PATH PLANNING AND OBSTACLE DETECTION FOR BLIND PERSON

ABSTRACT

This project describes the system architecture for a navigation tool for visually impaired persons. The major parts are: a multi-sensory system (comprising of IR and Ultrasonic sensors), a human-machine interface and an audio warning system. The sensory parts are described in more detail.

About 1% of the human population is visually impaired, and amongst them about 10% is fully blind. One of the consequences of being visually impaired is the limitations in mobility. For global navigation, many tools already exist, like GPS systems. These tools are not helpful for local navigation: local path planning and collision avoidance.

The goal of this project is to develop a wearable tool that assists the blind to accomplish his local navigation tasks. It consists of a sensory system controlled by the user. The primary data needed for local navigation is map data. Due to its passive communication circuit, RF transmitter can be embedded almost anywhere without an energy source. The tags stores location information and gives it to any reader that is within a proximity range which can be up to 10-15 meters for UHF RF systems. We propose an RF-based system for navigation in a building for blind people or visually impaired. The system relies on the location information on the tag, a destination, and a routing information where the shortest route from the current location to the destination. The local map is the input to a warning system that transforms the map data into audio instruction. The tool must provide information about the direct surroundings of the blind to enable him to move around without collisions. For this purpose, IR sensors are used for the obstacle detection on the sides and Ultrasonic sensors to detect obstacle in front. The algorithm developed gives a suitable audio instruction depending on the duration of ultrasound travel which in turn is made available by an mp3 module associated with the system. The output from these sensor modules are fed into an Arduino Microcontroller for processing and the controller will generate a voice output accordingly.

The system not only identifies hurdles but also suggests a safe path (if available) to the left or right side and tells the user to stop, move left, or move right. The system has been tested in real time by

both blindfolded and blind people at different indoor and outdoor locations, demonstrating that it operates adequately.

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1. INTRODUCTION

Blindness is a state of lacking the visual perception due to physiological or neurological factors. The partial blindness represents the lack of integration in the growth of the optic nerve or visual center of the eye, and total blindness is the full absence of the visual light perception[1] .

One of the consequences of being visually impaired is the limitations in mobility. Accordingly, they need to use a wide range of tools and techniques to help them in their mobility. For global navigation, many tools already exist like handheld GPS systems are now available to guide them in outdoor situations[2] . These tools are not helpful for local navigation: local path planning and collision avoidance. So an innovative and affordable system is needed to be implemented in order to avoid blind people colliding against fixed and moving obstacles and to guide them in indoor environments.

In this work, a simple, cheap, friendly user, smart blind guidance system is designed and implemented to improve the mobility of both blind and visually impaired people in a specific area. The proposed work includes a wearable equipment consists of a jacket, to help the blind person to navigate alone safely and to avoid any obstacles that may be encountered, whether fixed or mobile, to prevent any possible accident. Navigation, in turn, involves updating one's position and orientation during travel with respect to the intended route or desired destination and, in the event of becoming lost, reorienting and reestablishing travel toward the destination. Methods of updating position and orientation is handled by RF devices. The main components of this system are the ultrasonic and infrared sensors which are used to scan a predetermined area around blind by emitting-reflecting waves. The reflected signals received from the barrier objects are used as inputs to Arduino. The Arduino is then used to alerts the person. Along with the obstacle guidance, this project develops Navigational assistance technology for the blind using RF concepts. The implemented system is cheap, fast, and portable and an innovative affordable solution to blind and visually impaired people. The system can store a number of routes, each of which is numbered, and be selected using the same set of keys as for the decisions. In practice the number is likely to be set by the size of the available memory.

2. DESIGN METHODOLOGIES

Design methodology refers to the development of a system or method for a unique situation. Design methodology stresses the use of brainstorming to encourage innovative ideas and collaborative thinking to work through each proposed idea and arrive at the best solution.

1.Indoor positioning system based on sensor fusion for the Blind and Visually Impaired: Indoor positioning system that has been designed in that way, examining the requirements of the Blind and Vision Impaired in terms of accuracy, reliability and interface design. The methodology runs locally on a mid-range smartphone and relies at its core on a Kalman filter that fuses the information of all the sensors available on the phone (Wi-Fi chipset, accelerometers and magnetic field sensor). Each part of the system is tested separately as well as the final solution quality[4] . Indoor positioning systems that used radio beacons and Received Signal Strength Indicator (RSSI) measurements was the RADAR system developed by Microsoft Research. Reference RSSI measurements (i.e. Measurements taken in predefined locations) that are stored in the reference database, and which are then used by location estimation algorithms. Using this methodology, a wireless indoor positioning system can be developed as a part of a complex solution aiding the visually impaired in independent travel and mobility.

2.Computer vision based blindness navigation system: Using robust and stable computer vision technologies to strengthen the weakness of existing electronic intellectual aid device[5] . The system can offer state information of the road scene, and assists the blind to find out the obstacles and the walkable planar regions, through which the blind can walk independently. This provide a robust cognitive result of road scene.

The goal of the system is not only to provide navigation, but also to make the blind people perceive the world in as much detail as possible and live like a normal person. The proposed system includes a helmet molded with stereo cameras in the front, android-based smartphone, web application and cloud computing platform. The cloud computing platform is the core of the system, integrates object detection and recognition, OCR (Optical Character Recognition), speech processing, vision-based SLAM (Simultaneous Localization and Mapping) and path planning, which are all based on deep learning algorithm. The blind people interact with the system in voice. The cloud platform communicates with the smartphone through Wi-Fi or 4G mobile communication technology.

3. Using radio frequency identification (RFID) tags: It is a new way of giving location information to users. Due to its passive communication circuit, RFID tags can be embedded almost anywhere without an energy source[6]. The tags stores location information and gives it to any reader that is within a proximity range which can be up to 10-15 meters for UHF RFID systems. RFID-based system for navigation in a building for blind people or visually impaired is another method. The system relies on the location information on the tag, a destination, and a routing server where the shortest route from the current location to the destination.

2.1 Proposed methodology

In our Project, we proposed a method of sensing point-to- point distance using ultrasonic and IR sensors to detect moving and fixed obstacles. Besides obstacle detection, the peculiarity of the project is to develop navigational assistance technology for the blind or visually impaired. Specifically, we seek to develop a portable Electronic Travel Aid (ETA) for visually impaired users, along with the accompanying radio frequency identification (RFID) localization infrastructure used to equip buildings.

We propose using RF transmitters, to set up a location- tagging infrastructure within buildings such that the blind can use an RF receiver to determine their location as well as software that can utilize this localization data to generate vocal directions to reach a destination.

For outdoor navigation the availability of GPS-compatible cell phones and PDAs prompted appearance of several software products, some of which have accessibility features making them potentially suitable for the blind and visually impaired users. This system uses directional RF transmitters mounted in the environment, and a handheld receiver with a speaker.

2.2 Justification

- RF has different penetration through the walls of the buildings or houses based on the frequency. Hence used for radio and television transmission and for cellular mobile phone service.
- For many applications the medium of choice is RF since it does not require line of sight.
- RF modules may comply with any defined protocol for RF communications such as Zigbee, Bluetooth low energy, or Wi-Fi, or they may implement a proprietary protocol.

3. SCHEMATIC REPRESENTATIONS

3.1 Block diagram

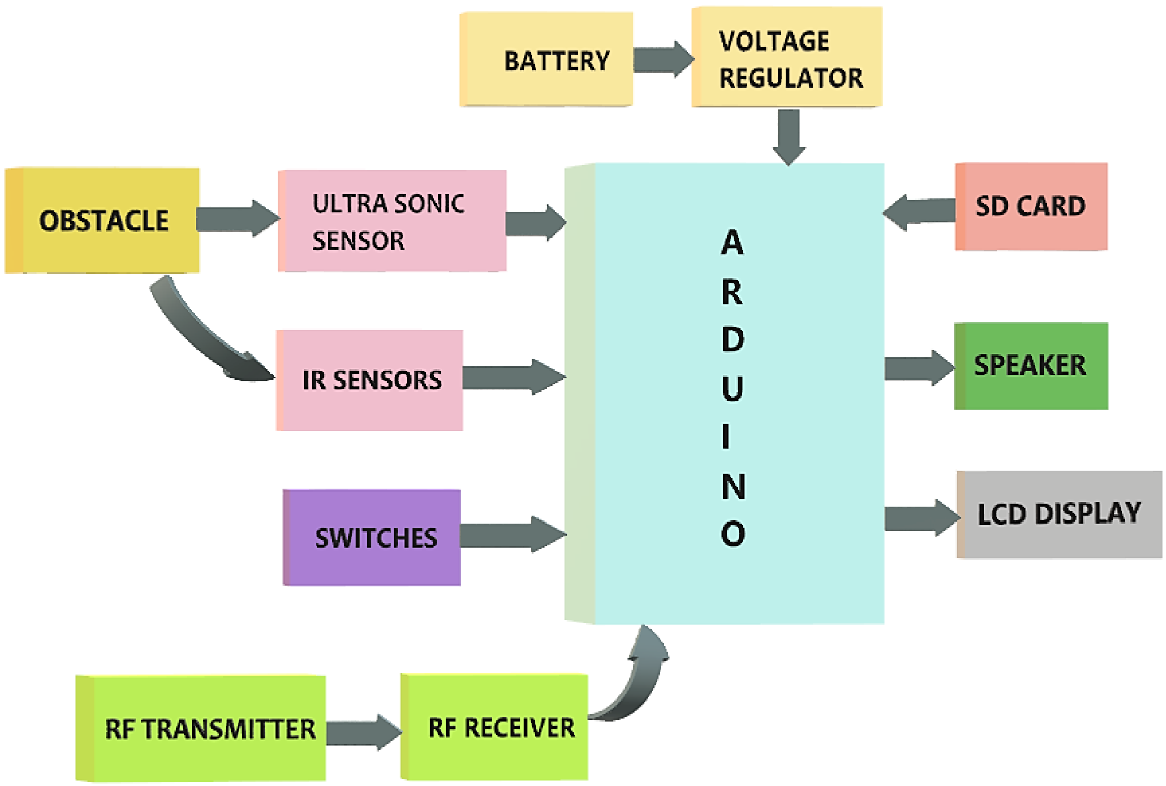

Figure 1: BLOCK DIAGRAM

The overall project hardware connections are represented schematically in the Figure1 diagram in which Arduino the main heart of the system is being interfaced with rest other components. When the power supply is provided to the Arduino and the receiver via 9v battery and when the transmitters are supplied through the 4-5v batteries provided, the entire system will be made functionally ON and rest other functionalities are made processed simultaneously.

3.2 Circuit diagram

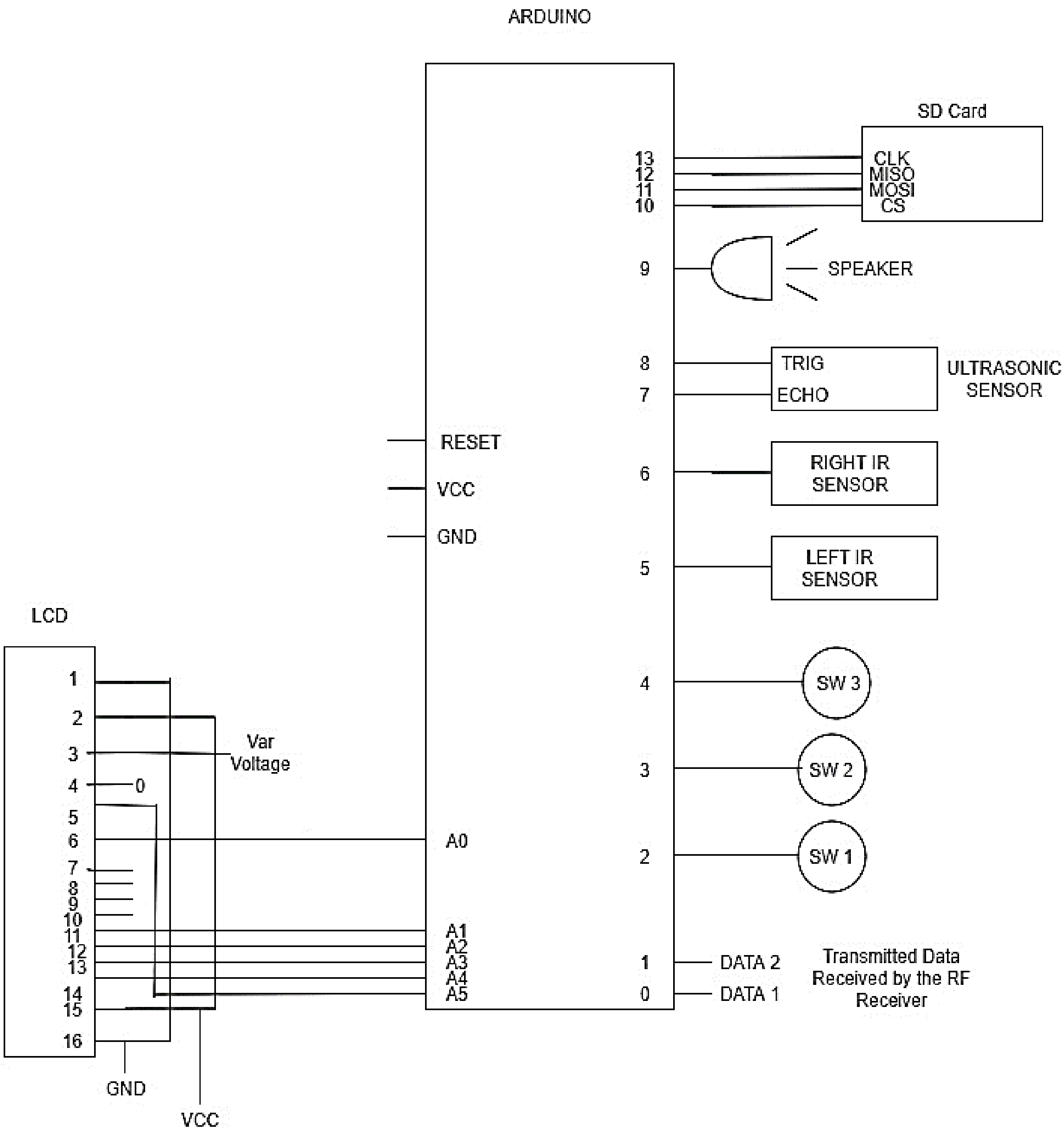

Figure 2: CIRCUIT DIAGRAM

3.3 Simulation circuit

Circuit has been schematically represented using Proteus 8 professional simulation software. The Proteus is proprietary software tool suite used primarily for electronic design automation, the software is used mainly by design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards.

Library packages of the major components like Arduino, ultrasonic and IR sensors & RF transmitters and receivers which are not inbuilt have been added separately.

Complete connections and interfacing the components with Arduino has been done in this platform Power supply, ground and basic components which are already available in the Proteus have been used to complete the whole circuit configurations.

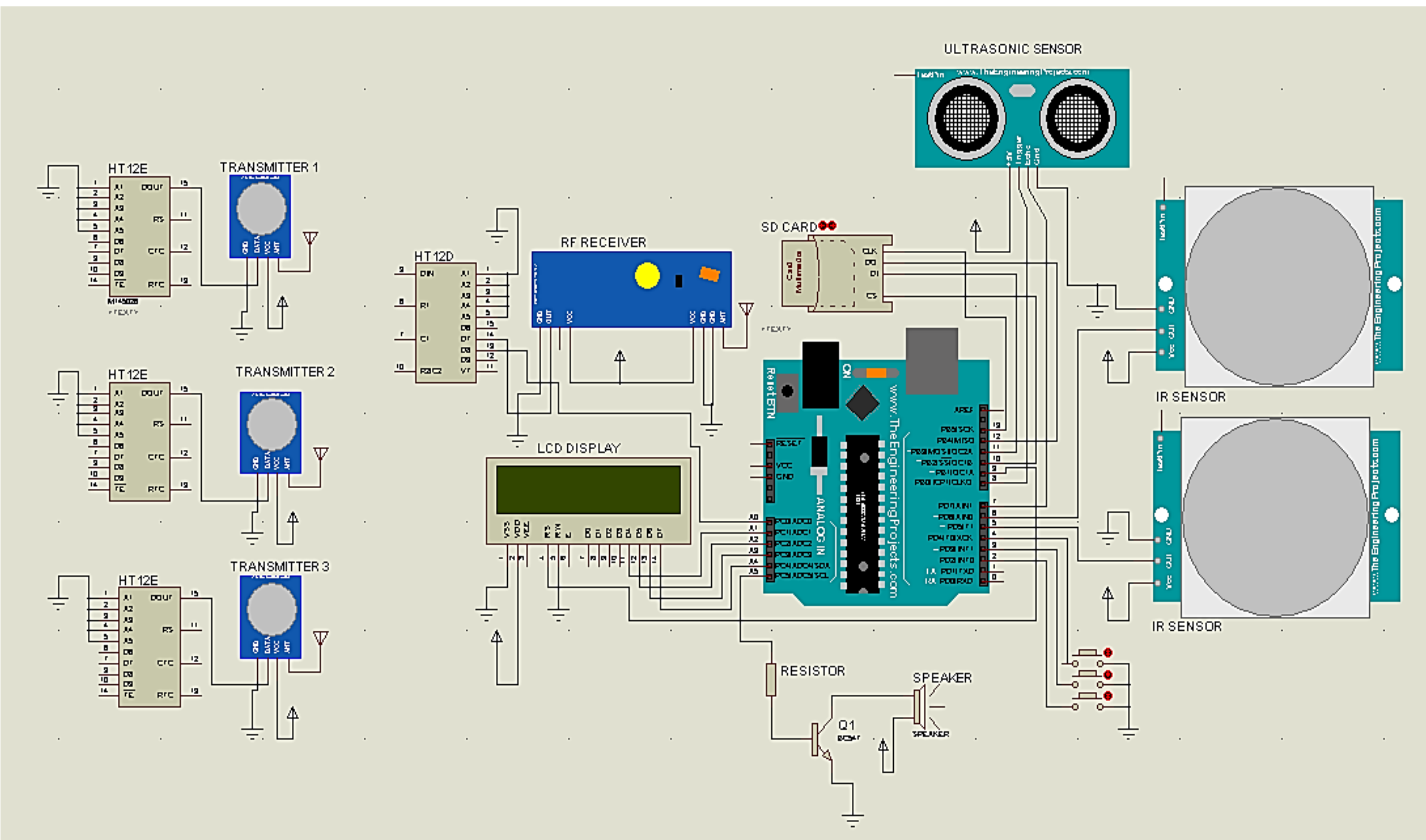

Figure 3: CIRCUIT SIMULATION

3.4 Flowchart

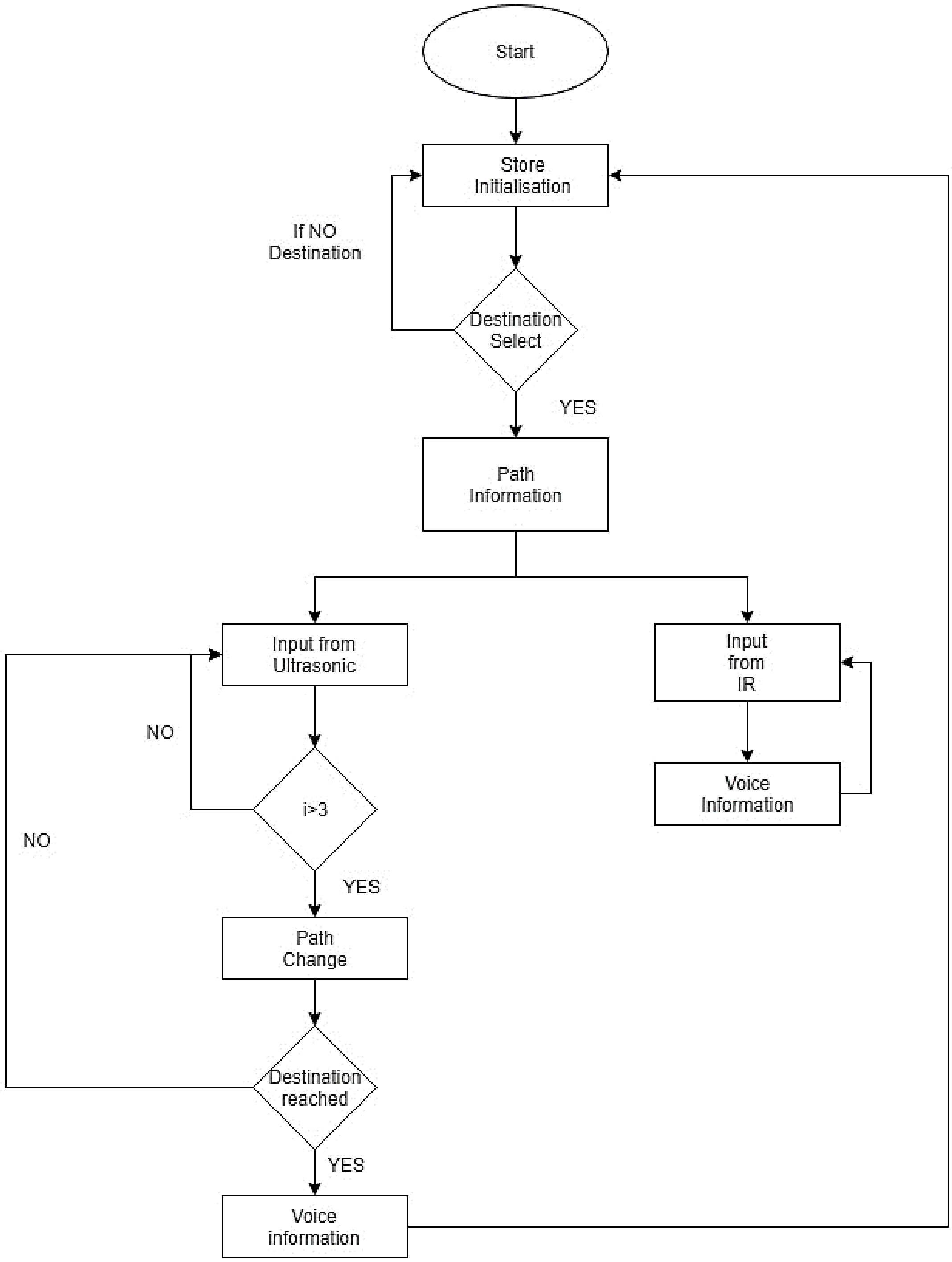

Figure 4: FLOW CHART

4. COMPONENTS AND PIN DIAGRAMS

4.1 ARDUINO UNO

The Arduino Uno[7] s a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

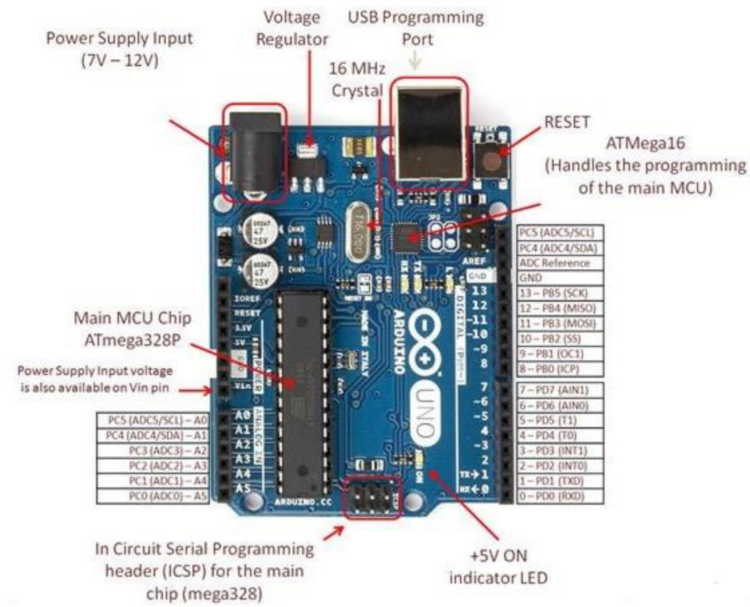

Figure 5: ARDUINO UNO

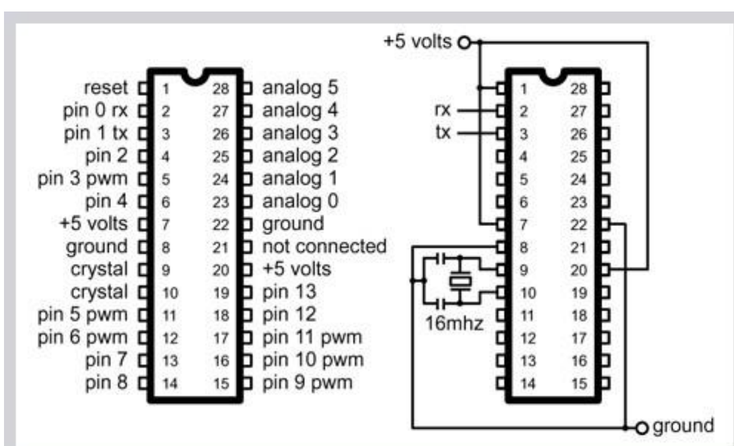

Figure 6: PIN DIAGRAM OF ATMEGA 328P IN ARDUINO UNO

4.1.1 Technical Specifications

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
Flash Memory	32 KB of which 0.5 KB used byboot loader
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz

4.1.2 Power

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and VIN pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12volts.

The power pins are as follows:

- VIN - The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through thispin.
- 5V - The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5Vsupply.
- 3V3 - A 3.3 volt supply generated by the on-board regulator. Maximum current draw is50mA.
- GND – Ground pins.

4.1.3 Memory

The Atmega328 has 32 KB of flash memory for storing code (of which 0.5 KB is used for the boot loader); It has also 2 KB of SRAM and 1 KB of EEPROM.

4.1.4 Input and Output

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 a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20- 50 kOhms. 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 attach Interrupt() function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analog Write() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently

included in the Arduino language.

- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

4.1.5 Communication

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega8U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '8U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, an *.inf file is required.

4.2 ULTRASONIC SENSOR

Ultrasonic distance sensors are designed to measure distance between the source and target using ultrasonic waves. We use ultrasonic waves because they are relatively accurate across short distances and don't cause disturbances as they are inaudible to human ear. The main aim of project is to interface HC-SR04 Ultrasonic sensor with Arduino for better navigation of blind person.

HC-SR04 is a commonly used module for non-contact distance measurement for distances from 2cm to 400cm. It uses sonar (like bats and dolphins) to measure distance with high accuracy and stable readings. It consist of an ultrasonic transmitter, receiver and control circuit. The transmitter transmits short bursts which gets reflected by target and are picked up by the receiver. The time difference between transmission and reception of ultrasonic signals is calculated. Using the speed of sound and 'Speed = Distance/Time' equation, the distance between the source and target can be easily calculated.

HC-SR04 ultrasonic distance sensor module has four pins:

- VCC – 5V, input power
- TRIG – Trigger Input
- ECHO – Echo Output
- GND –Ground

Figure 7: ULTRASONIC SENSOR

4.2.1 Working

It emits an ultrasound at 40000 Hz which travels through the air and if there is an object or obstacle on its path. It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance[8].

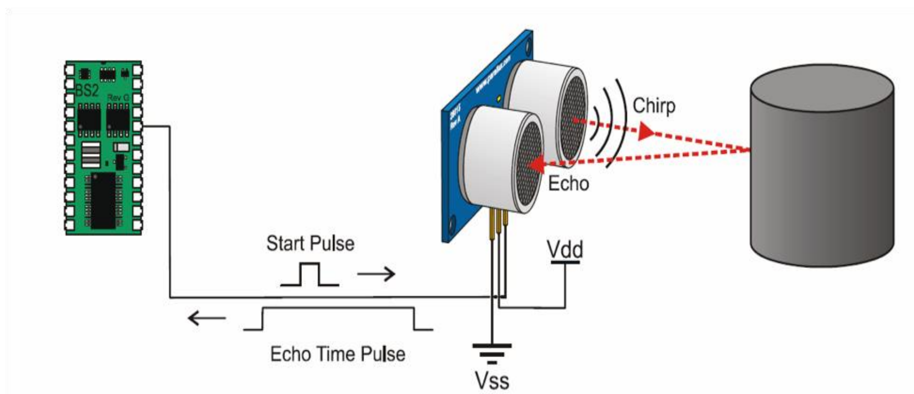

Figure 8: OBSTACLE DETECTION PROCESS

The HC-SR04 Ultrasonic Module has 4 pins, Ground, VCC, Trig and Echo. The Ground and the VCC pins of the module needs to be connected to the Ground and the 5 volts pins on the Arduino Board respectively and the trig and echo pins to any Digital I/O pin on the Arduino Board.
Apart from distance measurement, they are also used in ultrasonic material testing (to detect cracks, air bubbles, and other flaws in the products), Object detection, position detection, ultrasonic mouse, etc. These sensors are categorized in two types according to their working phenomenon – piezo electric sensors and electrostatic sensors. Here we are discussing the ultrasonic sensor using the piezoelectric principle. Piezoelectric ultrasonic sensors use a piezoelectric material to generate the ultrasonic waves.

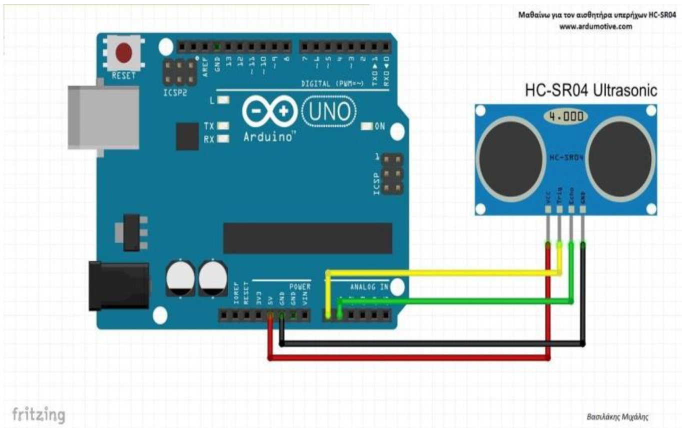

Figure 9: ARDUINO INTERFACING WITH ULTRASONIC SENSOR

4.3 IR SENSOR

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion[9].These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, The resistances and these output voltages, change in proportion to the magnitude of the IR light received.

Figure 10: IR SENSOR

IR sensors are classified into different types depending on the applications. Some of the typical applications of different types of sensors are -

The **speed sensor** is used for synchronizing the speed of multiple motors. The **temperature sensor** is used for industrial temperature control. **PIR sensor** is used for automatic door opening system and **Ultrasonic sensor** are used for distance measurement.

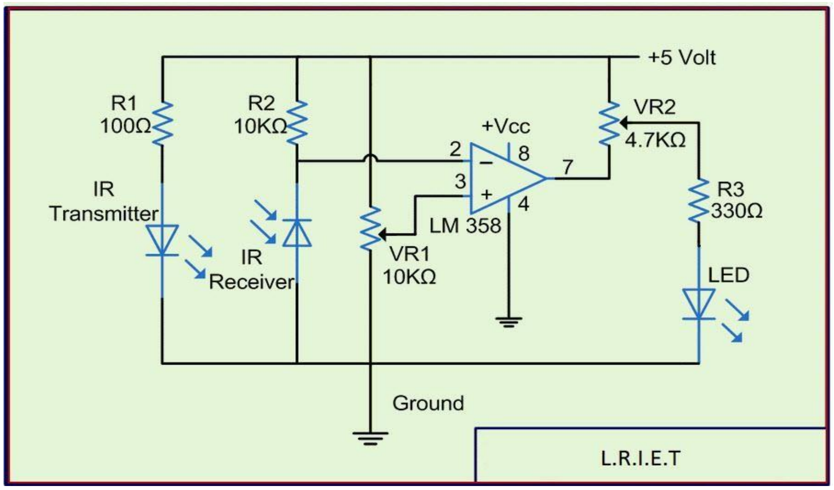

Figure 11: IR CIRCUIT DIAGRAM

The transmitter section includes an IR sensor, which transmits continuous IR rays to be received by an IR receiver module. An IR output terminal of the receiver varies depending upon its receiving of IR rays. Since this variation cannot be analyzed as such, therefore this output can be fed to a comparator circuit. Here an operational amplifier (op-amp) of LM 339 is used as comparator circuit. When the IR receiver does not receive a signal, the potential at the inverting input goes higher than that non- inverting input of the comparator IC (LM339). Thus the output of the comparator goes low, but the LED does not glow. When the IR receiver module receives signal to the potential at the inverting input goes low. Thus the output of the comparator (LM 339) goes high and the LED starts glowing. Resistor R1 (100), R2 (10k) and R3 (330) are used to ensure that minimum 10 mA current passes through the IR LED Devices like Photodiode and normal LEDs respectively. Resistor VR2(preset=5k) is used to adjust the output terminals. Resistor VR1 (preset=10k) is used to set the sensitivity of the circuit Diagram.

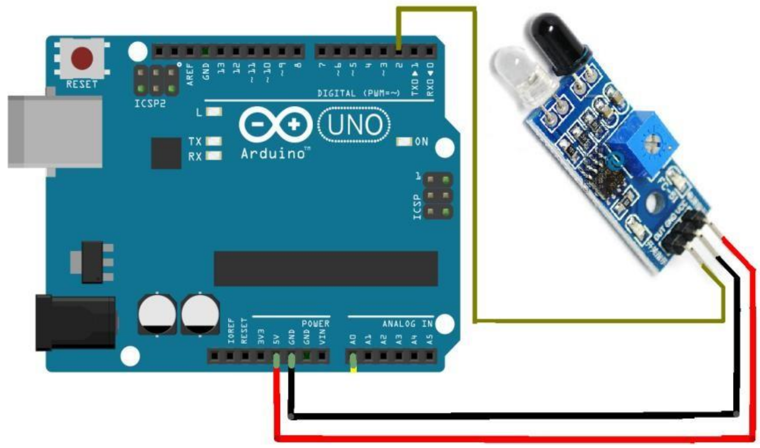

Figure 12: ARDUINO INTERFACING WITH IR SENSOR

The Ground and the VCC pins of the module needs to be connected to the Ground and the 5 volts pins on the Arduino Board respectively and the I/O pin is connected to the Digital I/O pin of the Arduino Board.

4.4 RF TRANSCEIVERS

Generally, an RF module is a small size electronic device, that is used to transmit or receive radio signals between two devices. The main application of RF module is an embedded 000system to communicate with another device wirelessly. This communication may be accomplished through radio frequency communication. RF transceiver module is used in a particular device where both the transmitter and receiver houses in a single module. Such devices transmit and receives RF signal, so that is named as RF Transceiver. Mostly the position of RF Transceiver module is in between Power amplifier/Low Noise Amplifier and Baseband MODEM in any wireless[10] communication system. Baseband Modem chip sets of several analog or digital modulation techniques and analog to digital conversion or digital to analog conversion chips. RF Transceiver module design is made up of amplifiers, RF Mixers, pads & other RF components using micro strip technology. The transmitter and Receiver parts in the RF transceivers called as RF Up converter and RF Down converter.

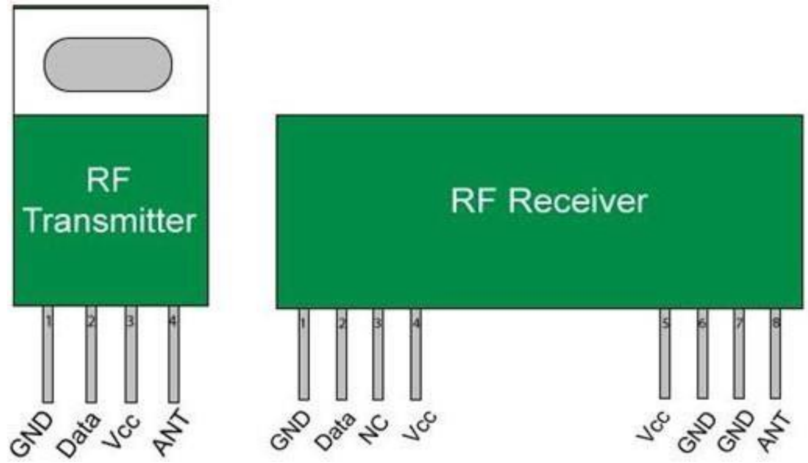

Figure 13: RF TRANSMITTER AND RECEIVER

4.4.1 RF Receiver

An RF receiver module takes the modulated RF signal to demodulate it. There are two kinds of RF receiver modules, namely the super-regenerative receivers and super- heterodyne receivers. Usually, super-regenerative modules are low power designs and low cost using a series of amplifiers to remove modulated data from a carrier wave. These modules vary, generally inaccurate as their operation of frequency significantly with power supply voltage and temperature. The main advantage of Super heterodyne receiver modules is a high performance over super-regenerative. They offer increased stability and accuracy over a large temperature and voltage range. This stability comes from a stable crystal design which in turn leads to a relatively more expensive product.

HT12D is a **decoder integrated circuit** that belongs to 2^{12} series of decoders. This series of decoders are mainly used for remote control system applications, like burglar alarm, car door controller, security system etc. It is mainly provided to interface RF and infrared circuits. They are paired with 2^{12} series of encoders. The chosen pair of encoder/decoder should have same number of addresses and data format. In simple terms, HT12D converts the serial input into parallel outputs. It decodes the serial addresses and data received by, say, an RF receiver, into parallel data and sends them to output data pins. The serial input data is compared with the local addresses three times continuously. The input data code is decoded when no error or unmatched codes are found. A valid transmission in indicated by a high. signal at VT pin.HT12D is capable of decoding 12 bits, of which 8 are address bits and 4 are data bits.

The data on 4 bit latch type output pins remain unchanged until new is received.

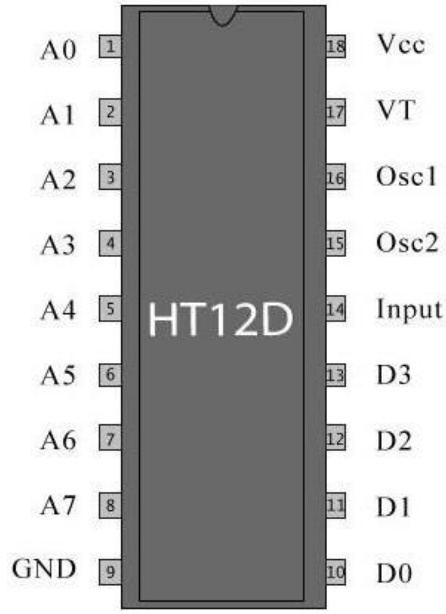

Figure 14: PIN DIAGRAM OF RF RECEIVER

4.4.2 RF Transmitter

An RF transmitter module is a small size PCB capable of transferring a radio wave and modulating radio wave to carry data. RF transmitter modules are usually applied along with a micro controller, which will offer data to the module which can be transmitted. These transmitters are usually subject to controlling requirements which command the maximum acceptable transmitter power o/p, band edge and harmonics requirements. **HT12E** is an **encoder integrated circuit** of 2^{12} series of encoders. They are paired with 2^{12} series of decoders for use in remote control system applications. It is mainly used in interfacing RF and infrared circuits. The chosen pair of encoder/decoder should have same number of addresses and data format. Simply put, HT12E converts the parallel inputs into serial output. It encodes the 12 bit parallel data into serial for transmission through an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits. HT12E has a transmission enable pin which is active low. When a trigger signal is received on TE pin, the programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium. HT12E begins a 4-word transmission cycle upon receipt of a transmission enable. This cycle is repeated as long as TE is kept low. As soon as TE returns to high, the encoder output completes its final cycle and then stops.

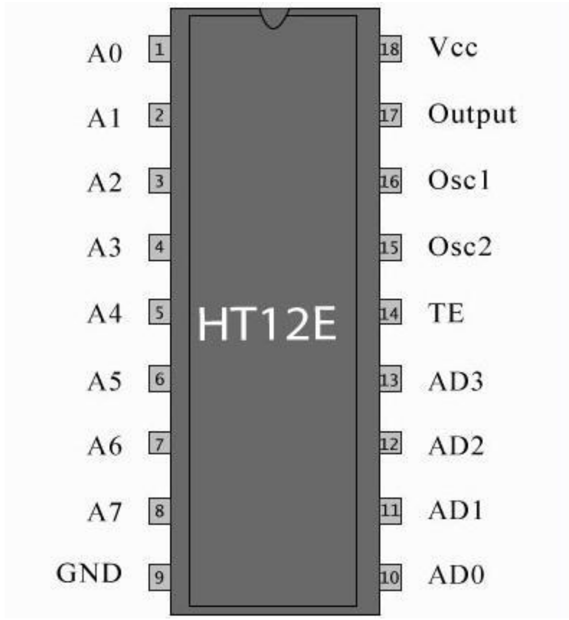

Figure 15: PIN DIAGRAM OF RF TRANSMITTER

4.5 SD CARD MODULE

An SD memory card (Secure Digital Card) is an ultra small flash memory card designed to provide high-capacity memory in a small size. SD cards are used in many small portable devices such as digital video camcorders, digital cameras, handheld computers, audio players and mobile phones. Inside every SD card, rows of tiny memory chips are at work – storing all your documents, music, photos and more. And because there are no moving parts, it's all done quickly and effortlessly. An SD card is an example of flash memory. These devices store data by using floating-gate transistors.

The solid-state chip inside the card's plastic cover contains many tiny electrical circuits. When the card is not in use, the circuits retain their charges without any additional power. When a card is placed in an activated device, such as a camera or a cellphone, a small electrical current from the device moves electrons in the flash memory chip. The digital patterns stored on the chip correlate to the data stored there. Data is erased when a slightly higher voltage is applied to the circuit. This allows for rewriting. SD cards write and erase memory in blocks or sections. This makes them faster than some other varieties of datastorage."

4.5.1 Arduino Interfacing with SDCard Module

The communication between the microcontroller and the SD card uses SPI, which takes place on digital pins 11, 12, and 13 (on most Arduino boards) or 50, 51, and 52 (Arduino Mega). Additionally, another pin must be used to select the SD card. This can be the hardware SSpin-pin 10 (on most Arduino boards) or pin 53 (on the Mega) - or another pin specified in the call to SD.begin().

Formatting and preparing the card

Most SD cards work right out of the box, but it's possible you have one that was used in a computer or camera and it cannot be read by the SD library. Formatting the card will create a file system that the Arduino can read and write to. You'll need a SD reader and computer to format your card. The library supports the FAT16 and FAT32 file systems but use FAT16 when possible. The process to format is fairly straight forward.

- Windows: right click on your card's directory and choose "Format" from the drop down. Make sure you choose FAT as the filesystem.
- It works with standard MicroSD Cards which operating voltage is 3.3 V. Therefore, the module has a voltage regulator and a level shifter so that we can use it with the 5 V pins of the Arduino Board.
- The SD Card Module have six pins, two for powering the module, the VCC and the GND pins, and four more pins for the SPI communication. Here's how we need to connect it to the Arduino Board.

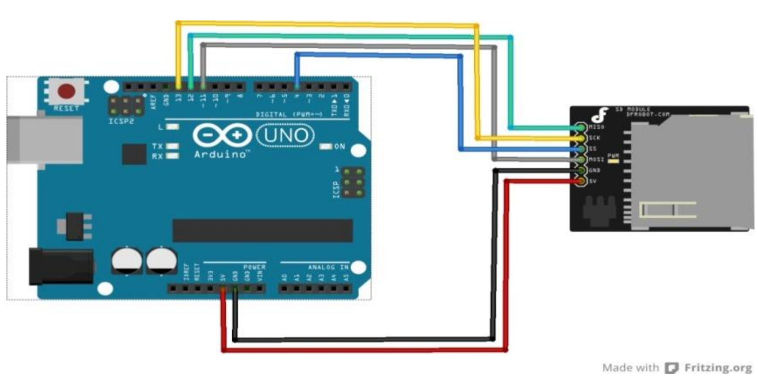

Figure 16: ARDUINO INTERFACING WITH SD CARD

4.6 SPEAKER

Speakers are one of the most common output devices used with computer systems. Some speakers are designed to work specifically with computers, while others can be hooked up to any type of sound system. Regardless of their design, the purpose of speakers is to produce audio output that can be heard by the 000listener.

Speakers are transducers that convert electromagnetic waves into sound waves. The speakers receive audio input from a device such as a computer or an audio receiver. This input may be either in analog or digital form. Analog speakers simply amplify the analog electromagnetic waves into sound waves. Since sound waves are produced in analog form, digital speakers must first convert the digital input to an analog signal, then generate the soundwaves.

The sound produced by speakers is defined by frequency and amplitude. The frequency determines how high or low the pitch of the sound is.

Figure 17: SPEAKER

To Play an Audio

Arduino audio player that plays ".wav" files. It consists of a speaker, a simple transistor acting as an amplifier, and a micro-SD card adapter with a micro-SD card in it where the .wav files are loaded and played. By supplying a current in accordance with a signal of the sound to be output, the speaker causes vibrations in the air, and produces sound. A speaker converts current to vibrations in the air, and a mic takes vibrations in the air and converts them into current for use as an audio signal

Software:

Arduino IDE, SD Association's SD Formatter tool, TMR pcm library (Git hub)

The Arduino in the circuit shown below loads the .wav files from the micro-SD card. It then generates a signal and outputs it through the speaker connected to digital pin 9. This makes the speaker create sounds and play music. It can play many different audios saved on the micro-SD card.

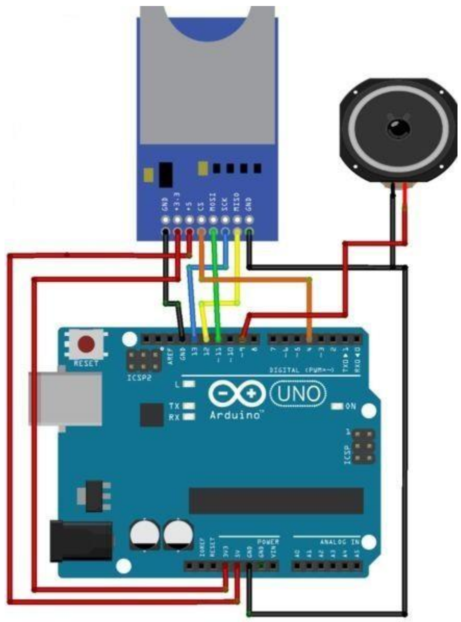

Figure 18: CONNECTION TO PLAY AN AUDIO

The .wav files used in this circuit have a slight limitation in playing audio. Since a transistor is used as an amplifier, it cannot read complex .wav files. Therefore, the .wav files should be converted to have these dimensions:

- Samples Per Second(Hz): 16000
- Channel: Mono
- Bits Per Sample:8

5. PROPOSED DESIGN OF HARDWARE

The RF transmitters are designed using PCB Wizard which is a powerful package for designing single sided and double sided printed circuit boards. It provides a comprehensive range of tools covering all the traditional steps in PCB production, including schematic drawing, schematic capture, component placement, automatic routing, Bill of Materials reporting and file generation for manufacturing.

Complete interfacing of all the hardware components have been studied by everyone individually. The two main goals of our project are:

- Path Planning using RF Transceivers
- Obstacle Detection Using Ultrasonic sensors

We have worked on the designing of RF Transmitters and RF Receiver. In this project, we are using three RF transmitters, one receiver and two IR sensors.

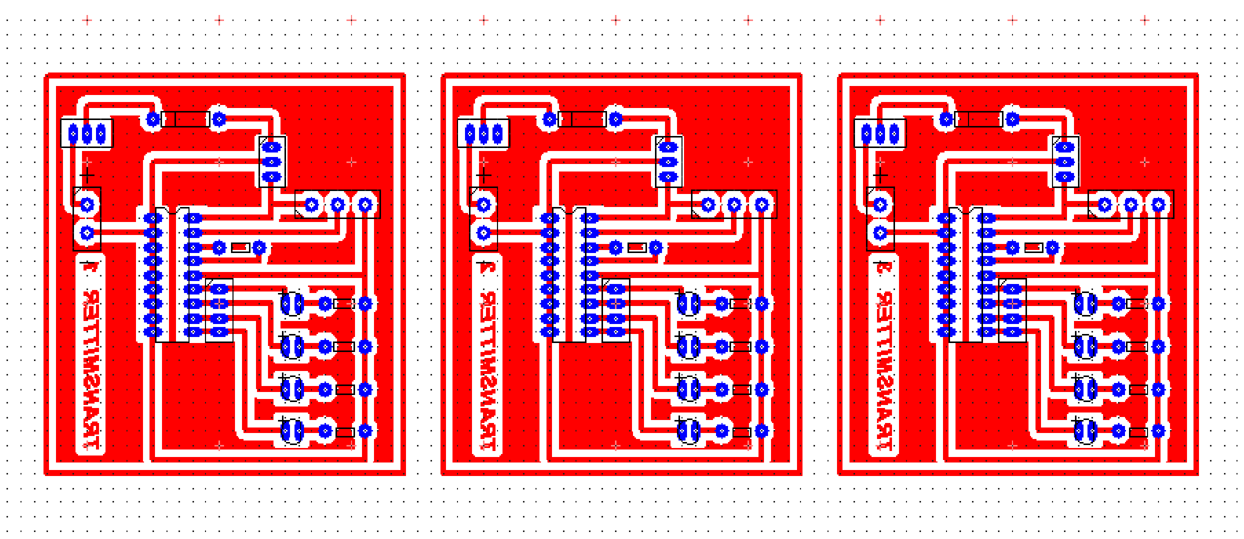

Figure 19: NORMAL VIEW OF RF TRANSMITTERS

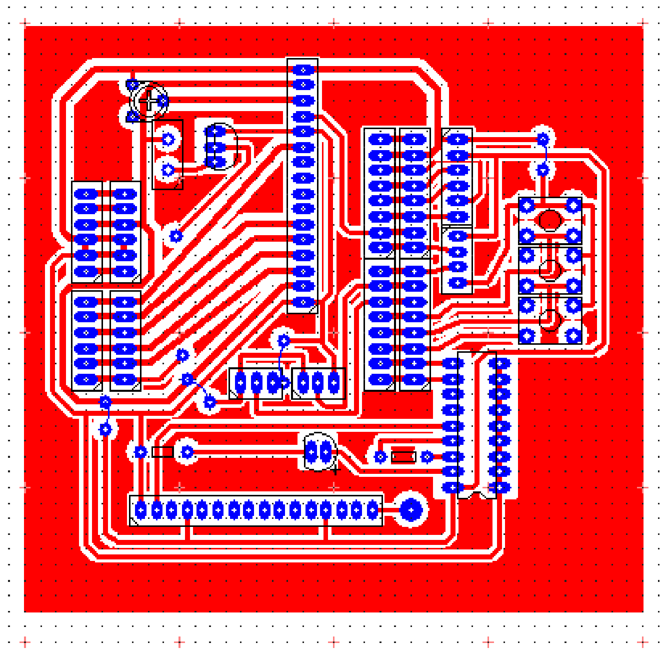

Figure 20: NORMAL VIEW OF RF RECEIVER

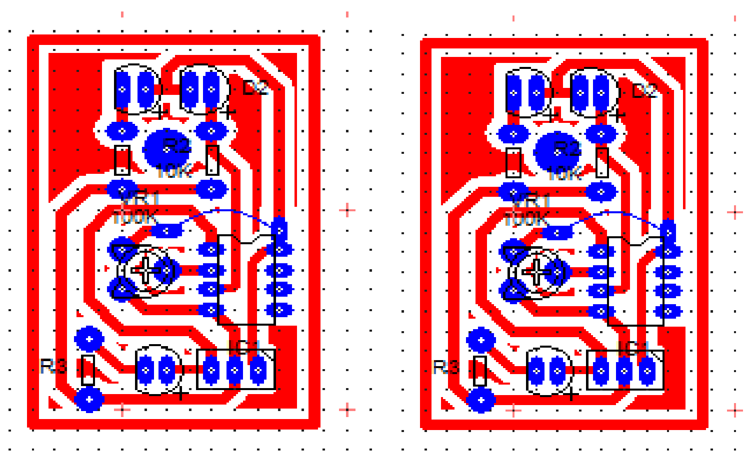

Figure 21: NORMAL VIEW OF IR SENSORS

6. WORKING DESCRIPTION

1. Initially the power is supplied to the Arduino and RF receiver section via 9v battery; and for all the RF transmitters through 4-5v batteries provided.
2. Different combinations of the predefined paths for the three stores are already stored in the SD card in the programming code.
3. As Arduino is charged, SD card gets initialized and LCD Display immediately shows the message *"SD card found"*, as soon as it is charged. If any problem in the circuit appears then it displays *"SD card not found"*.
4. When the switch1 is pressed RF receiver turns ON simultaneously and audio of *"Welcome to the store"* is heard through the headphones or speaker.
5. Whenever the person wants to move to any of the store 1 or 2, corresponding buttons are pressed and the data of the directions to reach the destination, is retrieved from the SD card and Arduino converts the data into WAV files to give the output as audio. Example: *"Go straight, left, straight, right, left, ..."*
6. In the meantime, the Ultrasonic sensor transmits corresponding Ultrasonic waves and IR sensor can be adjusted for the distance sensitivity for the photodiode using it's potentiometer.
7. If Ultrasonic sensor senses any object which is stationary in front of the blind person taking less than 3 seconds, it considers the respective obstacle as a moving person and announces "*wait a sec"* and then continues the path from the SD card stored previously.
8. If it senses any object in front of the person for more than 3 seconds, it considers the respective obstacle as a wall then the indication is given as "*wait a sec, wait a sec, wait a sec"* and the path is changed to next sequential followed direction "*Turn Right or Left*".
9. Simultaneously if any object is sensed by the left IR sensor's photo diode, then audio is heard as "*Look Left"* indicating that there is an obstacle in the left side.
10. Similarly, if any object is sensed by the right IR sensor's photo diode, then audio is heard as "*Look Right"* indicating that there is an obstacle in the right side.
11. When the RF receiver receives the signals from the selected RF transmitter through the switch, then the "*Destination reached"* audio is heard.

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