Voice Based Navigation System for Guiding Visually Impaired People

B.Sc. (Engineering) PROJECT

A project submitted to the Department of Information and Communication Engineering, Faculty of Engineering, University of Rajshahi in partial fulfillment of the requirements for the Degree of Bachelor of Science in Information and Communication Engineering.

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ABSTRACT

Navigating the visually impaired people is challenging in the unfamiliar indoor environment and also challenging to walk avoiding the obstacles in the outdoor environment. This project proposes a system for the impaired people to guide them towards a destination in the unfamiliar environment and help to walk by avoiding the obstacles. The propose system at first informs the way to destination. Then guides towards the destination by making different sound informing different things in the environment. Following the sound, the impaired people knows the characteristics of the environment and predicts the position of the things and moves towards the destination. This project uses Bluetooth wireless modules to accomplish the navigation. Two types of modules are designed namely receiver module and transmitter module. Receiver modules are located on different things in the environment. The impaired people carries the transmitter module in his/her hand. During the movement of the impaired people the nearby receiver modules receive the transmitter signal and make sound informing the location and nature of the things. The study shows that the designed system useful in navigating the impaired people.

ACKNOWLEDGEMENT

At first, I am indebted to almighty Allah who gives me the extreme grace and mercy to finish the work in properly.

I am debtor to my parents to give their endless love, financial support and mental encouragement.

During this project, a lot of people have helped and encouraged me. First of all, I am indebted to my supervisor Dr. Md. Emdadul Haque for his proper guidance and many good advices. I am grateful to him for his cooperation. Without his thoughtful decisions, this project would not have been completed. I am really to our honorable teachers of the Information and Communication Engineering (ICE) department, RU, for their encouragement towards my project. Finally, I want to think for all support extended to me by my families, friends, well-wishers and staffs of ICE department during my project work as well as during my study period at ICE department for long 4 years.

The Author

Table of Contents

List of Tables

List of Figures

CHAPTER 1
INTRODUCTION

CHAPTER 1

INTRODUCTION

1.1 Introduction

A number of different wireless technologies have been developed for very short distances. Bluetooth is one of them. It is a type of wireless communication used to transmit voice and data at high speeds using radio waves. It is a standard protocol for short-range radio communications between many different types of devices, including mobile phones, computers, entertainment systems and other electronics. It is an open standard for wireless connectivity with supporters mostly from the PC and cell phone industries.

Bluetooth networks (commonly referred to as **piconets**) use a master/slave model to control when and where devices can send data. In this model, a single master device can be connected to up to seven different slave devices. Any slave device in the piconet can only be connected to a single master. The master coordinates communication throughout the piconet. It can send data to any of its slaves and request data from them as well. Slaves are only allowed to transmit to and receive from their master. They can't talk to other slaves in the piconet.

Not surprisingly, its primary market is for data and voice transfer between communication devices and PCs. In this way, it is similar in purpose to the IrDA protocol. Bluetooth, however, is a radio frequency (RF) technology utilizing the unlicensed 2.5 GHz industrial, scientific, and medical (ISM) band. Target applications include PC and peripheral networking, hidden computing, and data synchronization such as for address books and calendars. Other applications could include home networking and home appliances of the future such as smart appliances, heating systems, and entertainment devices.

1.2 Background of the Study

According to the World Health Organization (WHO) estimation (2017) 253 million people in the world live with vision impairments: 36 million are blind and 217 million are severe impairments. 81% of the people who are blind or have moderate or severe vision impairment are aged 50 years and above [1]. In spite of being blind they are not free from their social responsibilities. They need to go to different places including city office and bank on a regular or non-regular basis. In such public offices they cannot move around in the environment to do the work independently. They need help of someone else.

Mobility is one of the critical problems encountered by visual impaired persons in their daily life. Over decades, these people were using navigational aids like guide dogs, white cane, or electronic travel equipment. Dogs are very capable guidance for orienting the blind people outdoors and offer impaired persons with the highest degree of mobility and independence. However, this method necessitates an extensive training and selective breeding. Furthermore, trained dogs are only useful for about five years.

Recently, robotic technology has been involved in guiding and navigating impaired people. The use of robotics is a promising alternative to guide dogs. A well-designed navigation robotic system could enhance reliability and reduce high cost required for such complicated systems. A project named Eye Blind has started in 2012, which mainly aims to build a robotic system which should be able to guide blind people to reach their destinations with the least cost and the shortest route possible. In addition to track and localize the blind person's position, in order to help him/her in emergency situations.

Usually, navigation systems consist of three main parts to help blind people to travel with a greater degree of comfort and independency. First, sensing the instant environment for obstacles and hazards, second, providing information about location and orientation, and third, providing the optimal route towards the desired locations. The system presented in this paper aims to cover the aforementioned three main components in one system.

A number of research works could be found on indoor navigation for visually impaired people in the indoor environment. Most of the existing works use smart phone as the device for the impaired people. But operating smart phone is not easy for the impaired people of developing countries especially for Bangladesh where most of the people have no sufficient education facilities. For this environment easy operate user friendly device is required.

The object of this project is to develop a system that enables them to do their work in an indoor and outdoor environment without being dependent on someone else. The proposed system consists of a Bluetooth wireless network with multiple receiver modules and one portable transmitter module. The receiver modules are mounted on different objects on the environment. The impaired people hold the transmitter module and walk around the environment. The transmitter module has a keypad consists of different push buttons. Each push button has a specific predefined purpose.

By turning ON the power switch of the transmitter device the visually impaired people will be informed about the use of portable transmitter module. The information will be pre-presented by playing recorded voice. Once the impaired people understand how to use the module, he/she will press the desired location button. When he/she presses the button for the first time the end user device will inform him/her about the destination and recorded voice sound coming from the desired receiver device.

The receiver module continuously senses the channel for the signal from the transmitter. The receiver module receives the transmitter signal when the impaired people with the module reach to the communication range and press the button. Upon receiving the transmitter signal the receiver module starts making sound informing the object on which it is mounted. The module continuously makes the sound until the transmitter module reaches out of its communication range or press the button second time. From the played sound the impaired people understand the location and characteristics of the object. The proposed system is easy to understand the operating procedure for the impaired people. Within very short time a user becomes familiar with the device.

1.3 Aims and Objectives

The main aim of this project is to propose, design, implement, and test a navigation system to safely guide the visually impaired people to travel from one location to another using the low cost wireless system. The objectives of this project are given below-

- Study, analyze, and categorize the existing systems used to guide blind people
- Designed low cost wireless system, which has one transmitter and multiple receivers.
- The design of transmitter circuit, which is portable, easily operable and applicable for both indoor and outdoor environments.
- The design of receiver circuit, which is simple and easily can setup in the environment.
- The receiver device gives the environmental information using where the receiver device is setup.

This system usually implements in the public large office or bank.

Chapter 2
Requirements

Chapter 2
Requirements

2.1 Literatures Review of the Existing System:

A number of researcher works could be found on navigating the impaired people in indoor and outdoor environment. This section reviews various proposed navigational aids for the visually impaired people. Most of the methods assume that visually impaired people have knowledge of environment where they act in either well-known or partially known of surrounding [2]. There are many navigation systems for the visually impaired people which are based on Global Positioning System (GPS) [3], Smart phone [4], [5], Radio Frequency Identification (RFID) [6], [7] and wearable devices [8].

There are many methods and devices used to assist and guide blind people. Several research works are being performed by several institutions throughout the world. This section reviews various navigational aids for blind individuals and categorizes them based on the technology used to guide blind people. Navigation systems can be divided into 5 categories as presented in Figure 2.1, namely: GPS based systems, Radio Frequency IDentification (RFID) based systems, camera-based systems, sensor-based systems, and inertial navigation-based systems.

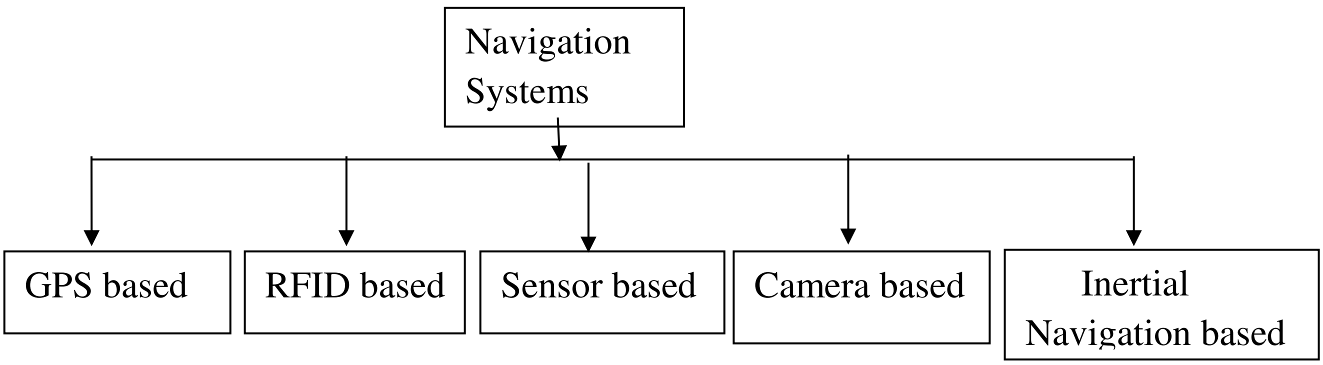


Figure 2.1. Classification of the existing navigation systems

First, **GPS based** systems are considered. A GPS receiver is used in this kind of systems to navigate blind persons, according to the longitude and latitude values received from GPS satellites. An electronic device was designed in [9], to navigate blind people with no need for any human assistant. The proposed system consists of the following components: GPS receiver, PIC microcontroller, and voice recorder. This work aimed to fabricate a device which is cheaper than using other complicated and expensive devices. In [10], a mobile assistant system to locate and orient blind passengers in a Metrobus environment was introduced. A low-cost system was developed based on using a mobile phone, GPS receiver, and a compass device to provide a good functionality. Interaction among these devices is achieved using Bluetooth communications. Furthermore, an audible interface was implemented to inform the blind person about his/her location within the Metrobus environment.

Second, **RFID based** systems are taken place in this section. RFID based systems consists of RFID tags and readers. Usually, RFID readers are required to be distributed over the navigational area, while the RFID tags might be attached to each robot device, or vice versa. The RFID reader detects the serial number stored in the RFID tag attached to each robot, and then transmits the location information to a base station in order to compute the robot's location. A navigational robotic system based on a combination of RFID and GPS systems was proposed in [11] which is called Smart-Robot (SR). While the implemented robotic system in [12] based on the RFID technology; RFID passive tags were deployed over the area of interest, whereas RFID reader was attached to the blind person. This work is similar to Blind Interactive Guide System (BIGS) presented in [13]. BIGS is an indoor navigation system and includes scattering the RFID tags and readers in the same way as in [12].

In [14], an RFID robotic system was introduced, which consists of an RFID reader and a laser range finder. RFID technology was used to determine the location of the blind person, whereas the laser range finder was used to find out and obstacles facing the blind person. On the other hand, Smart Vision is a development of an electronic white cane that helps blind people moving around in both indoor and outdoor environments, providing contextualized geographical information using RFID technology for indoor environments and GPS for outdoors [15].

Third, **sensor-based** systems are considered in this section. This kind of systems navigates blind people using sensor devices such as ultrasonic, infrared, light sensors, or a combination of the aforementioned sensors. In [16], an earlier tool designed in the early 1960, which consists of a sweep FM ultrasound emitter and three laterally displaced sensors. The proposed work aimed to warn the blind person from any obstacles and walls in his/her way. An assistance system was designed where the goal was to enhance interactions between a blind person and technological devices at home.

A sensor module was developed, which can be handled like a flashlight by a blind user and can be used for searching tasks within a three-dimensional environment. The proposed work is based on stereo camera, and ultrasonic sensors. On the other hand, Navebelt system was also proposed to guide visually impaired people, which consist of a belt, a portable computer and an array of ultrasonic sensors placed on the front of the belt.

Fourth, **camera-based** systems. A camera device is used to guide and navigate blind people by capturing images around the navigational area and then processing them. The work presented in [17] includes a visual navigational system using ultrasonic sensor and USB camera. Also [18] includes a prototype assistive-guide robot (eyeDog) which provides the visually impaired person with autonomous vision-based navigation and laser-based obstacle avoidance function using USB webcam. A new robotic system based on using camera and laser range finders was proposed in [19], where sensors and a laptop were placed on a trolley walker.

Fifth, the **Inertial Navigation** systems are reviewed in this section, a navigational robotic system, and a device called ROVI was produced. ROVI is a device that can be used to guide visually impaired people based on using ultrasonic sensors, and digital encoder. The ultrasonic sensor was deployed to estimate the distance between the blind person and obstacles, while the role of the digital encoder was to estimate the distance travelled by ROVI. The work presented in [17] involves a visual odometry system with an assisted inertial navigation filter to produce a precise and robust navigation system which does not rely on particular infrastructure.

The developed navigation systems have some disadvantages. For example, the disadvantage of the GPS or GPRS system that location of the blind person could be tracked only by using the specified cell phone number i.e. if the saved number in the system is lost or deactivated the location tracking would fail. Only outdoor Navigation could be provided using GPS as GPS doesn't work for indoor navigation in Bangladesh. The RFID based only applicable in the indoor navigation.

2.2 Proposed System:

The proposed system designed in a form that can operate for both indoor and outdoor environments. In outdoor environment, usually the visually impaired people require to avoid the obstacle in the walking road. To move the impaired people in indoor environment, where large numbers of obstacles and very few free space, it is the most important challenges for the visually impaired people. We design a system, which is better than existing system and can be used to solve the problem in the indoor and outdoor environment for the visually impaired people. This system consists low number of function keys and easy to operate for the visually impaired persons. In the outdoor busy environment for example shopping area or busy city area where people visit frequently we proposed the receiver devices to be mounted on different things. The receiver devices make sounds when the impaired people move around the place. In the indoor environment, we designed two devices, one is transmitter, which is same as for outdoor environment where it is user end device and another is receiver, which is installed in the specific environment. These receiver devices make voice sound and this voice indicate the specific sport of the environment.

Chapter 3

Hardware Components

Chapter 3

Hardware Components

3.1 Transmitter Subsystem

The system is designed and implemented using two subsystems. One is the transmitter and another is the receiver. The transmitter used as the user end device and receiver used as environmental device. The block diagram of end user device shown in the figure 3.1

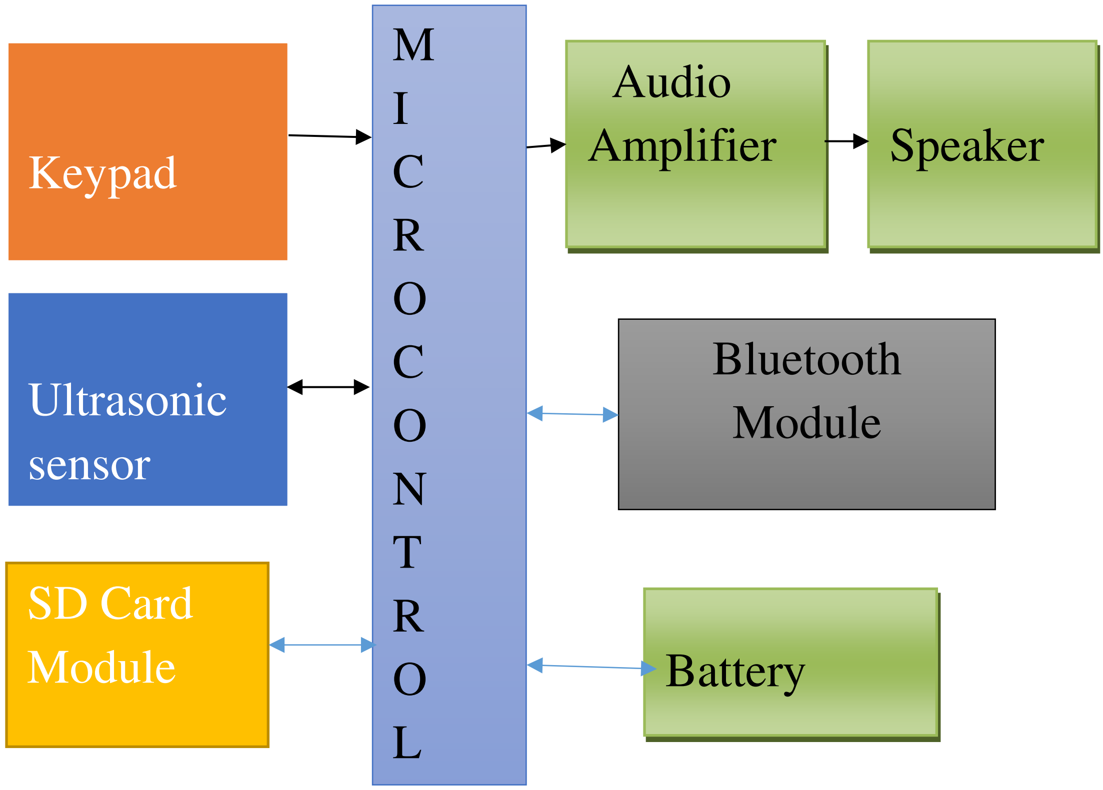


Figure 3.1: Block diagram of user end device.

Keypad section construct by the 4 pin push buttons. The number of push button depend on the requirement in the environment. The ultrasonic sensor is used the HC-SR04 ultrasonic ranging sensor. The HC-05 Bluetooth module used in the system. This module applicable both master and slave configuration. The audio amplifier section by LM386 IC.

3.2 Receiver Subsystem

The number of environmental or receiver devices depend on the environment. Large area requires many environmental devices and small area requires few receiver devices.

The block diagram of environmental device shown in the figure 3.2

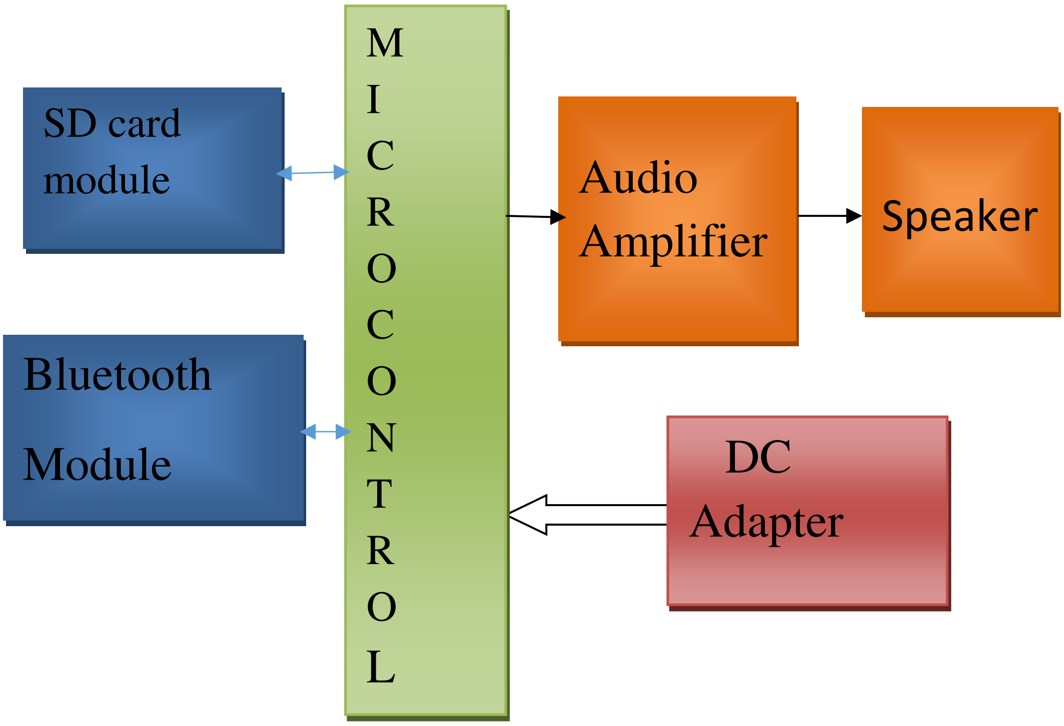


Figure 3.2: Block diagram of environmental device.

3.3 Hardware Modules Used in the System:

The entire system (end user device and environmental devices) consists of the following components

- HC-05 Bluetooth Module
- Micro SD Card Reader module and Micro SD Card
- LM386 Audio Amplifier
- Speaker
- Ultrasonic Sensor
- Keypad
- DC adapter
- Battery

3.3.1 HC-05 Bluetooth Module

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices and building personal area networks (PANs). Range is approximately 10 Meters (30 feet). It is a great solution for low cost wireless communication. There are many Bluetooth modules in the market. The HC-05 Bluetooth Module can be used in a Master or Slave configuration. By default, the factory setting is SLAVE. The slave module cannot initiate a connection to another Bluetooth device, but can accept connections. HC-05 Bluetooth Module shown in the Figure 3.3.

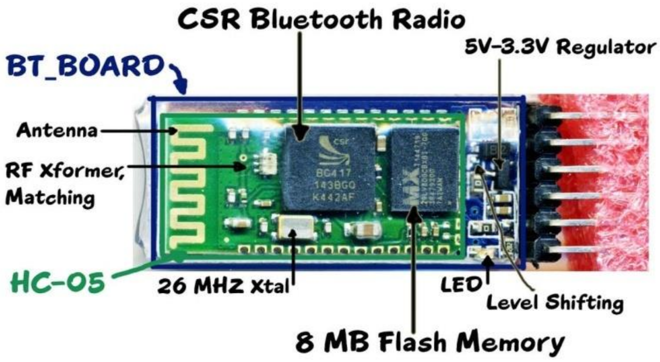


Figure 3.3: HC-05 Bluetooth Module

Specification: We used ZS-040 model of HC-05 Bluetooth module. It has the following specification-

- Integrated Bluetooth Serial Pass-through Module Master-Slave 6 Pin JY-MCU anti-reverse
- High frequency: 2.4GHz
- With VCC, GND, TXD, RXD, EN, STATE foot for the Bluetooth
- Master and slave, two modes in one module
- Original Quality CSR mainstream Bluetooth chip
- Bluetooth V2.0 protocol standards
- Input voltage: 3.6~6V
- Fully compatible with Arduino
- High speed: Asynchronous: 2.1Mbps(Max) / 160 kbps, Synchronous: 1Mbps/1Mbps
- Item Weight: 0.2 ounces
- Bluetooth TTL transceiver module device to both send or receive the TTL data
- Coverage up to 30ft. Built in antenna
- Working current: 30 mA

Pin Definition:

The pin definition of HC-05 Bluetooth module shown in the figure 3.4

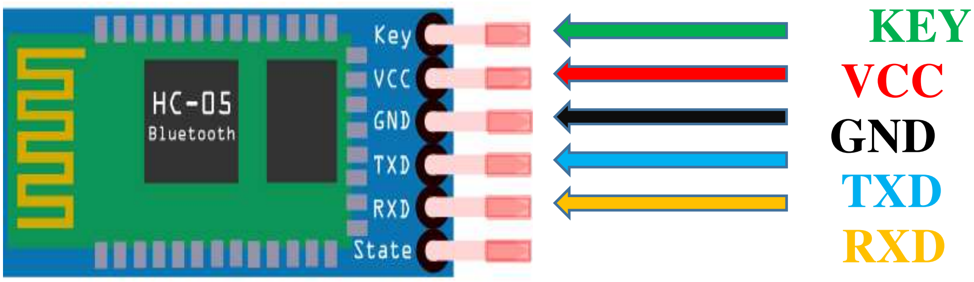


Figure 3.4: PIN Configuration of HC-05 Bluetooth Module

Table.3.1 Pin description of HC-05 Bluetooth Module.

Pin	Description	Function
VCC	+5V	Connect to +5V
GND	Ground	Connect to Ground
TXD	UART_TXD, Bluetooth serial signal sending PIN	Connect with the MCU's (Microcontroller and etc.) RXD PIN.
RXD	UART_RXD, Bluetooth serial signal receiving PIN	Connect with the MCU's (Microcontroller and etc.) TXD PIN.
KEY	Mode switch input	If it is input low level or connect to the air, the module is at paired or communication mode. If it's input high level, the module will enter to AT mode.

The role of the module (Master or Slave) can be configured only by AT COMMANDS. Master module can initiate a connection to other devices. The following AT COMMANDs used for HC-05 Bluetooth modules.

Table 3.2: List of AT Commands for HC-05 Bluetooth modules.

SL No.	Command	Response	Parameters
1	AT	OK	None
2	AT+RESET	OK	None
3	AT+VERSION	+VERSION:<Parameter> OK	Version
4	AT+ORGL	OK	None
5	AT+ADDR?	+ADDR:<Parameter> OK	Device address

6	AT+NAME?	+NAME:<Parameter> OK	Device name
7	AT+NAME=<Parameter>	OK	Desired Bluetooth name
8	AT+ROLE?	+ROLE:<Parameter> OK	0- Slave Role 1- Master Role 2- Slave Loop Role
9	AT+RSWD?	+PSWD:<Parameter> OK	Device password
10	AT+PSWD=<Parameter>	OK	Enter Device Password
11	AT+CMODE?	+CMODE:<Parameter> OK	0- Connect the module to specified Bluetooth address 1- Connect the module to specified Bluetooth address 2- Slave-Loop
12	AT+BIND?	+BIND:<Parameter> OK	Address in the Binding list
13	AT+BIND=<Parameter>	OK	Address for binding Format- 0000,00,000000
14	AT+PMSAD=<Parameter>	OK	Address of Bluetooth to be deleted
15	AT+RMAAD	OK	None
16	ATADCN?	+ADCN:<Parameter> OK	Number of Authenticated Device
17	AT+STATE?	+STATE:<Parameter> OK	“INITIALIZED” “READY” “PAIRABLE”

			“PAIRED” “CONNECTING” “CONNECTED” “DISCONNECTED”
18	AT+LINK=<parameter>	OK	Address of Remote Device

3.3.2 Micro SD Card Reader module

Micro SD cards are 'raw' storage device. They're just sectors in a flash chip, there's no structure that you have to use. There are two ways to interface with SD cards - SPI mode and SDIO mode. SDIO mode is faster but is more complex. Instead, every SD card has a 'lower speed' SPI mode that is easy for any microcontroller to use.

Communication interface of micro SD card reader module is a standard Serial Peripheral Interface (SPI). SPI mode has three lines common to all devices

- **MISO** (Master In Slave Out) - The Slave line for sending data to the master,
- **MOSI** (Master Out Slave In) - The Master line for sending data to the peripherals,
- **SCK** (Serial Clock) - The clock pulses which synchronize data transmission generated by the master

And one-line specific for every device:

- **SS** (Slave Select) - the pin on each device that the master can use to enable and disable specific devices [2].

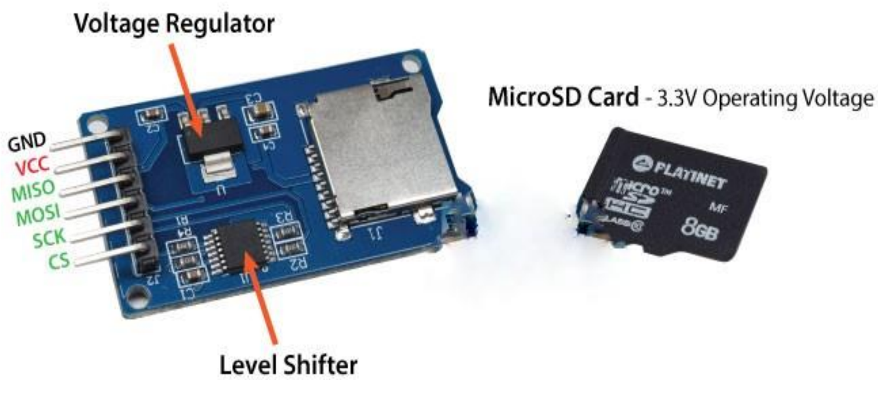
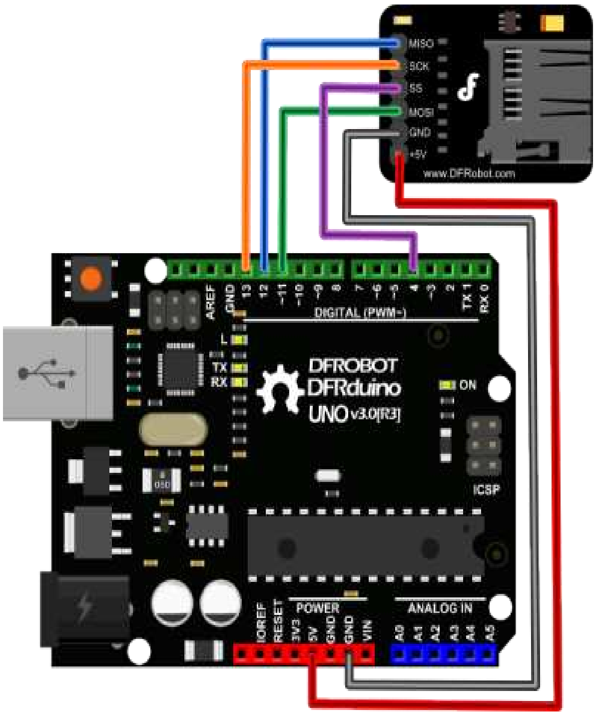


Figure 3.5: Micro SD Card Reader Module

Specification

- Working Voltage:5V
- Size:20x28mm
- Interface: SPI
- Compatible: MicroSD(TF)

The connection of micro SD card reader module with Arduino Uno shown in the figure 3.6.



SDmodule	Arduino
MISO	D12
SCK	D13
SS chipSelect	D4
MOSI	D11
GND	GND
VCC	5V

Figure 3.6: Connection between Arduino UNO and micro SD card reader module.

3.3.3 LM386 Chip:

The LM386 is quite a versatile chip. Only a couple resistors and capacitors are needed to make a working audio amplifier. The chip has options for gain control and bass boost, and it can also be turned into an oscillator capable of outputting sine waves or square waves.

There are three varieties of the LM386, each with different output power ratings:

- LM386N-1: 0.325 Watts
- LM386N-3: 0.700 Watts
- LM386N-4: 1.00 Watts

The actual output power you get will depend on your supply voltage and speaker impedance. The LM386 is an all – in – one Class AB Audio Amplifier IC that can be used in a variety of applications. LM386 IC has been in use for decades and is still being used as Amplifier in

Computer speakers and Portable Stereos. LM386 is a low voltage power amplifier with an inactive power draw of 24mW, which makes it suitable for battery-controlled applications. The most common package for LM386 is an 8 – pin DIP.

The pin diagram of LM386 IC is shown in the figure 3.7

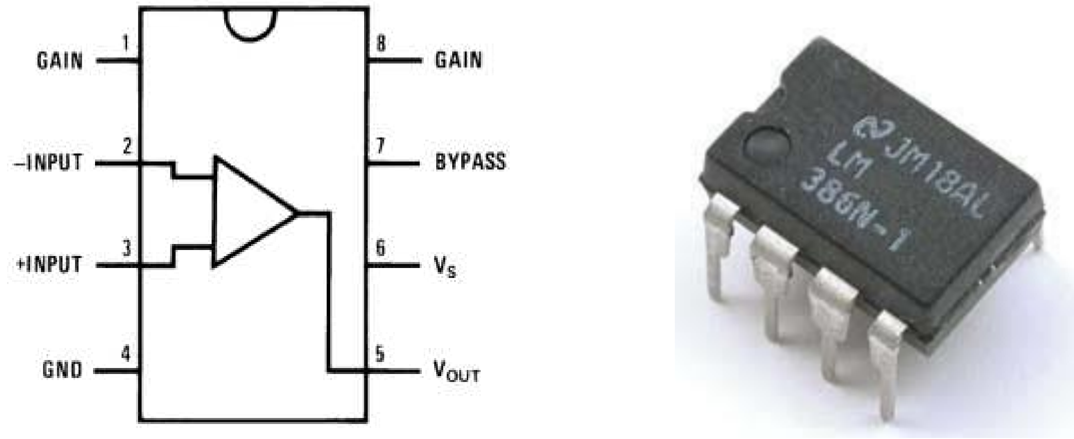


Figure 3.7: Pin diagram of LM386 chip.

From the pin diagram, it is clear that LM386 is a simple Amplifier IC with possibly minimum external connections. The following table shows the functions of each pin in the LM386 Amplifier IC.

Table 3.3: Pin description OF LM386 IC.

Pin Number	**Pin Name**	**Function**
1	Gain	Gain Setting Pin
2	Input –	Inverting Input
3	Input +	Non – Inverting Input
4	GND	Ground
5	Vout	Output
6	Vcc	Power Supply Voltage
7	Bypass	Bypass decoupling path
8	Gain	Gain Setting Pin

Pins 1 and 8 are Gain Control Pins. By default, the Gain of the LM386 Amplifier is set to a factor of 20. When a capacitor is placed between pins 1 and 8, it bypasses the internal resistor (which is responsible for setting the gain to 20) and increases the gain to 200.

Pins 2 and 3 are the inverting and non – inverting inputs of the amplifier (internally, they are connected to an OP-AMP). Audio input from devices like microphone, mobile phones, laptops, etc. is given through these pin. The inverting input (Pin 2) of LM386 is usually connected to Ground.

Pins 6 and 4 are the power supply pins. The maximum power supply to LM386 is 15V. We have used a 12V Power supply in this project. Pin 7 sets the path for decoupling and a capacitor must be connected between Pin 7 and Ground. Pin 5 is the output pin. Proper filtering must be done before connecting the output to a speaker as any DC signal might permanently damage the speaker.

The LM386 is a type of operational amplifier (Op-Amp). Operational amplifiers have a basic task. They take an input potential (voltage) and produce an output potential that’s tens, hundreds, or thousands of times the magnitude of the input potential. In an amplifier circuit, the LM386 takes an audio input signal and increases its potential anywhere from 20 to 200 times. That amplification is what’s known as the voltage gain.

General Specification:

- Wide supply voltage range: 4V–12V or 5V–18V
- Low quiescent current drain: 4mA
- Voltage gains from 20 to 200
- Ground referenced input
- Self-centering output quiescent voltage
- Low distortion: 0.2% (AV = 20, VS = 6V, RL = 8W, PO = 125mW, f = 1kHz)
- Available in 8 pin MSOP package

3.3.4 Ultrasonic Sensor:

An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object. Since it is known that sound travels through air at about 344 m/s (1129 ft/s), you can take the time for the sound wave to return and multiply it by 344 meters (or 1129 feet) to find the total round-trip distance of the sound wave. Round-trip means that the sound wave traveled 2 times the distance to the object before it was detected by the sensor; it includes the 'trip' from the sonar sensor to the object AND the 'trip' from the object to the Ultrasonic sensor (after the sound wave bounced off the object). To find the distance to the object, simply divide the round-trip distance in half.

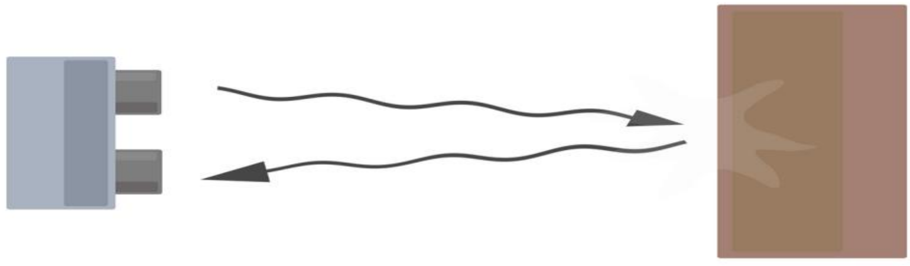


Figure 3.8: Diagram of the basic ultrasonic sensor operation.

$$distance = \frac{speed\ of\ sound\ \times time\ taken}{2}$$

In this I used the HC-SR04 ultrasonic ranging sensor. This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit. There are only four pins on the HC-SR04: VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground).

Figure 3.9: HC-SR04 Ultrasonic Sensor

3.3.5 Arduino UNO:

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board. Various kinds of Arduino boards are available depending on different microcontrollers used. However, all Arduino boards have one thing in common: they are programmed through the Arduino IDE. The differences are based on the number of inputs and outputs (the number of sensors, LEDs, and buttons you can use on a single board), speed, operating voltage, form factor etc. Some boards are designed to be embedded and have no programming interface (hardware), which you would need to buy separately. Some can run directly from a 3.7V battery, others need at least 5V.

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

"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.

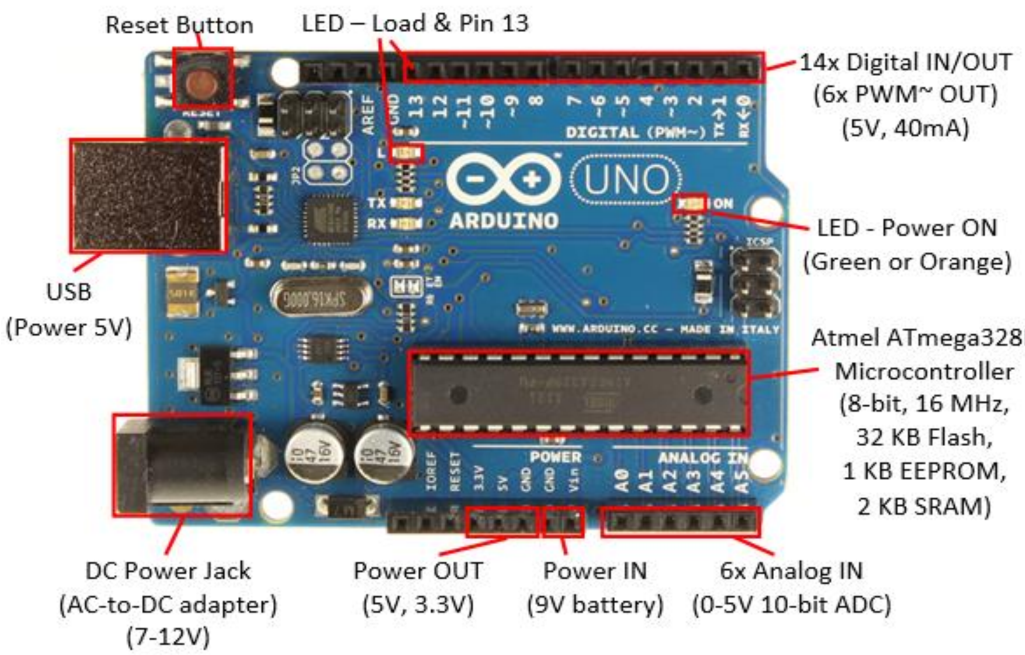


Figure 3.10: Arduino UNO

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.

In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default, they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function. There are a couple of other pins on the board:

- AREF. Reference voltage for the analog inputs. Used with analogReference().
- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Pin configuration of ATmega328 microcontroller shown in figure 2.10

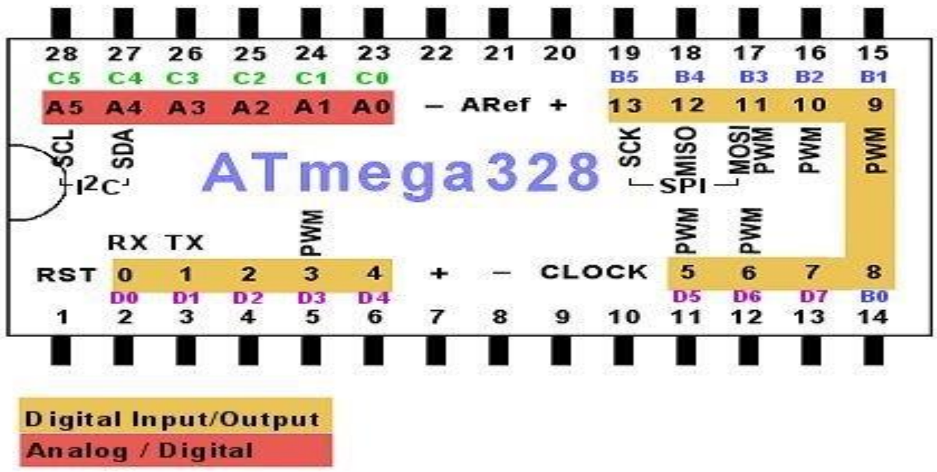


Figure 3.11: Pin configuration of ATmega328 microcontroller

General Specification:

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g

Chapter 4

Circuit Design and Working Principle

Chapter 4

Circuit Design and Working Principle

4.1 Master-Slave Configuration:

HC-05 Bluetooth module has two modes of operation, Command Mode where we can send Attention (AT) commands to it and Data Mode where it transmits and receives data to another Bluetooth module.

The default mode is DATA Mode, and this is the default configuration, that works fine for many applications. The default configuration mode of HC-05 Bluetooth modules given below:

- Baud Rate: 9600 bps, Data: 8 bits, Stop Bits: 1 bit, Parity: None, Handshake: None
- Passkey: 1234
- Device Name: HC-05

In some cases, we need to change some of the configuration setup values. There are two ways to get into Command Mode:

In first way we need to connect the KEY pin high before applying power to the module. This will put the module into command mode at 38400 baud. This is commonly used and needed if we don't know the baud rate the module is set to.

In second way we need to apply power to the module then pull the KEY pin high. This will enter command mode at the currently configured baud rate. This is useful if we want to send AT commands from a microcontroller as the KEY pin can be controlled from one of the microcontroller pins. But we need to know the currently configured Baud Rate.

Commands are sent to the module in UPPERCASE and are terminated with a CR/NL pair. Before connecting the HC05 module, upload an empty sketch to Arduino. This bypass the Boot loader of UNO and the Arduino is used as USB-UART converter. The empty sketch given below:

```
----------------------------------------------------------------------
void setup ()

{

}

void loop ()

{

}

---------------------------------------------------------------------------
```

After uploading this empty sketch, remove USB power from Arduino and do the following connections with HC05 Slave:

HC-05 **ARDUINO UNO**

Tx --------------------------> Tx (1)

Rx-------------------------> Rx (0)

Vcc -------------------------> 5v

GND -------------------------> GND

KEY------------------------> 3.3V

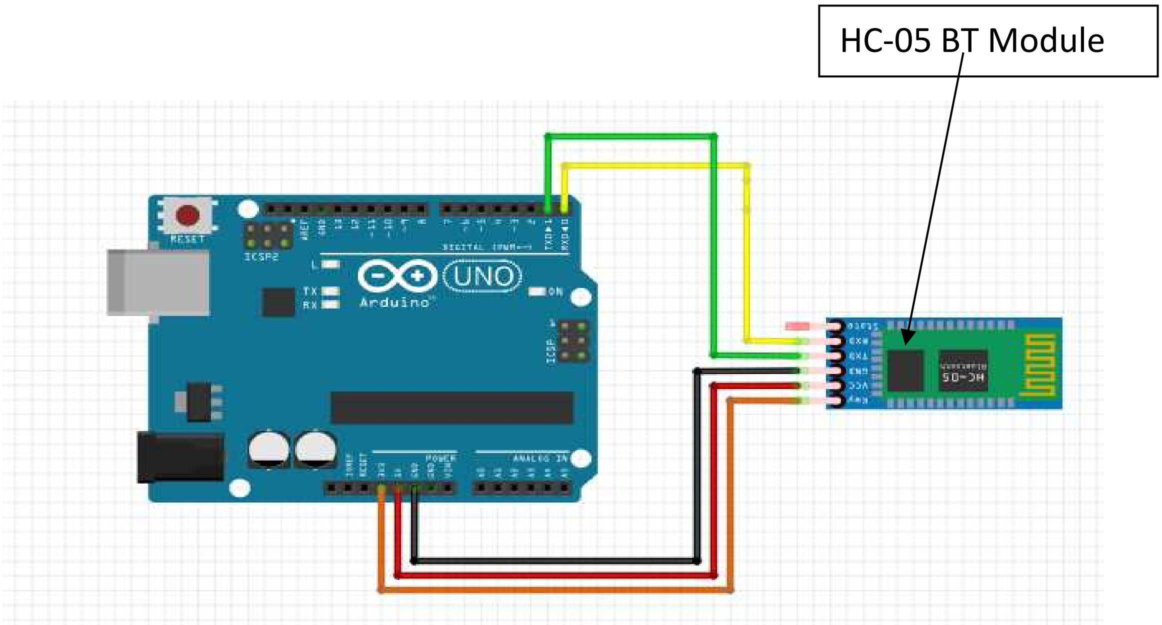


Figure 4.1: Bluetooth Module with Arduino for Master-Slave Configuration.

Now provide the power to the module by connecting USB cable to Arduino. The Status LED starts blinking slowly (once per 2 sec.). This indicates that the module has entered the command mode at the **BAUD RATE 38400**. Open the Serial Monitor of Arduino. Ensure to **select "BOTH NL & CR" and Baud Rate as 38400** at the bottom of the serial monitor. This is very important as the Bluetooth module HC05 expects both Carriage Return and Line Feed after every AT command.

Command Mode Commands:

The format of commands is:

- Always starts with "AT"
- Then "+" followed by <Parameter Name>
- Then either:
    - ? (returns current value of parameter)

- = (New Value of parameter)

A few examples:

- AT (AT Test command. Should respond with OK)
- AT+VERSION? (show the firmware version)
- AT+UART=9600,0,0 (Set baud rate to 9600, 1 stop bit, no parity)

Bluetooth Master Mode:

To configure the module as Bluetooth Master and to pair with another Bluetooth module follow these steps. First, we need to put the module into command mode as above by pulling the CMD pin high before power on. Enter these commands in order:

- AT+RMAAD Clear any paired devices
- AT+ROLE=1 Set mode to Master
- AT+RESET After changing role, reset is required
- AT+CMODE=0 Allow connection to any address (I have been told this is wrong and CMODE=1 sets "any address"
- AT+INQM=0,5,5 Inquire mode - Standard, stop after 5 devices found or after 5 seconds
- AT+PSWD=1234 Set PIN. Should be same as slave device
- AT+INIT Start Serial Port Profile (SPP) (If Error(17) returned - ignore as profile already loaded)
- AT+INQ Start searching for devices

A list of devices found will be displayed, one of which is the slave module. The format of the output is
+INQ: address, type, signal.
The address of the module is what we need and is in the format 0123:4:567890
The address format of the module is depend on the manufacturing company. In our experiment the address of master module is 98d3:31: fb1932 and we used two slave modules whose addresses are 21:13: ACF4 and 21:13: ACD5

We need to replace the colons with commas when we use the address with the following commands. If you get more than one device listed and don't know which one is the slave module, you can query the module for its name using:
AT+RNAME? <Address>
e.g. AT+RNAME21,13,ACD5
After the found of correct slave address, we need to pair with it, so carry on with the next set of commands:

- AT+PAIR=<address>, <timeout> The timeout is in seconds and if you need to type in the pin on the slave device you need to give enough time to do this.
- AT+BIND=<address> Set bind address to the slave address
- AT+CMODE=0 Allow master to only connect to bound address (slave). This allows the master to automatically connect to the slave when switched on
- AT+LINK=<address> Connect to slave.

Slave Mode:

The following commands are used to setup the HC-05 Bluetooth modules as slave:

- AT+ORGL Reset to defaults
- AT+RMAAD Clear any paired devices
- AT+ROLE=0 Set mode to SLAVE
- AT+ADDR Display SLAVE address

4.2 Design of LM386 Audio Amplifier Circuit:

In this project, I designed a LM386 Audio Amplifier Circuit. It is a very low-cost audio amplifier and can power any speaker. The integrated chip LM386 is a low power audio frequency amplifier requiring a low-level power supply (most often batteries). It comes in an 8-pin mini-DIP package. The IC is designed to deliver a voltage amplification of 20 without external add-on parts. But this voltage gain can be raised up to 200 (Vu = 200) by adding external parts.

I used the following components to design LM386 audio amplifier in this project

- LM386 Audio Amplifier IC
- 470 µF Capacitor
- 10 µF Capacitor (two)
- 0.05 µF Capacitor (two 0.1 µF Ceramic Capacitors in series would do the job)
- 10 KΩ Potentiometer (for input volume control)
- 10 Ω Resistor (1/4 Watt)
- 8 Ω Speaker
- 9V Power Supply
- Connecting Wires
- Breadboard

The Circuit diagram of LM386 audio amplifier shown in the figure 4.2

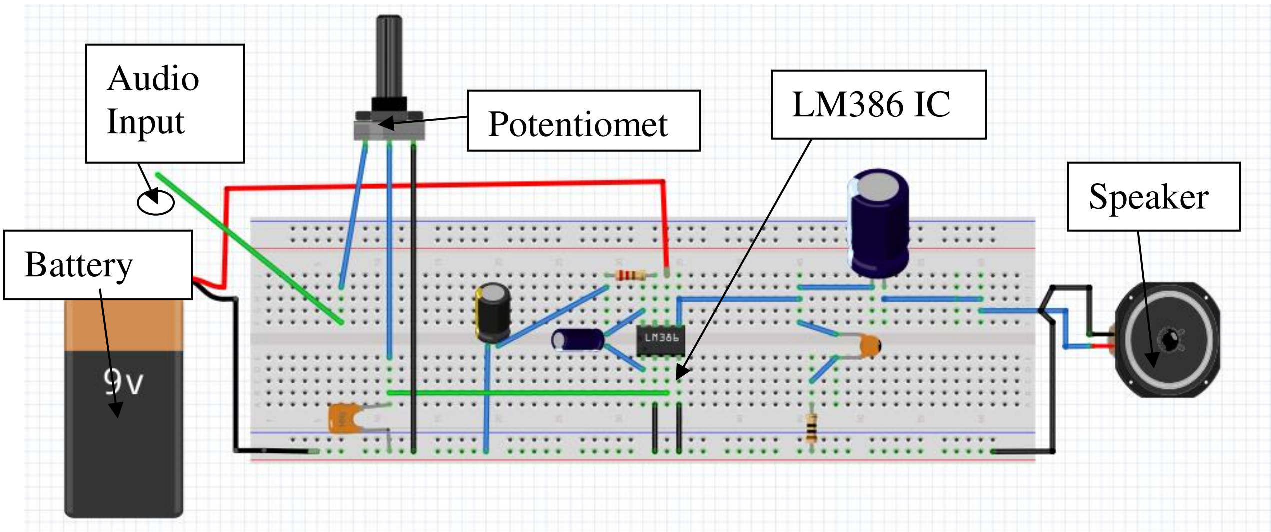


Figure 4.2: LM386 audio amplifier circuit

The design of LM386 Audio Amplifier Circuit is very simple. First, I connect the power supply pins (Pins 6 and 4) to 9V and Ground respectively. The maximum power supply for LM386 is 15V.

Next, we need to connect the input. The input can be given from any audio source like mobile phone or a microphone. We have given the audio input from Arduino UNO ATmega328 microcontroller digital pin 9 using the connecting.

To control the level of the input, I connect a 10 KΩ Potentiometer at the input. Additionally, a small capacitor can be connected in series with the input to filter out the DC Components. Internally, the gain of the LM386 Audio Amplifier is set to 20 (without any gain control circuitry). I connected a 10 µF Capacitor between the gain control pins i.e. pins 1 and 8. Hence, the gain is now set to a factor of 200.

Although the data sheet of LM386 says the bypass capacitor at Pin 7 is optional, I connect at pin 7, 10 µF capacitor with 10 KΩ resistors in series and ground. Finally, for the output, first connect a 0.05 µF Capacitor and a 10 Ω Resistor in series between the output pin (Pin 5) and ground. Next is the speaker connection. LM386 can drive any speaker within the impedance range of 4 Ω to 32 Ω. We have used an 8 Ω Speaker. Connecting the speaker through a big 470µF capacitor was really helpful as it filtered out the unnecessary DC signals.

4.3 Working of LM386 Audio Amplifier Circuit:

A simple but efficient Audio Amplifier is designed using LM386 Audio Amplifier IC. The working of the circuit is very straight forward as all the work is done by the LM386 IC itself. When the system is powered on and proper audio input is given at the input, the LM386 Amplifier the input signal by a factor of 200 and drives the output speaker. One of the main problems with audio amplifiers like LM386 is the noise. Our designed audio amplifier circuit, there was very less noise from the speaker.

4.4 Design of Transmitter Circuit:

The design of transmitter circuit or user end device is relatively complex to receiver circuit or environmental device. This circuit consists by many sections.

- Keypad section
- Audio input section
- Audio amplifier section
- Obstacle detection section
- Transmitter section
- Power source section

Figure 4.3 shown the transmitter or user end device circuit diagram.

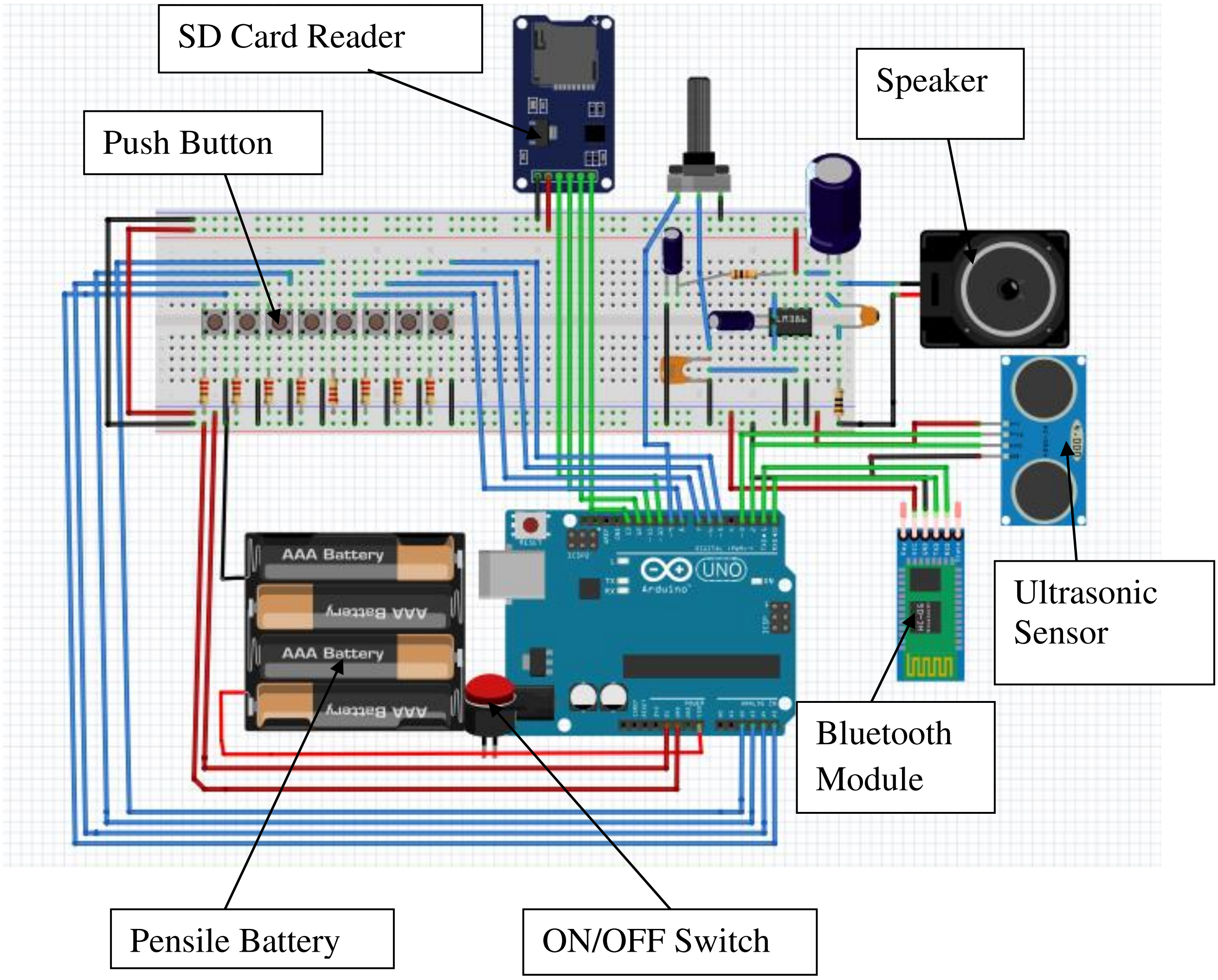


Figure 4.3: Circuit Diagram of End User Device.

Keypad Section:

The keypad section constructs by push button. In this project we used total 8 push buttons. These push buttons have four pins. One pin from one side is connecting to the ground with 1 KΩ resistor and another pin is connected with 5v power supply. One pin of another side is used to control the push button. This pin connected to the Arduino pin by the connecting wire. These push button used for specific function. The users control the receiver using these push buttons. The number of push buttons in the section can be increased according to the requirements. These push buttons numbered from upper to lower. The connection of these push buttons with Arduino UNO given in the following form, where ‘D’ indicates the digital pin and ‘A’ indicates the analog pin.

Table 4.1: Connection of Push Button with Arduino UNO.

No. Of Push Button	Pin of Arduino UNO
Button 1	D5
Button 2	D6
Button 3	D7
Button 4	D8
Button 5	A0
Button 6	A1
Button 7	A2
Button 8	A3

Audio input section:

The recorded voice store in the row storage device SD card, which is read by micro SD card reader. The SD card interface with micro SD card reader module by SPI mode. Serial Peripheral Interface (SPI) mode has three lines common to all devices. **MISO** (Master In Slave Out), **MOSI** (Master Out Slave In), **SCK** (Serial Clock). In Arduino UNO the MISO pin is digital pin 12, MOSI pin is digital pin 11 and SCK pin is digital pin 13 which these pins in ATmega328 are 18, 17 and 19 respectively. So, I connect the MISO pin of micro SD card reader module with Arduino UNO pin 12, MOSI pin with pin 11 and SCK pin connect to the pin 13 with Arduino UNO. The micro SD card reader module has another pin CS (chip select), which is connect to the digital pin 4 of Arduino UNO.

Audio Amplifier section:

The audio output from digital pin 9 of Arduino UNO is low power output. Which is need to amplify for high output power. I used the LM386 IC to make audio amplifier circuit. Its gives the high gain output. So, the audio output from Arduino UNO is the input of the audio amplifier circuit.

Obstacle Detection Section:

Transmitter circuit usually used as the user end device. In this project the obstacle sensors are used for unwanted obstacle at path of the user. When the obstacle in between the distance 10 to 70 Centimeter, this is detecting by the obstacle sensor. This sensor has four pins, two pins used for power supply and another two pins are trigger (Trig) pin and echo (Echo) pin. The trig pin and echo pin connect to the pin 2 and 3 of Arduino UNO respectively.

Transmitter Section:

The transmitter section consists by the HC-05 Bluetooth module, which act as master module. The master module initiates the connection and connects the maximum 7 slave devices. HC-05 Bluetooth module connect with Arduino UNO cross connection, i.e. TX pin of HC-05 Bluetooth connect RX pin of Arduino UNO and RX of HC-05 Bluetooth module connect TX pin of Arduino UNO.

Power Source Section:

To operate the whole system, we need power source. Since the transmitter device used as the end user device, so it is must portable for the users. In this case I used power source as four 1.5-volt pensile batteries with series connection.

4.5 Code Description of Transmitter Circuit:

```
// Program for Master device
#include <NewPing.h>
#include "SD.h"          //Lib to read SD card
#include "TMRpcm.h"      //Lib to play audio
#include "SPI.h"         //SPI lib for SD card
//Chip select is pin number 4
#define SD_ChipSelectPin 4
//Lib object is named "music"
   TMRpcm music;
#define button1 5
#define button2 6
#define button3 7
#define button4 8
#define button5 A0
#define button6 A1
#define button7 A2
#define button8 A3
#define trigPin 2
#define echoPin 3
int count1=0,count2=0,count3=0,count4=0;
int count5=0,count6=0,count7=0,count8=0;
int buttonState1 = 0;
int buttonState2 = 0 ;
int buttonState3 = 0 ;
int buttonState4 = 0 ;
int buttonState5 = 0 ;
int buttonState6 = 0 ;
int buttonState7 = 0 ;
int buttonState8 = 0 ;
 //NewPing sonar(TRIGGER_PIN, ECHO_PIN, MAX_DISTANCE);
```

```
 NewPing sonar(trigPin,echoPin,200);
void setup()
{
   music.speakerPin = 9;       //Auido out on pin 9
      // Default communication rate of the Bluetooth module
      Serial.begin(9600);
      if (!SD.begin(SD_ChipSelectPin))
      {
 Serial.println("SD fail");
return;
      }
      music.quality(1);
     music.play("info.wav");
     delay(1000);
    pinMode(button1, INPUT);
    pinMode(button2, INPUT);
    pinMode(button3, INPUT);
    pinMode(button4, INPUT);
    pinMode(button5, INPUT);
    pinMode(button6, INPUT);
    pinMode(button7, INPUT);
    pinMode(button8, INPUT);
    pinMode(trigPin, OUTPUT);
    pinMode(echoPin, INPUT);
}
void loop()
{
  delay(100);
  int distance;
  distance=sonar.ping_cm();
  if (distance <=70 && distance >= 10 && !music.isPlaying())
  {
   music.play("obs.wav");
  }
  else if(distance >=70 && distance <= 10 && !music.isPlaying())
  {
  }
     buttonState1 = digitalRead(button1);
     buttonState2 = digitalRead(button2);
     buttonState3 = digitalRead(button3);
     buttonState4 = digitalRead(button4);
     buttonState5 = digitalRead(button5);
     buttonState6 = digitalRead(button6);
     buttonState7 = digitalRead(button7);
     buttonState8 = digitalRead(button8);
  if (buttonState1 == HIGH && count1==0)
  {
    music.play("1.wav");
    //when button1 pressed once time transmit 'a' to the receiver
    Serial.write('a');
```

```
    delay(100);
    count1=1;
  }
 else if (buttonState1 == HIGH && count1==1)
  {
    //when button1 pressed two times transmit 'b' to the receiver
    Serial.write('b');
    delay(100);
    count1=0;
  }
else if (buttonState2== HIGH && count2==0)
{
  //when button2 pressed one time transmit 'c' to the receiver
    music.play("2.wav");
    Serial.write('c');
    delay(100);
    count2=1;
}
else if (buttonState2== HIGH && count2==1)
{
  //when button2 pressed two times transmit 'd' to the receiver
    Serial.write('d');
    delay(100);
    count2=0;
}
 else if(buttonState3== HIGH && count3==0)
 {
  //when button3 pressed one time transmit 'e' to the receiver
     music.play("3.wav");
    Serial.write('e');
    delay(100);
    count3=1;
 }
  else if(buttonState3== HIGH && count3==1)
 {
  //when button3 pressed two times transmit 'f' to the receiver
    Serial.write('f');
    delay(100);
    count3=0;
 }
else if(buttonState4== HIGH && count4==0)
 {
  //when button4 pressed one time transmit 'g' to the receiver
     music.play("4.wav");
    Serial.write('g');
    delay(100);
    count4=1;
 }
 else if(buttonState4== HIGH && count4==1)
 {
```

```
 //when button4 pressed two times transmit 'h' to the receiver
   Serial.write('h');
   delay(100);
   count4=0;
 }
 else if(buttonState5== HIGH && count5==0)
 {
    //when button5 pressed one time transmit 'i' to the receiver
    music.play("5.wav");
    Serial.write('i');
   delay(100);
   count5=1;
 }
 else if(buttonState5== HIGH && count5==1)
 {
 //when button5 pressed two times transmit 'j' to the receiver
   Serial.write('j');
   delay(100);
   count5=0;
 }
 else if(buttonState6== HIGH && count6==0)
 {
 //when button6 pressed one time transmit 'k' to the receiver
   music.play("6.wav");
   Serial.write('k');
   delay(100);
   count6=1;
 }
 else if(buttonState6== HIGH && count6==1)
 {
 //when button6 pressed two times transmit 'l' to the receiver
   Serial.write('l');
   delay(100);
   count6=0;
 }
 else if(buttonState7== HIGH && count7==0)
 {
 //when button7 pressed one time transmit 'm' to the receiver
    music.play("7.wav");
   Serial.write('m');
   delay(100);
   count7=1;
 }
 else if(buttonState7== HIGH && count7==1)
 {
//when button7 pressed two times transmit 'n' to the receiver
Serial.write('n');
   delay(100);
   count7=0;
 }
```

```
 else if(buttonState8== HIGH && count8==0)
 {
 //when button8 pressed one time transmit 'o' to the receiver
    music.play("8.wav");
   Serial.write('o');
   delay(100);
   count8=1;
 }
 else if(buttonState8== HIGH && count8==1)
 {
//when button8 pressed two times transmit 'p' to the receiver
   Serial.write('p');
   delay(100);
   count8=0;
 }
}
```

4.6 Functional Description of Transmitter Circuit:

The above program is uploaded to the transmitter circuit to operate as a user-friendly device. The power supply of the whole circuit is controlled by the ON/OFF switch. When switch is ON, then the transmitter circuit is active and gives the information of function of the transmitter device and how to use in the environment with the help of stored pre-recorded voice. After the information of the device, the user can use it properly in the unfamiliar environment. The user uses as the push buttons for different purpose in the environment. The keypad section consists of the push button. Each push button has the specific purpose. When the push button pressed by the user, it gives the receiver information and what work done after pressing button as voice which stored in the micro SD card. Depending on the pressed push button and of number of pressed, the transmitter circuit transmit different signal to the receiver. If the push button pressed one time gives a transmitted signal and if again pressed this same button, then gives another signal. So, each push button gives two signals according to the number pressed. The following table gives transmitted signal, which transmit by the transmitter.

Table 4.2: List of Transmitted signal by Push Buttons

Push Button No.	**Transmitted Signal**	**Push Button No.**	**Transmitted Signal**
Button1	a, b	Button5	i, j
Button2	c, d	Button6	k, l
Button3	e, f	Button7	m, n
Button4	g, h	Button8	o, p

Each push button performs two works depending on time of pressing, first time pressed gives the recorded voice sound from the specific receiver device which he/she wants. Now following this voice sound, he/she walks toward the receiver device. The transmitter device has an obstacle detection ultrasonic sensor, it is used to detect unwanted obstacle in the walking path of the visually impaired people. In the transmitting range of the Bluetooth module, the user can move any desired location by pressing the push buttons.

4.7 Design of Receiver Circuit:

The design of receiver circuit is relatively simple compare to the transmitter circuit. The number of receiver circuit depends on the environment where this system is installed. The design of all the receiver circuit is almost same, only the stored recorded voice is different. The receiver circuit is the environmental device, which setup on the fixed location of the environment. According to the user command in the transmitter circuit, the receiver circuit gives the response. Figure 3.4 shown the circuit diagram of the installed environmental (receiver) circuit.

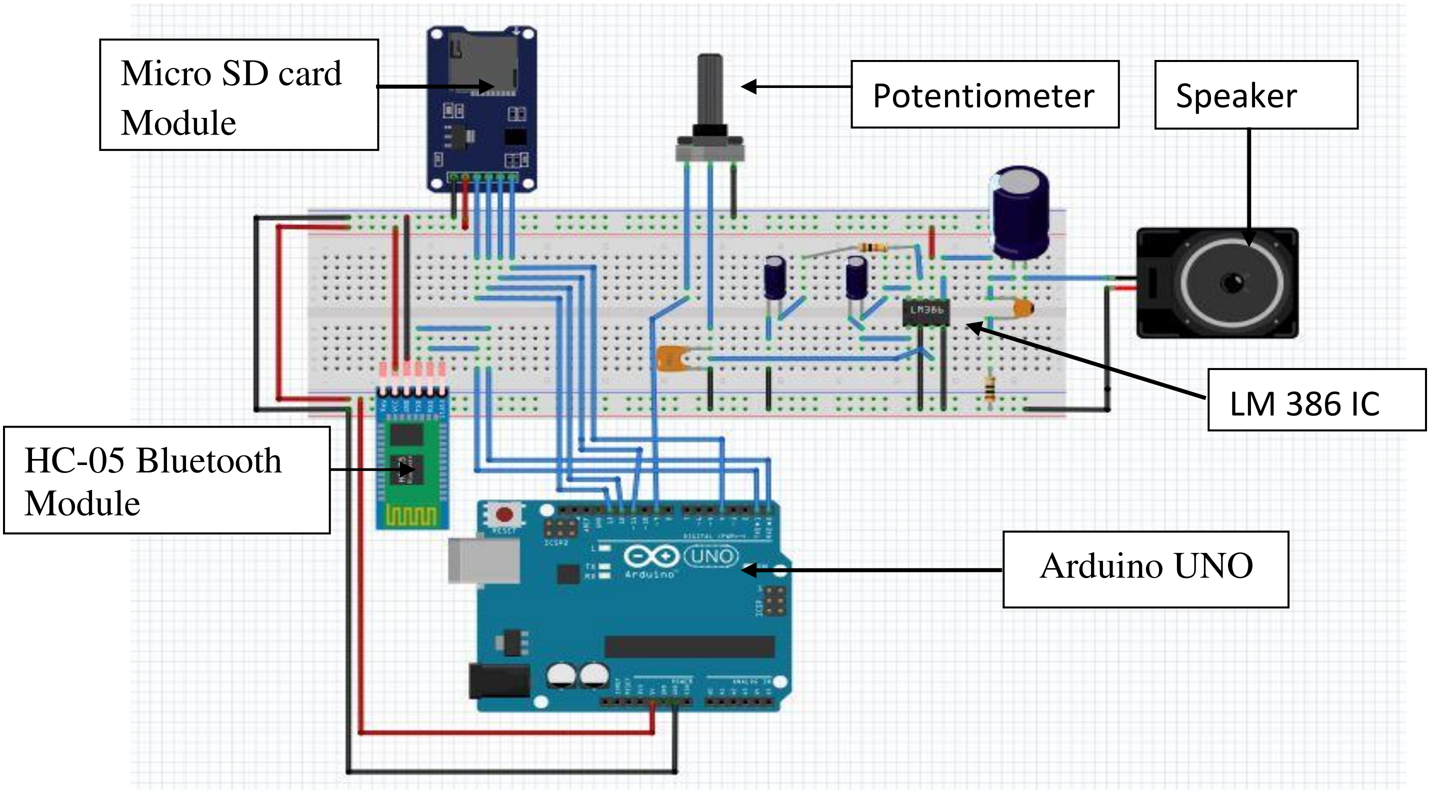


Figure 4.4: Circuit Diagram of Installed Environmental (Receiver) Device.

The receiver circuit consists of the following sections-

- Receiver section
- Audio Amplifier section
- Micro SD Card Reader section

Receiver Section:

This section consists of the HC-05 Bluetooth module, which act as the slave module. It only gives the response for the given command from transmitter section.

Audio Amplifier section:

The audio amplifier section is similar to the audio amplifier circuit in transmitter device which is user end device. It is used to amplify the recorded voice, so the output of the audio signal amplifies form in the speaker.

Micro SD Card Reader Section

The stored recorded voice in the micro SD card can read by SD card reader module. This section consists by the micro SD card and the six pin SD card reader module. This SD card reader module interface with Arduino, which operate by SPI Mode.

4.8 Code Description of Receiver Circuit:

In this project, I used two receiver circuits, the program of the one receiver circuit given below.

```
//slave code 1 for BL-01
#include "SD.h"         //Lib to read SD card
#include "TMRpcm.h"     //Lib to play auido
#include "SPI.h"        //SPI lib for SD card
#define SD_ChipSelectPin 4   //Chip select is pin number 4
  TMRpcm music;           //Lib object is named "music"
  int ledPin=8;
  //int Buzzer1 = 7;
  int state = 0;
  void setup() {
   music.speakerPin = 9;    //Auido out on pin 9
   Serial.begin(9600);
   // Default communication rate of the Bluetooth module
   if (!SD.begin(SD_ChipSelectPin))
   {
       Serial.println("SD fail");
         return;
   }
   music.quality(1);
   pinMode(ledPin, OUTPUT);
   digitalWrite(ledPin,HIGH);
  }
  void loop() {
   delay(50);
  if(Serial.available() > 0)   // Checks whether data is comming from the serial port
  {
    state = Serial.read();    // Reads the data from the serial port
  }
 if (state == 'a' && !music.isPlaying())
```

```
    {
      Serial.write(state);
      music.play("ch.wav");
     }
else if(state=='c' && !music.isPlaying())
     {
      Serial.write(state);
      music.play("off.wav");
     }
else if(state == 'e' && !music.isPlaying())
     {
      Serial.write(state);
      music.play("fir.wav");
      }

 else if(state == 'g' && !music.isPlaying())
     {
      Serial.write(state);
      music.play("abd.wav");
      delay(200);
     }
 else if (state=='b' || state=='d' || state=='f' || state=='h' && music.isPlaying())
     {
      music. disable();
     }
  }
```

4.9 Functional Description of Receiver Circuit:

In the receiver circuit the Bluetooth slave module receives the transmitted signal. The above source code uploads to the receiver circuit. After the reception of the transmitted signal, program works in receiver circuit. The slave module waits for receiving transmitted signal. The pre-stored recorded voice in the micro SD card read by the micro SD card reader module. The amplifier circuit amplifies the recorded voice, which is then feed to the speaker. The speaker is 8-ohm impedance. The recorded voice makes sound and gives the information of installed environment according to the command in the transmitter circuit. The transmitter circuit operates the receiver circuit. The user controlls the receiver circuit using the transmitted signal by the pressing the push button of the user end device. The uploaded program processed by the ATmega328 microcontroller.

Chapter 5
Implementation

Chapter 5
Implementation

5.1 Setting Devices in the Environment:

After the design of transmitter and receiver devices, I set different receiver devices in the office of the department of Information and Communication Engineering of University of Rajshahi. In this project, I designed only two receiver devices for primary implementation. I place one receiver device in the door and another receiver device in corner as shown in Fig. 5.1.

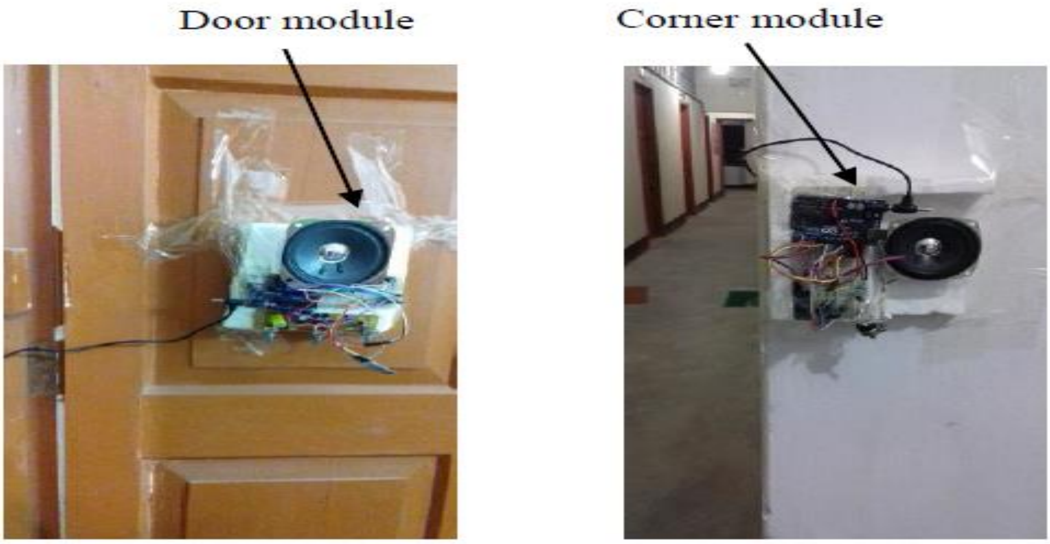


Figure 5.1: Installed receiver (a) door and (b) corner modules

Since the receiver modules are fixed in position we power the receiver modules with cable connected with AC source by 12-volt AC/DC adapter. To hear the pre-recorded voice, I used 8-ohm speaker, which gives the information about installed environment to visually impaired people. Fig. 5.2 shows the door module and the corner module in one picture.

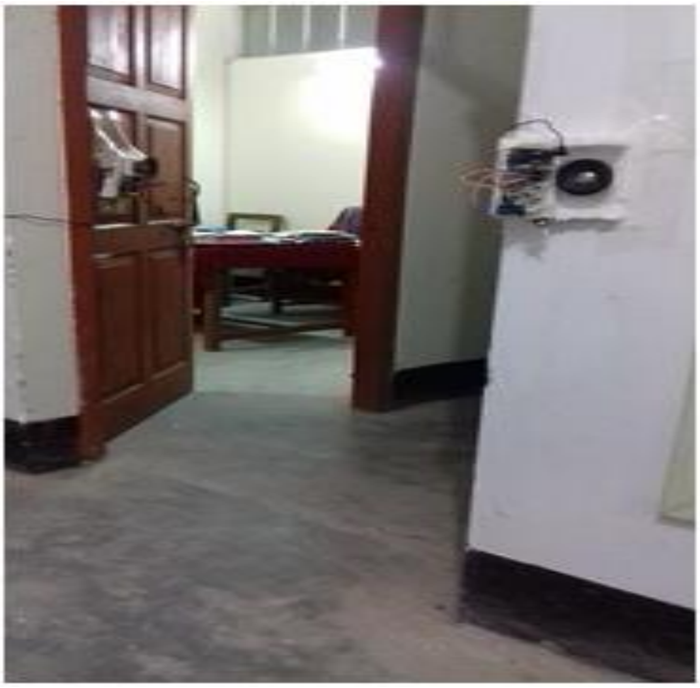


Figure 5.2: Installed receiver door and corner modules

5.2 Experimental Results:

Finally, Fig. 5.3 shows the user module. Since the impaired people carry the transmitter module. The end user module is powered by the battery. I used that the transmitter module will be kept in some fixed position of the office. It may be at the entrance point of the office. The user module has eight buttons in the keypad. The functions of the all key are indicate the direction of 8 locations in the office. In the outdoor environment, the transmitter module not will keep in some fixed position. In this case require the visually impaired people only the transmitter module. The transmitter module able to detect the obstacle in the front of the device. From Fig. 5.3, it shown, the transmitter device, which is user end device, carry by a visually impaired person to move from one point to another point in the different direction of department of information and communication engineering. In this project shown the result of indoor environment. For the outdoor environment, it can easily implement, because the outdoor environment only requires the user end or transmitter device. By carry this device the visually impaired people move from one point to another point independently.

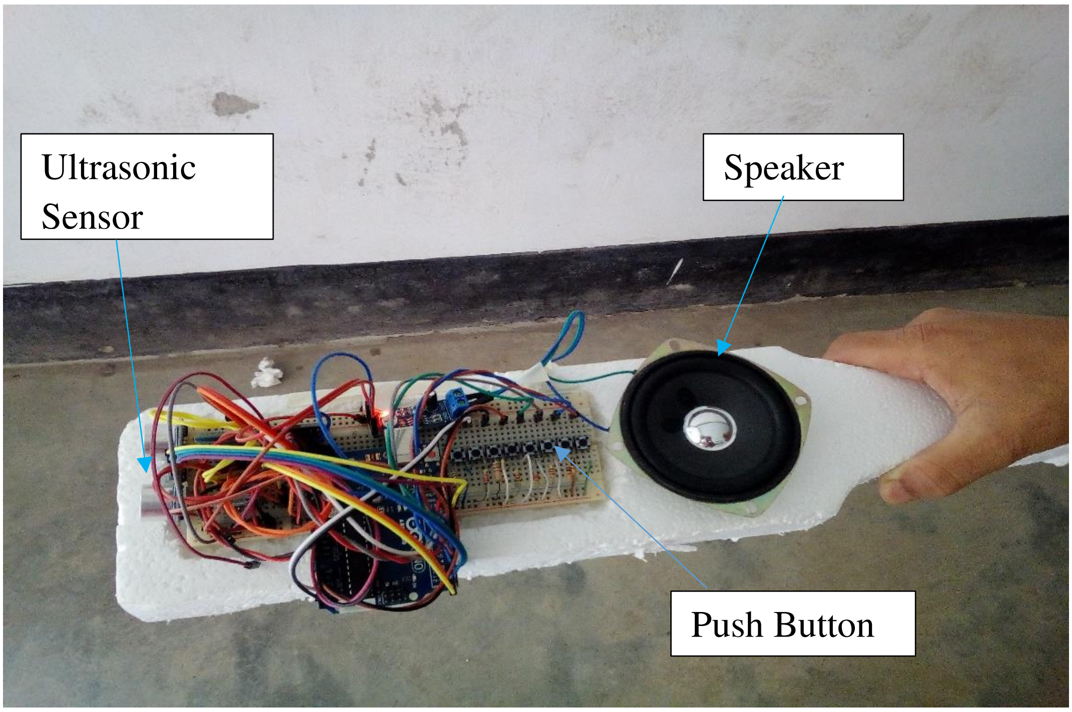


Figure 5.3: End user (transmitter) module.

Chapter 6
Conclusion

Chapter 6
Conclusion

6.1 Conclusion:

Navigation systems have been widely over the past few years. The range of applications of navigation system is still growing up, from indoor to outdoor environments. In this project, we designed a system for the public offices including city office and bank, where the impaired people need to move one location to another location to get the services. We designed two types of devices including transmitter and receiver device. The receiver device produces sound about the information of the locations according to the demand of the user. Based on the objects the messages are different for the different places. The device also provides information about the obstacles along the path he/she wants to move. The user end (transmitter) device is portable, small device and easy to use. The Smartphone based navigation system is not easy to operate by the impaired people. The designed system is easy to operate and within very short time the visually impaired can move in the installed environment, by pressing different buttons in the keypad of user end device.

To move from one location to another in outdoor environment, the installed environmental devices also installed in the environment. With the help of ultrasonic sensor of the user end device, the visually impaired person can avoid the obstacles in the outdoor environment. The advantages of the designed system are low design time, low production cost, applicable for both the indoor and outdoor environment, setting the destination is very easy, this system be capable of using in public places, dynamic system, less space, low power consumption. The applications are the system can be used in the home, hospitals and colleges and both the known and unknown environments like airports, malls and public parks etc.

6.2 Limitations:

This project has some limitations. These limitations divided into two categories.

1. In indoor environment

In indoor environment the transmitter and receiver devices need to be within approximately 10 meters of each other, and the typical data transfer rate is around 2 megabits per second (Mbps). Bluetooth coverage distance range is small compare to other wireless communication system. Number of environmental devices depends on the set up environment. To cover the large area, many receiver or environmental devices are required. The voice sound fixed for the environment and sound come from the receiver, user need to follow the sound.

2. In outdoor environment

In outdoor environment have fewer limitations compare to the indoor environment. The user end device can detect the obstacle, which are in the front of the device.

6.3 Future Work:

Future works will be focused on enhancing the performance of system. Several improvements can be made on the designed system. The user end device can inform the distance between the user and the installed environmental devices. The number of desired location is fixed in the present system. So, the system could be extending for increasing number service point in the office. Bluetooth wireless communication system can be replaced with another wireless communication system for cover large areas.

Furthermore, we aim to investigate more technologies which might be integrated to enhance the reliability and efficiency for the proposed navigation system, and to overcome the limitations.

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