS to get the location for the stick is around 30 second to one minute. In addition to that, GPS system cannot be used indoor because of the GPS signal will be too weak. The vibration motor only will activate if the distance is less than 50 cm from the obstacles.

2.2 Ultrasonic Spectacles and Waist-belt for Visually Impaired and Blind Person [4]:

This project presents an electronic navigation system for visually impaired and blind people. In this wearable system, two ultrasonic sensor pairs are mounted on the eye glasses and rest three pairs are mounted on customized waist belt. These three ultrasonic sensor pairs are placed 12 cm apart facing towards front left, centre and right direction. Using this placement and alignment of ultrasonic sensor pairs, the project was able to detect obstacles from waist level height to head level height in the range of 500 cm in any direction. These five pairs of ultrasonic sensors collect real time data after every 20 msec. and send it to AT89S52 microcontroller. The block diagram of the system is given in Figure 2.2.

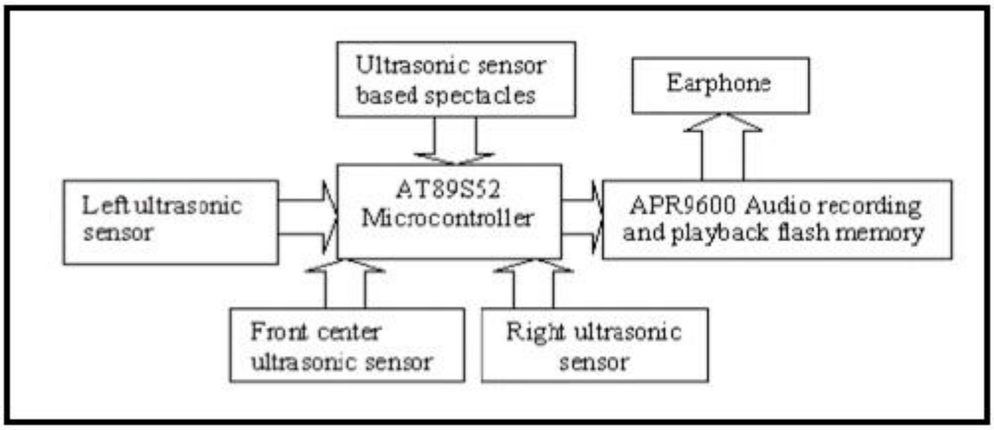

Figure 2.2: Ultrasonic Spectacles and Waist-belt for Visually Impaired and Blind Person

After processing this data, microcontroller invokes relevant speech message stored in flash memory. APR9600 audio recording and playback flash memory is used for storing pre-recorded speech messages. Variable duration of speech messages up to 60 sec. duration can be stored in this memory. It effectively calculates distance of the detected object from the user and prepares navigation path accordingly avoiding obstacles. Based on direction and distance of detected obstacle, relevant pre-recorded speech message stored in APR9600 flash memory is invoked. Such speech messages are conveyed to the subject using earphone.

Advantages

• Accurate detection of obstacles in front left and right direction.

• Detection of waist level height to head level height obstacles

• Minimum physical interface

Disadvantages

• Detection of ground level obstacles

• Recognition of obstacles and colours

2.3 Distance Sensing with Ultrasonic Sensor and Arduino [5]

A sensor is a device that converts one type of energy to another. Arduino is a small microcontroller board with a USB plug to connect to the computer. The Arduino board senses the environment by receiving input from a variety of sensors and can affect its surroundings by controlling LCDs, speakers, motors and GS module. Ultrasonic Sensor measure the distance of target objects or materials through the air using "non-contact" technology. They measure distance without damage and are easy to use. The output Signals received by the sensor are in the analog form, and output is digitally formatted and processed by microcontroller. In present work, it is used to detecting an obstacle, along with its exact distance. The internal analog to digital converter is used is calibrated to get almost accurate distance measurement. The measured distance is also displayed on an LCD screen.This application is based upon the reflection of sound waves. Sound waves are defined as longitudinal pressure waves in the medium in which they are travelling. Here the medium for the sound waves is air, and the sound waves used are ultrasonic, since it is inaudible to humans.

The measured results are displayed in liquid crystal display. The results are transferred to personal computer. This application is also used to find the obstacles detection and the exact distance can also be obtained. The measured distance is displayed on the LCD display.

The Ultra Sonic sensor works as a burst signal is transmitted for short duration (is emitted) by the emitter. After that there will be a silent period. This period is actually called “response time” and is the time waiting for reflected waves. This back bounced signal is called “echo”. The block diagram of the system is given in Figure 2.3.

Advantage

The system can detect the target and calculate the distance of the target. It is a handy system for non-contact measurement of distance. The bigger is the target, stronger will be the reflected signal and more accurate will be the distance calculated.

Disadvantage

For calculating the distance using this device, the target whose distance is to be measured should always be perpendicular to the plane of propagation of the ultrasonic waves. Hence the orientation of the target is a limitation of this system.

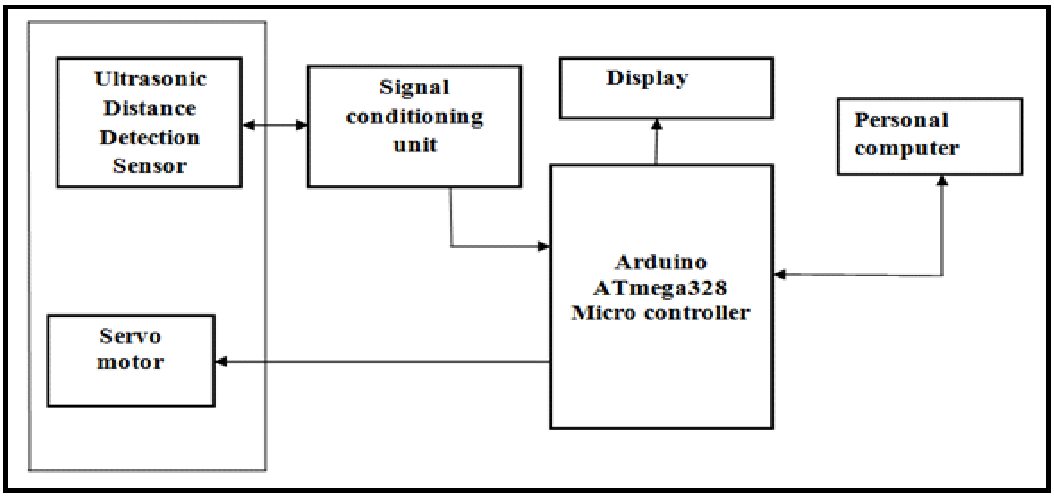

Figure 2.3: Block diagram of Ultrasonic Distance Detection with Arduino

Chapter 3

Requirement Analysis

3.1 Performance Requirements

Response Time

Response time is basically the time taken to do something after it has been given enough input. Whatever is been given as an output must be measurable in the real system. Care must be taken to ensure that the performance measurement is unambiguous, concise and completely defined.

Scalability

In one respect scalability is simply specified as the increase in the system's workload that the system should be able to process. The scalability required is often driven by the lifespan and the maturity of the system.

3.2 Software Requirement

Operating System: Windows 2000 or Higher
Software: Arduino

3.3 System Hardware Requirement (Minimum)

Processor: 1 GHz 32-bit or 64-bit processor

RAM: 2GB

Hard Disk: 3 GB

3.4 Hardware Components Required

1. Arduino UNO [6]
2. Ultrasonic Sensors [7]
3. Bluetooth Module [8]
4. Push Button
5. Smartphone

Chapter 4

Design

Designing basically refers to developing the various designs and diagrams that are required to implement a project. This chapter focuses on the various diagrams that are developed as a part of the proposed system and gives their short description. UML diagrams used are Sequence diagram, Activity diagram and Deployment diagram.

4.1 Sequence Diagram

A sequence diagram simply depicts interaction between objects in a sequential order i.e. the order in which these interactions take place. We can also use the terms event diagrams or event scenarios to refer to a sequence diagram. Sequence diagrams describe how and in what order the objects in a system function.

A sequence diagram shows, as parallel vertical lines (lifelines), different processes or objects that live simultaneously, and, as horizontal arrows, the messages exchanged between them, in the order in which they occur. This allows the specification of simple runtime scenarios in a graphical manner.

The objects in this system are User, Toggle Button, Sensor, Arduino Uno, Bluetooth Module and Smart Phone. The user will start the system by pressing the Toggle Button. Accordingly, the sensors will start sending ultrasonic waves to detect the objects. The sensed objects are then informed to the Arduino Uno. Arduino will process these signals received from the Ultra Sonic sensors and calculate the distance. According to the distance of the sensed objects the Arduino will send the distance in the form of text strings to the user's smartphone via the Bluetooth module. Thus, voice output will be provided to the user by converting the text into speech through the smartphone. Figure 4.1 shows the sequence diagram for Blind Navigation.

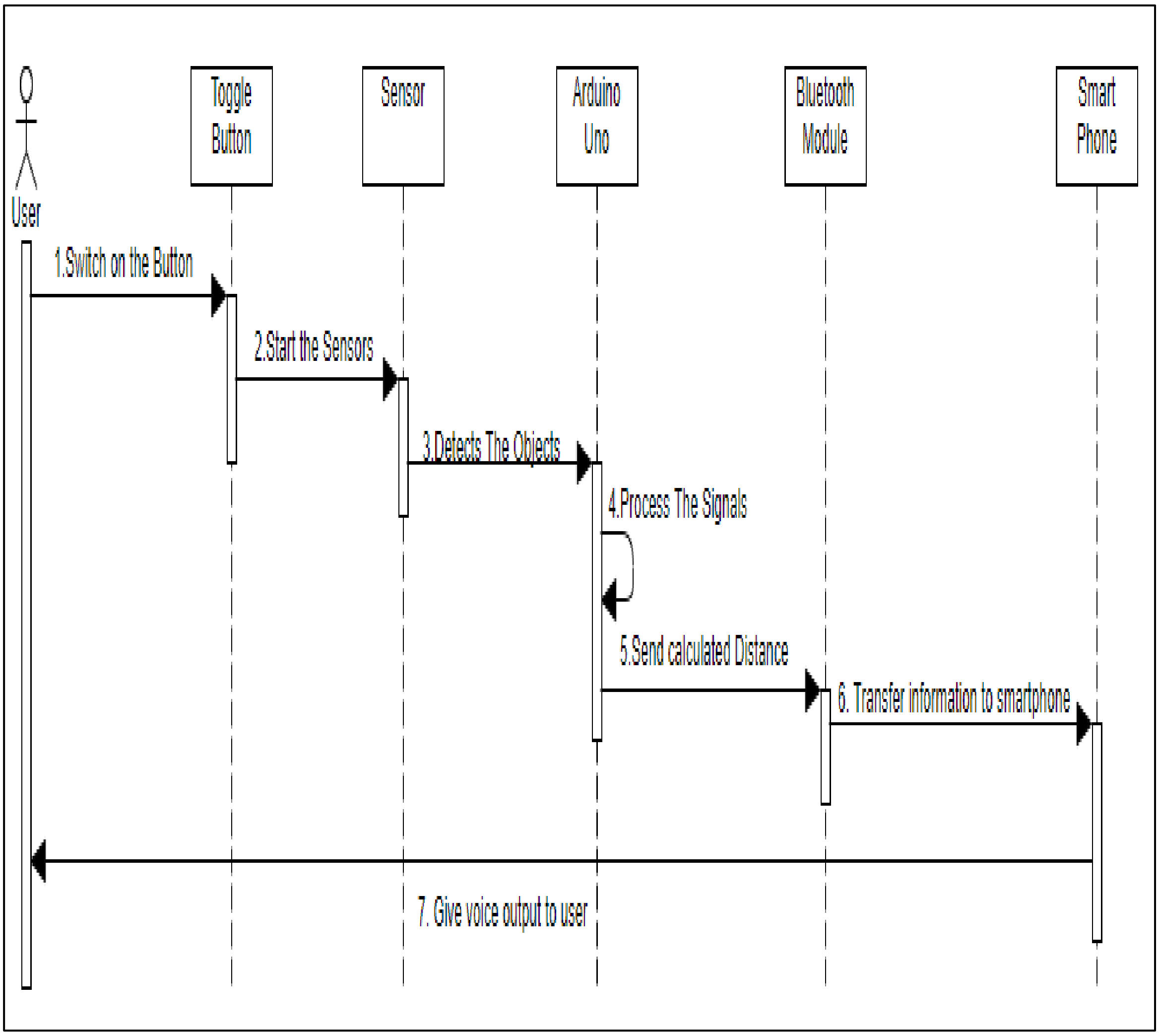

Figure 4.1: Sequence Diagram for Blind Navigation

4.2 Activity Diagram

Activity diagram is a flow chart to represent the flow form one activity to another activity. The activity can be described as an operation of the system. The control flow is drawn from one operation to another. This flow can be sequential, branched, or concurrent. Activity diagrams deal with all type of flow control by using different elements such as fork, join, etc. Figure 4.2 shows the Activity diagram of the system.

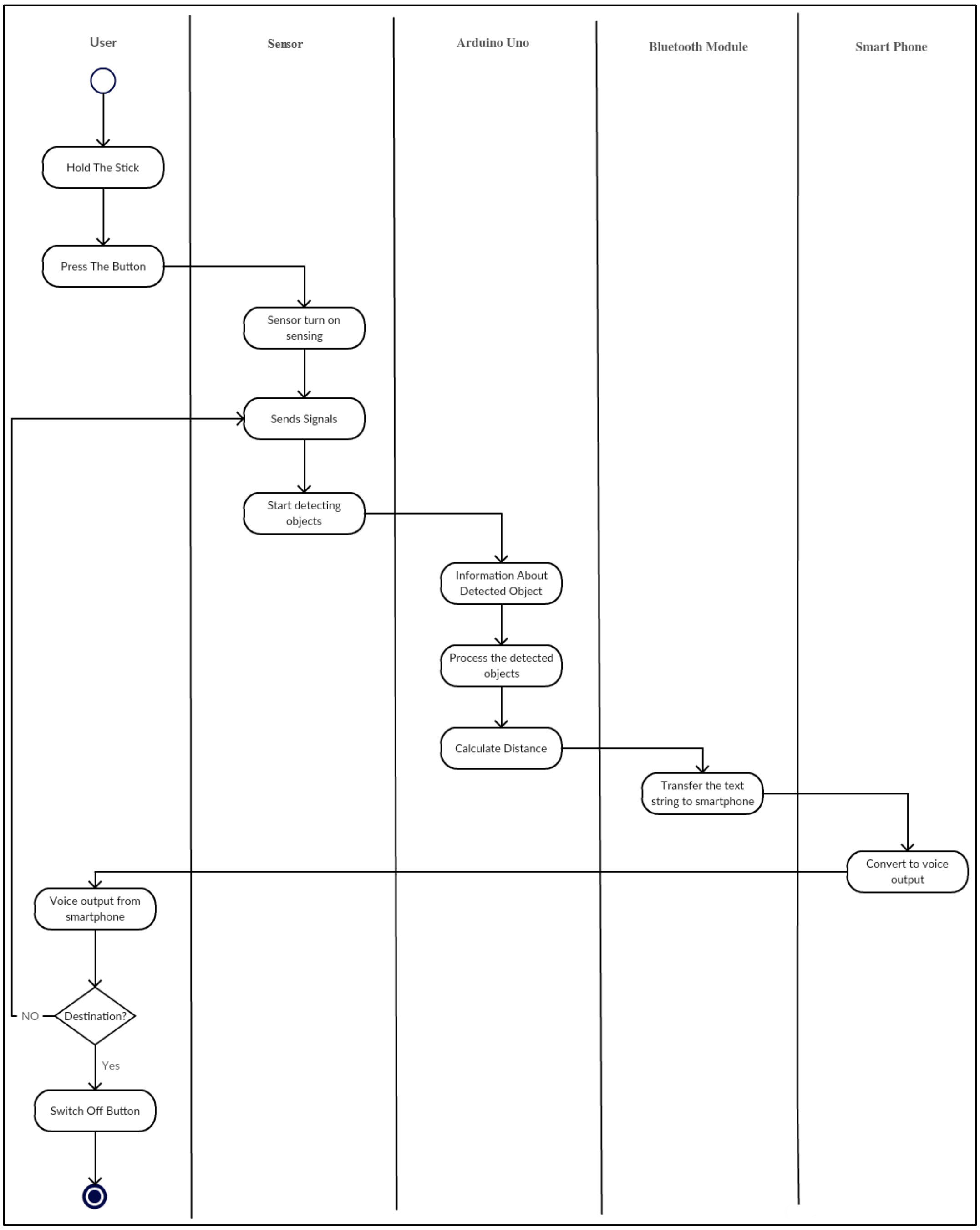

Figure 4.2: Activity Diagram for Blind Navigation

The basic purpose of activity diagram is similar to other four diagrams. It captures the dynamic behaviour of the system. Other four diagrams are used to show the message flow from one object to another but activity diagram is used to show message flow from one activity to another.

The user starts the system and the sensor starts sensing the objects once the user presses the start button. Once an object is detected the information about the detected object is given to the Arduino for further processing. The Arduino calculates the distance of the detected object from the user from the signals received from the ultrasonic sensor. Based on the distance calculated corresponding text string is transferred to the user's smartphone via the Bluetooth Module. The voice message is then given to the user. This continues till the user reaches his/her destination.

4.3 Data Flow Diagram (DFD)

A data flow diagram (DFD) is a graphical representation of the "flow" of data through an information system, modelling its process aspects. A DFD is often used as a preliminary step to create an overview of the system without going into great detail, which can later be elaborated. Figure 4.3 shows the DFD diagram of the system.

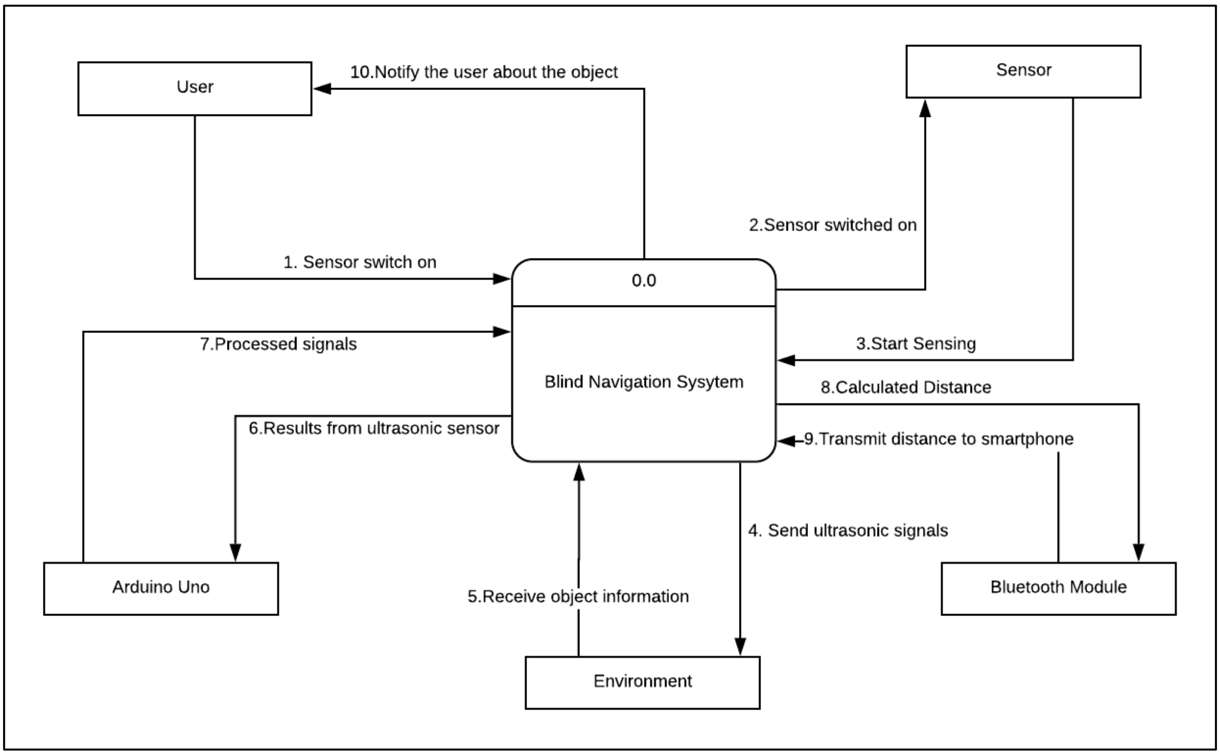

Figure 4.3: DFD for Blind Navigation

The user first switches on the system and thus the sensor starts sensing objects. It sends ultrasonic signals in the environment to detect the nearby objects. The detected objects are then informed to the Arduino. The Arduino processes these signals and calculates the distance of the detected object from the user. The distance in the form of text string is given to the user's smartphone via the Bluetooth module. The voice output is then given to the user to notify him/her about upcoming obstacles in his/her path.

Chapter 5

Report on Present Investigation

This chapter discusses the concept of ultrasonic sensing and the steps required for the proposed system. It gives a brief overview of the Architecture diagram and the various system components used in this system.

5.1 Methodology

The proposed system concentrates on helping the visually impaired people in navigation in their day to day life and to make their life easy and relatively simple. The proposed system aims to detect objects in the path of the visually impaired people and notify them via voice output. This method of object sensing is carried out using ultrasonic sensors. The system will use Ultrasonic sensors interfaced with Arduino Uno R3. The Ultrasonic sensors will transmit ultrasonic signals from the transmitter part of the sensor and detect incoming ultrasonic signals from the receiver part of the sensors. Using Arduino, the detected ultrasonic signals will calculate the distance of the detected object from the user with the help of a function defined in the Arduino IDE. Based on the distance of the detected object a string of text message will be generated by the Arduino which will alert the user about the distance of the object from him. The text string is then transferred to the user’s smartphone via the Bluetooth module. According to the processed signals from the Arduino, the voice messages will be given to the user via ear phones. The system will thus help them to navigate around surroundings with ease without depending on any other people for help.

5.2 Architecture Diagram:

The circuit has HC-SR04 Ultrasonic Sensor, HC-05 Bluetooth module and a tactile switch interfaced to the Arduino UNO. The architecture diagram of the system is given in Figure 5.2.

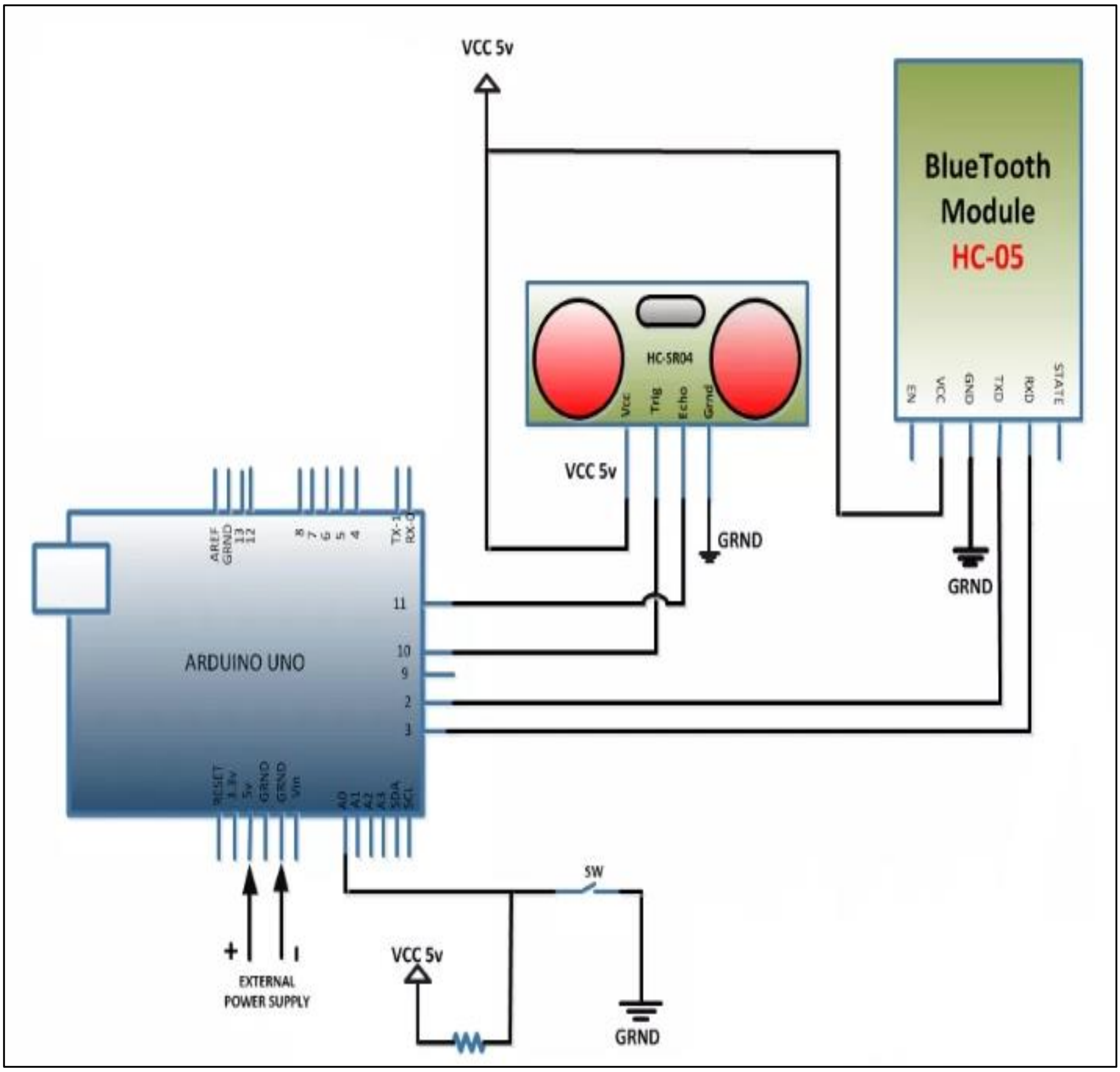

Figure 5.2: Architecture Diagram for Blind Navigation

HC-SR04 Ultrasonic Sensor - The ultrasonic sensor is connected to pins 10 and 11 of the Arduino board. The ultrasonic sensor has four pins - Ground (Pin 1), Echo (Pin 2), Trigger (Pin 3) and Trigger. The VCC and ground pins are connected to common VCC and Ground respectively. The Echo pin is connected to pin 11 of the Arduino board while Trigger pin is connected to pin 10 of Arduino board.

HC-05 Bluetooth Module - The Bluetooth module has six pins - Enable, VCC, Ground, Transmit Data (TxD), Receive Data (RxD) and State. The Enable and State pin are unused and so not connected in the circuit. The VCC and Ground pins are connected to the common VCC and Ground. The TxD and RxD pins of the module are connected to the pins 2 and 3 of the Arduino.

Tactile Switch - The tactile switch is used to prompt the Arduino device to send the text string containing distance information to the Android App on Bluetooth. The switch is connected at A0 pin of the Arduino with another end of the switch connected to Ground. The pin by default receives VCC through a pull-up resistor.

Android phone - Any Android phone can be used. The user needs to install and run app on the phone. The phone must be paired with the Arduino device using Bluetooth.

5.3 Working of system

5.3.1 Setting up connections

Step 1**:** The Arduino is interfaced with Bluetooth module along with the ultrasonic sensors.

Step2**:** The code is uploaded into the Arduino before starting the system.

Step3: Bluetooth connection is established.

5.3.2 Implementation

Step 1: Switch on the ultrasonic sensors to start sensing the objects.

Step 2: The ultrasonic sensors will sense the objects in the user’s proximity and send the necessary signals to the Arduino.

Step 3: The Arduino processes these signals and converts it to numeric value in the form of distance from the detected object.

Step 4: Based on the calculated distance the text strings are transferred to the smartphone of the user via the Bluetooth module.

Step 5: The text string is then given as voice output to the user via earphones.

Chapter 6

Results and Discussions

In this chapter discussion about the results of implemented system and how precisely and accurately it can give us an output. In this system Arduino is used along with Ultrasonic sensors and Bluetooth Module to provide navigational aid to the visually impaired people that will help them to detect the objects detected by the ultrasonic sensors. Text strings processed by the Arduino in the form of distance (in centimetres) from the detected object will be given to the Bluetooth Module which will transmit this information to the user's smartphone. Accordingly, voice output will be given to the user.

6.1 Results:

The below Figure 6.1 shows the circuit connections on the breadboard required for blind navigation system.

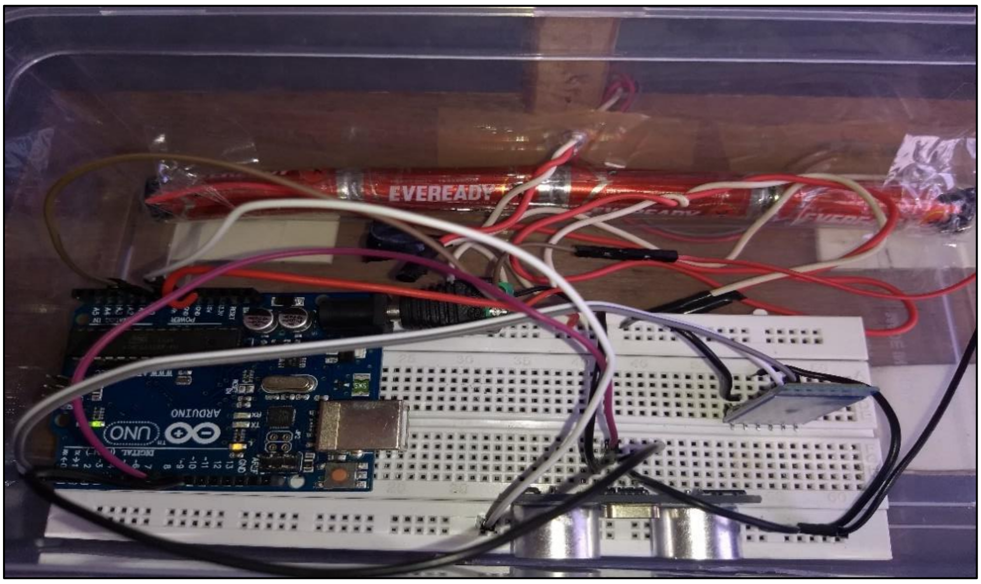

Figure 6.1 Circuit Connections on breadboard

The below Figure 6.2 shows the Ultrasonic sensors connected on the breadboard. These sensors are used to provide signals to the Arduino UNO which helps to calculate the distance.

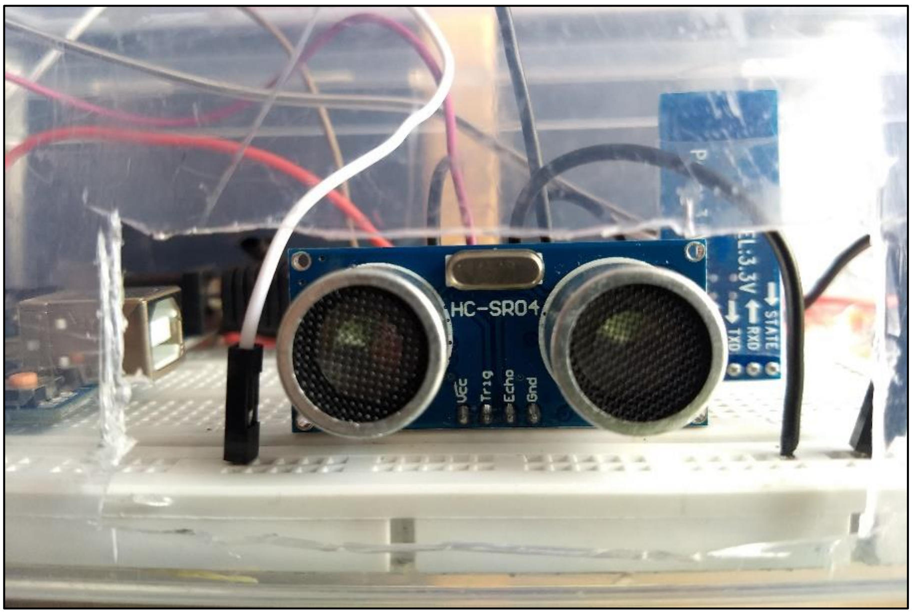

Figure 6.2 Ultrasonic Sensors mounted on breadboard

The calculated distance from the detected object is shown in the app as shown in Figure 6.3 as shown below.

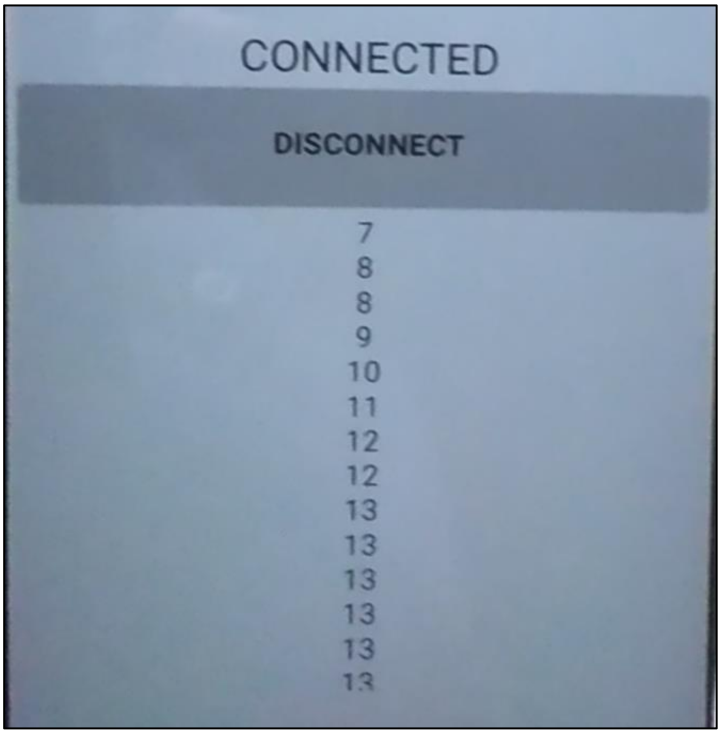

Figure 6.3 App Interface

The below Figure 6.4 shows the calculated distance as shown in the Arduino IDE.

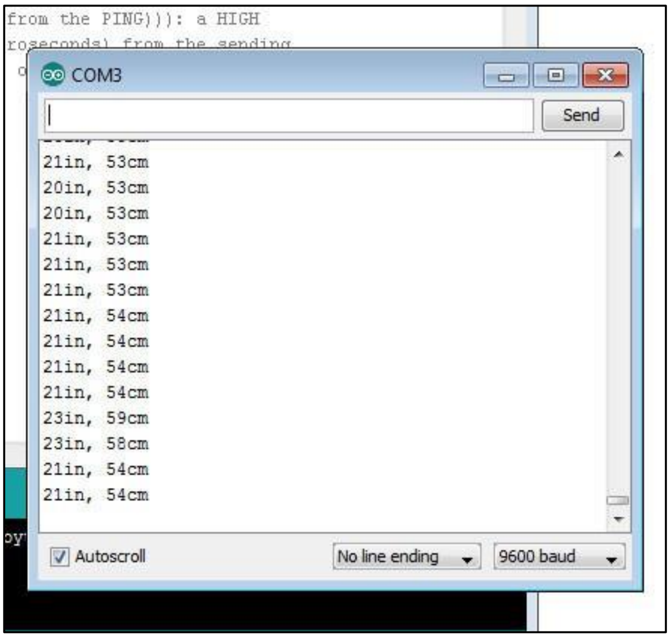

Figure 6.4: Arduino IDE

The below Figure 6.5 shows the blind stick containing the circuit attached to the bottom of the stick.

Figure 6.5: Blind Stick

Chapter 7

Conclusion and Future Work

7.1 Conclusion:

In this project a smart walking stick is developed for visually impaired people which will help them to navigate in their surroundings. For creating the system, the ultrasonic sensors are used which will detect the objects in the path. The user was able to get the readings from the sensors with the help of Arduino interfaced with the Bluetooth module in the circuit. Voice was given to the user according to the obstacle detected in the path in terms of distance calculated from the user in centimetre. Voice was provided from the user's smartphone which was connected via the Bluetooth module. Hence, the user was able to detect obstacles in his/her path which helped in navigation.

7.2 Future Work:

The project on blind navigation basically detects object and notifies the user regarding the distance between the user and the object. Further a plan to add buzzer is made so that the visually impaired person will be notified without using earphone. The proposed system also aims to add water sensor to detect presence of water and roller at the bottom for easy mobility.

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Appendix

Technologies Used

Arduino IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. The source code for the IDE is released under the GNU General Public License, version 2.

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

The coding for calculating the distance from the received ultrasonic sensors is done using this Arduino IDE. The distance is converted into text string and transferred to the Bluetooth module using this technology.

Arduino UNO

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328Pmicrocontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform. The ATmega328 on the Arduino Uno comes pre-programmed with a bootloader that allows uploading new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. The Uno also differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Rather than requiring a physical press of the reset button before an upload, the Arduino/Genuino Uno board is designed in a way that allows it to be reset by software running on a connected computer. The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board.

The Arduino/Genuino Uno has a number of facilities for communicating with a computer, another Arduino/Genuino board, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board.

Ultrasonic Sensor (HC-SR04):

The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package.

From 2cm to 400 cm or 1” to 13 feet. Its operation is not affected by sunlight or black material like sharp rangefinders are (although acoustically soft materials like cloth can be difficult to detect). It comes complete with ultrasonic transmitter and receiver module.

Ultrasonic Sensor Pin Configuration

Pin No.	**Pin Name**	**Description**
1	Vcc	The Vcc pin powers the sensor, typically with +5V
2	Trigger	Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.
3	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4	Ground	This pin is connected to the Ground of the system.

Specifications

- Power supply: 5V DC
- Quiescent current: <2mA
- Effectual angle: <15°
- Ranging distance: 2cm – 500 cm
- Resolution: 1 cm
- Ultrasonic Frequency: 40k Hz

Bluetooth Module:

The HC-05 is a module which can add two-way (full-duplex) wireless functionality to your projects. You can use this module to communicate between two microcontrollers like Arduino or communicate with any device with Bluetooth functionality like a Phone or Laptop. There are many android applications that are already available which makes this process a lot easier. The module communicates with the help of USART at 9600 baud rate hence it is easy to interface with any microcontroller that supports USART.

HC-05 module Information

- HC-05 has red LED which indicates connection status, whether the Bluetooth is connected or not. Before connecting to HC-05 module this red LED blinks continuously in a periodic manner. When it gets connected to any other Bluetooth device, its blinking slows down to two seconds.
- This module works on 3.3 V. We can connect 5V supply voltage as well since the module has on board 5 to 3.3 V regulator.
- As HC-05 Bluetooth module has 3.3 V level for RX/TX and microcontroller can detect 3.3 V level, so, no need to shift transmit level of HC-05 module. But we need to shift the transmit voltage level from microcontroller to RX of HC-05 module.

Pin Configuration

Pin Number	Pin Name	Description
1	Enable / Key	This pin is used to toggle between Data Mode (set low) and AT command mode (set high). By default, it is in Data mode.
2	Vcc	Powers the module. Connect to +5V Supply voltage.
3	Ground	Ground pin of module, connect to system ground.
4	TX–Transmitter	Transmits Serial Data. Everything received via Bluetooth will be given out by this pin as serial data.
5	RX – Receiver	Receive Serial Data. Every serial data given to this pin will be broadcasted via Bluetooth
6	State	The state pin is connected to on board LED, it can be used as a feedback to check if Bluetooth is working properly.
7	LED	Indicates the status of Module • Blink once in 2 sec: Module has entered Command Mode

		• Repeated Blinking: Waiting for connection in Data Mode • Blink twice in 1 sec: Connection successful in Data Mode
8	Button	Used to control the Key/Enable pin to toggle between Data and command Mode.

External Library Used:

SoftwareSerial Library

The Arduino hardware has built-in support for serial communication on pins 0 and 1 (which also goes to the computer via the USB connection). The native serial support happens via a piece of hardware (built into the chip) called a UART. This hardware allows the Atmega chip to receive serial communication even while working on other tasks, as long as there room in the 64 byte serial buffer.

The SoftwareSerial library has been developed to allow serial communication on other digital pins of the Arduino, using software to replicate the functionality (hence the name "SoftwareSerial"). It is possible to have multiple software serial ports with speeds up to 115200 bps. A parameter enables inverted signaling for devices which require that protocol.

Publication

The research paper titled “Blind Navigation” is yet to be published in International Journal of Scientific Research in Computer Science Applications and management Studies (IJSRCSAMS).

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Any errors are own and should not tarnish the reputations of these esteemed persons.

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