VISVESVARAYA TECHNOLOGICAL UNIVERSITY
Jnana Sangama, Belagavi - 590 018

MINI PROJECT REPORT ON

Voice Controlled Robot With Human Interaction

Mini project submitted in partial fulfillment for the Award of Degree of
Bachelor of Engineering
in
Electronics and Communication Engineering

Submitted by

Ranjitha R	1RN19EC174
Sampath T S	1RN20EC416
Shivani Kumari	1RN19EC128
Sahana G	1RN20EC414

Under the Guidance of
Mr. Praveen G
Assistant Professor

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

RNS INSTITUTE OF TECHNOLOGY
(AICTE Approved, VTU Affiliated and NAAC A Grade Accredited)
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Channasandra, Dr.Vishnuvardhan Road, Bengaluru-560098

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ESTD 2001

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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CERTIFICATE

Certified that the mini project work entitled **"Voice Controlled Robot With Human Interaction"** is carried out by **Ranjitha R(1RN19EC174), Samapath T S(1RN20EC416), Shivani Kumari(1RN19EC128) and Sahana G(1RN20EC414)** in partial fulfillment for the award of degree of Bachelor of Engineering in **Electronics and Communication Engineering** of Visvesvaraya Technological University, Belagavi, during the year 2021-2022. It is certified that all corrections and suggestions indicated during internal assessment have been incorporated in the report. The mini project report has been approved as it satisfies the academic requirements in respect of the mini project work prescribed for the award of degree of **Bachelor of Engineering**.

Mr. Praveen G	Dr. Vipula Singh	Dr. M K Venkatesha
Assistant Professor	Head of the Department	Principal

External Viva

Name of the examiners	**Signature with date**
1	.....
2	.....

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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DECLARATION

We here by declare that the entire work emobodied in this mini project report titled, **"Voice Controlled Robot With Human Interaction "** submitted to **Visvesvaraya Technological University**, Belagavi, is carried out at the department of **Electronics and Communication Engineering, RNS Institue of Technology, Bengaluru** under the guidance of **Mr. Praveen G**, Assistant Professor. This report has not been submitted for the award of any Diploma or Degree of this or any other University.

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the Department of Electronics & Communication Engineering.

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IRTS in the IETE Sponsored Fifth National Conference on "Emerging Trends in Engineering, Science & Technology" held on June 22, 2022, Organized by the Department of Electronics & Communication Engineering.

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Acknowledgement

The joy and satisfaction that accompany the successful completion of any task would be incomplete without thanking those who made it possible. We consider ourselves proud to be a part of RNS Institute of Technology, the institution which moulded us in all our endeavors.

We express our gratitude to our beloved Chairman **Late Dr. R N Shetty** and Managing Director, **Mr. Satish R. Shetty**, for providing state of art facilities.

We would like to express our sincere thanks to **Dr. M K Venkatesha**, Principal and **Dr. Vipula Singh**, Professor and HOD, Department of Electronics and Communictaion Engineering, for their valuable guidance and encouragement throughout our program.

We express our profound gratitude to the coordinators who have given valuable suggestions and guidance throughout the mini project. We would like to express our sincere gratitude to our guide **Mr. Praveen G**, Assistant Professor, Department of Electronics and Communictaion Engineering, for his guidance, continuous support and motivation in completing the project successfully.

Finally, we take this opportunity to extend our earnest gratitude and respect to our parents, teaching and non-teaching staff of the department, the library staff and all our friends who have directly or indirectly supported us.

Ranjitha R

Sampath T S

Shivani Kumari

Sahana G

Abstract

The purpose of robotics in commercial and residential intention has come to be quite essential for executing challenging work into more conveniently simple way. There are a lot of researches working on to enhance the connection between humans and robot. The paper presents the research of the designing and development of a voice controlled talking robot using mobile phone based on microcontroller. The control system of the robot movement will be employed by the voice and the robot will response the commanding persons by generating sounds of human voice with each verbal instruction. The proposed system will be designed based on microcontroller which is connected to smart android phone through wi-fi for receiving voice command. The voice command is converted to text by an app of the android phone and sends necessary data to the microcontroller for controlling robot movement. After receiving the data the robot responses according to the command by performing proper movement to the proper direction according to the voice command. A DFPlayer along with microSD card which will consist some pre-recorded human voice as audio file will be used by the robot for the development of the robot's talking system. After getting each command the robot will act according to the instruction and will be able to speak different sentences.

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Chapter 1

Introduction

The surprising raise in the utilizing of robots and automation offers various advantages as well as it has drawn the attention of both academic investigation and commercial programs.The analysis on numerous technique of controlling robot has accomplished quite a few success by introducing a number of innovative and unique methods of robot movement control. Verbal interaction intended for robot controlling is actually sort of an innovative process among many methods which are introduced regarding robotics control.

1.1 Motivation

The use of robots in the present day has moves from industries to the normal day to life The use of voice commands to control a robot is much easier for domestic as well as industrial users.Verbal interaction intended for robot controlling is actually sort of an innovative process among many methods which are introduced regarding robotics control.This project proposes the development of a voice controlled robot which has the ability to follow voice command from user and does communicate with user by using pre-recorded human voice sound.

1.2 Objectives

Our main objectives are as follows:-
Replace the old working car with our wifi based voice controlled car

1. To support of disable people of india as well as world .
2. To increase the application of the robotics and automation.
3. To reduce the cost of making this kind of embedded systems wich are more efficient and user friendly and reliable.
4. To reduce the maintenance charges.
5. To Operating the robot wirelessly through smart phone.
6. To control the speed of robot automatically.

1.3 Block diagram

The functional diagram of the proposed robot is shown in figure 1.1. The central processing unit will be a esp32 connected with an android operated smart phone via wi-fi. It will be used to give voice command using an app and will convert the voice command into text as well as send the data to google firebase using wi-fi.The text stored in the google datbase are further read by esp32.

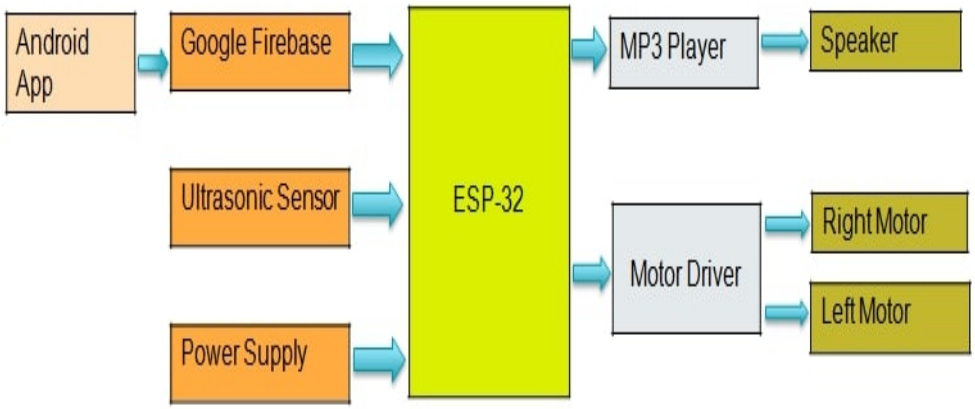

Figure 1.1: Functional Block Diagram Of Proposed Robot

Motor driver will be required for controlling the movement of the robot and it will be operated by the esp32 to control two different motor of left and right by controlling the direction of rotation of motors. An ultrasonic sensor will be interfaced to detect obstacle.A DFPlayer with microSD card will be connected to the esp32 for storing the pre-recorded human voices.A speaker will be connected for generating the received sound of recording from micro SD card through esp32.

1.4 Methodology

The control system of the robot is employed by the voice. Firebase is a Backend-as-a-Service which act as server, APIs and datastore all written so generically that it can be modify to suit our needs. When we give any command through an android app it converts speech to text and store that command in database of google firebase and further the command is being read by esp32 using that database. After giving the command robot will first speak the sentence using DFPlayer and then it will act

according to the command such as forward,backward,right,left and stop.For driving the robot there will be two geared DC motors with gripped tyre which will be operated by the help of L298N motor driver. The ultrasonic sensor placed in forward direction searches for the obstacles, if there is any object found robot will have the following movements as per the given distances:-

- For less than 20cm(very nearer), the robot will be stopped.
- For distance more than 20cm and less than 50cm,the robot will reduce it speed.
- For distance more than 50cm ,the robot will move normally with specified speed.

1.5 Applications

1. Robot application in industries.
2. It is the one of the important stage of Humanoid robots.
3. The robot can be used in toys.
4. The robot is useful in places where humans find difficult to reach but human voice reaches. E.g. in fire situations, in highly toxic areas.
5. Can be used to detect the object

1.6 Advantages and Disadvantages

1.6.1 Advantages:

- The robot is small in size, so space required for it is small
- We can access the robot from the distance of meters as we are using Wifi for the connection between robot and the server PC.
- Cost of system is low as we are using smart phone which is nearby available to everyone.

1.6.2 Disadvantages:

- Even the best speech recognition systems sometimes make errors. If there is noise or some other sound in the room the number of errors will increase.
- Speech Recognition works best if the microphone is close to the user will tend to increase the number of errors.

- In Speech recognition system, there is a possibility of unauthorized usage. Since this doesnt depends upon which person is speaking.

1.7 Organisation of Report

Chapter 1 : Introduction This chapter just provides the introduction to our project and discusses the motivation and the different objectives of our project and just gives a glimpse of the methodology we used and what were the advantages ,disadvantages and applications.

Chapter 2 : Literature Survey This chapter gives a summary of the paper we used for reference and explains the methodology behind it and how it contributed to the making of our project and the ideas we took from the different papers.

Chapter 3 : System Analysis This chapter gives us insight into the technical details of our project such as the software requirement specification, hardware requirement specifications, high-level design, etc.

Chapter 4 : Implementation This chapter elaborates the whole process and the methodology behind the implementation of the project in a step-by-step process and provides insight into programming coding guidelines used during the making of our project.

Chapter 5 : Discussion of Results In this chapter, we discuss the outputs rather than the results obtained after completion of our project with the efficiency of the model or the accuracy of making correct predictions by our model.

Chapter 6 : Conclusion and Future Work Here we provide the conclusion obtained by our project with the future work which tries to cover the probable loopholes in our project that may occur in future as the scenario of the future may be different as compared to now.

Chapter 2

Literature Survey

This chapter gives a summary of the paper we used for reference and explains the methodology behind it and how it contributed to the making of our project and the ideas we took from the different papers.

[1]. R. L. Khan, D. Priyanshu and F. S. Alsulaiman, "Implementation of Human Voice Controlled Robotic Car," 2021 10th International Conference on System Modeling and Advancement in Research Trends (SMART), 2021, pp. 640-646, doi: 10.1109/SMART52563.202 1.9676319.

In this paper an android app is utilised in this system to transmit human instructions to the microcontroller. The UART protocol may be used to connect a controller to a Bluetooth module. The android app receives the speech and the voice module processes it. After then, the voice is transformed to text. This text will be further processed by the microcontroller, which is going to take appropriate step taken to control the avoice control robotic car. The purpose of this system is to construct a robotic car that can be operated with a human voice for basic actions like going ahead and turning left or right. The ATmega Arduino board is the Hardware Development board utilised in this project. The programmed is written in the Embedded C/C++ is used by the Arduino IDE. This is a simple robotic application approach.

[2]. J. Nádvorník and P. Smutný, "Remote control robot using Android mobile device," Proceedings of the 2014 15th International Carpathian Control Conference (ICCC), 2014, pp. 373-378, doi: 10.11 09/CarpathianCC.2014.6843630.

This paper describes the design and realization of the mobile application for the Android operating system which is focused on manual control of mobile robot using wireless Bluetooth technology. The application allows the robot controlinteraction with the display, or voice. When we use a graphical interface, we can monitor the current distance of the robot from obstacles. The measurement of distance is carried out by ultrasonic sensor placed in front of the robot. It was necessary to build a

prototype of a mobile robot for the development of the application. The prototype of the mobile robot is based on the differential gear.

[3]. A. Aneiba and K. Hormos, "A model for Remote Controlled Mobile Robotic over Wi-Fi network using Arduino technology," International Conference on Frontiers of Communications, Networks and Applications (ICFCNA 2014 - Malaysia), 2014, pp. 1-4, doi: 10.1049/cp.2014.1429.

This paper presents the development of a robotic module based on Arduino Uno technology. Communication between the robotic module and the operator (an end-user device) is done via a WiFi network for operation and control purposes. This communication occurs over a secured custom-made Encryption/Decryption Algorithm to prevent others from controlling the module. The distance between the module and the operator depends on the adapter itself. A camera "eye of robot" captures and transmits images/videos to the operator who can then recognize the surrounding environment and remotely control the module. The operator can control the module from any development software, by using of the private Encryption/Decryption Algorithm, and the correct controlling messages.

[4]. M. Basha, K. Vamshi, K. Bhavana and M. Bhavitha, "Command Control Robot using Internet of Things on Field Programmable Gate Array," 2020 International Conference on Electronics and Sustainable Communication Systems (ICESC), 2020, pp. 1068-1073, doi: 10.1109/ICESC48915.2020.9155989.

This paper has intended the utilization of Field Programmable Gate Arrays (FPGA) chip for the Internet of Things (IoT) controlled robot by using a Wi-Fi module. Internet of Things controlled robot is developed on Verilog hardware description language and acknowledged on Nexys-4 XC7A100TCSSG324-1 FPGA using Xilinx Vivado 2014.4. This paper CCR mainly focuses on voice commands given to a mobile robot through mobile application according to the necessity of the task. The robot will traverse to the required location by sensing the environment, updating the sensor information on to the cloud to finish it. The task accomplishment will be known through a mobile application designed on MIT App Inventor. The navigation and control of the robot are executed remotely through an Android mobile phone. Any Android wireless device can be used for enabling remote control for the robot.

[5]. A. Carullo and M. Parvis, "An ultrasonic sensor for distance measurement in automotive applications," in IEEE Sensors Journal, vol. 1, no. 2, pp. 143-, Aug 2001, doi: 10.1109/JSEN.2001.936931.

This paper describes an ultrasonic sensor that is able to measure the distance from the ground of selected points of a motor vehicle.The sensor is based on the measurement of the time of flight of an ultrasonic pulse,which is reflected by the ground.A constrained optimization technique is employed to obtain reflected pulses tht are easily detectable by means of a threshold comparator.Such a technique,which takes the frequency response of the ultrasonic transducers into account,allows a sub-wavelength detection to be obtained.This gives an idea about the usage of ultrasonic sensor.

[6]. Humayun Rashid, Iftekhar Uddin Ahmed, Sayed Bin Osman, Qader Newaz, Md. Rasheduzzaman and S M Taslim Reza,"Design and Implementation of a Voice Controlled Robot with Human Interaction Ability", in International Conference on Computer, Communication, Chemical, Materials and Electronic Engineering IC4ME2-2017, 26-27 January, 2017 Paper ID: 65 ISBN: 978-984-34-2030-5 148

In this paper,the control system of the robot movement will be employed by the voice and the robot will response the commanding persons by generating sounds of human voice with each verbal instruction. The proposed system will be designed based on microcontroller which is connected to smart android phone through Bluetooth module for receiving voice command. The voice command is converted to text by an app of the android phone and sends necessary data to the microcontroller for controlling robot movement. After receiving the data the robot responses according to the command by performing proper movement to the proper direction according to the voice command. A SD card module along with a SD card which will consist some pre-recorded human voice as audio file will be used by the robot for the development of the robot's talking system. After getting each command the robot will act according to the instruction and will be able to speak different sentences.

[7] A. Chaudhry, M. Batra, P. Gupta, S. Lamba and S. Gupta, "Arduino Based Voice Controlled Robot," 2019 International Conference on Computing, Communication, and Intelligent Systems (ICCCIS), 2019, pp. 415-417

In this paper, a system is being proposed, which focuses on the concept of how a robot can be controlled by the human voice. Voice control robot is just a practical example of controlling motions of a simple robot by giving daily used voice commands. In this system, an android app is used as a medium for the transmission of human commands to microcontroller. A controller can be interfaced with the Bluetooth module through the UART protocol. The speech is received by the android app and processed by the voice module. Voice is then converted to text. The microcontroller will further process this text, which will take suitable action to regulate the robot. The objective is to design a robotic car whose basic movements such as moving forward, turning to left or right can be controlled by the human voice.

[8]. Roni Stiawan, Adhi Kusumadjati, Nina Siti Aminah, Mitra Djamal ,Sparisoma Viridi "An Ultrasonic Sensor System for Vehicle DetectionApplication" IOP Conf. Series: Journal of Physics: Conf. Series 1204(2019) 012017 doi:10.1088/1742-6596/1204/1/012017

This study develops an ultrasonic sensor system that can be used to determine the number, type, and speed of car vehicles passing a point over some specified time period. The proposed system consists of two ultrasonic sensors and a microcontroller equipped with datalogging shield. The data were recorded and then analyzed using a computer program written in Java. Actual experiments that have been conducted indicates that this system can give a correct number of vehicles in a given interval of time.

[9].Michal Kelemen, Ivan Virgala, Tatiana Kelemenová,Ľubica Miková, Peter Frankovský,Tomáš Lipták, and Milan Lörinc, "Distance Measurement via Using of Ultrasonic Sensor."Journal of Automation and Control,vol. 3, no. 3 (2015): 71-74. doi: 10.12691/automation-3-3-6.

In this paper, Ultrasonic sensors have variety application as distance measurement, obstacle avoiding and anti-collision detection, robot navigation, measurement in automotive parking assistance systems, measurement of air flow velocity - anemometer, medical ultrasonography, non-destructive testing, piezoelectric transducers, level measurement, pallet detection on forklifts, vehicle detection in barrier systems etc.Ultrasonic sensors are non-intrusive in that they do not require physical contact with their target, and can detect certain clear or shiny targets otherwise obscured to some vision-based sensors. On the other hand, their measurements are very sensitive to temperature and to the angle of the target.

Temperature and humidity affect the speed of sound in air. Therefore, range finders may need to be recalibrated to make accurate measurements in anew environment. Temperature variations and air currents can create invisible boundaries that will reflect ultrasonic waves, so care must be taken to avoid these. For the transmitted wave to echo back to the receiver, the target surface must be perpendicular to the transmitter. Round objects are therefore most easily sensed since they always show some perpendicular face. When targeting a flat object, care must be taken to ensure that its angle with respect to the sensor does not exceed a particular range.Ultrasonic sensors typically have a "dead zone"immediately in front of them in which objects cannot be detected because they deflect the wave back before the receiver is operational. Some materials are more absorbent than others, and these will reflect less ultrasound. This complicates using the attenuation method to measure the distance of arbitrary objects.

[10]. Arun Francis G, Arulselvan M ,Elang kumaran P,Keerthivarman S, Vijaya Kumar J "Object Detection Using Ultrasonic Sensor" International Journal of Innovative Technology and Exploring Engineering(IJITEE) ISSN:22783075 Volume-8 Issuse-6S,April 2019

Radio Detection and Ranging (RADAR), a device that can be used to monitor a distinct area continuously. It is a detection system which utilizes radio waves to decide the range,angle or velocity of objects. The presence of aircrafts, ships, spacecraft and weather formations. The main intent of this project is to help our fishermen who are caught by the neighbouring country's Navy. They are getting caught while fishing near the neighbouring country's border. This project helps the fishermen to escape from them by raising an alert message. The alert message will be exhibited on the shade. While seeing the alert note, they can get alerted and move away from the place immediately. The location and the distance of the object is also measured and indicated to the people. This system has an Arduino which is connected to an Ultrasonic Sensor which is attached on a DC Motor.

[11]. Sowmya B J, Supriya M "Robot Controlled Car Using Voice and Wi-Fi Module" International Research Journal of Engineering and Technology (IRJET) Volume: 08 Issue: 08 — Aug 2021 e-ISSN: 2395-0056 p-ISSN: 2395-0072

In this paper, The aim of the project is to develop a real time voice control system which is implemented and tested on a mobile robot The microcontroller

ESP32 is programmed using Arduino IDE. Making use of Google speech recognition technology, Android software is developed that can access voice command information and it will later convert that to text .This is done by speech to text technique of Google for the conversion from voice to text , text is then transmitted to ESP32. To receive this information which is in text, ESP32 will be programmed through Bluetooth .Programming is done giving the commands for the movement in all four directions like left, right, forward and backward as well it is programmed for stop. Programming for independence is also done through robot will incorporate fully independent Operation making use of IR sensor. This facility makes the detection of obstacle if any easier and in turn will avoid collision.

[12]. S. Azargoshasb A. H. Korayem Sh. Tabibian "A Voice Command Detection system for controlling Movement of SCOUT Robot"2018 6th RSI International Conference on Robotics and Mechatronics (IcRoM) DOI: 10.1109/ICRoM.2018.8657523 ISBN:978-1-7281-0128-6

The robot termed as SCOUT robot is controlled through the detection system using voice commands. Hidden Markov model is used for the implementation of the detection system for the transmission of voice commands. A database for speech is created incorporating needed commands. The database is non-native and it has different commands like ready, left, right, stop, forward, backward, fast, slow and go. Twenty Persian language speakers have uttered each of the command. Among them ten are male and ten are female. On the basis of HMM, the detection of voice commands done. The Bluetooth is used for the transmission of detected command to the robot. The evaluation results of the designed system shows the performance improvement in the interaction of human and robot.

[13]. Ms Sarita S Umadi, Dinesh Patil "DC MOTOR SPEED CONTROL USING MICROCONTROLLER" International Journal of Engineering and Techniques -Volume 2 Issue 6,Nov – Dec 2016 ISSN : 2395-1303

This paper is to control the speed of DC motor. The main advantage in using a DCmotor is that the Speed-Torque relationship can be varied to almost any useful form. To achieve thespeed control an electronic technique called Pulse Width Modulation is used which generates High andLow pulses. These pulses vary the speed in the motor. For the generation of these pulses amicrocontroller (AT89c51) is used. As a microcontroller is used to set the speed ranges which is done bychanging

the duty cycles time period in the program. This is practical and highly feasible in economic point of view, and has an advantage of running motors of higher ratings. This paper gives a reliable,durable, accurate and efficient way of speed control of a DC Motor.

[14]. Aniket R. Yeole1, SapanaM. Bramhankar2, Monali D. Wani3, Mukesh P. Mahajan "Smart Phone Controlled Robot Using ATMEGA328 Microcontroller " ISSN(Online): 2320-9801ISSN ijircce.2015.0301020

In this paper Nowadaysandroid smart phones are themost popular gadget. There are multiple applications on the internet that exploit inbuilt hardware in these mobile phones, such as Bluetooth, Wi-Fi and ZigBee technology to control other devices. With the development of modern technology and Android Smartphone, Bluetooth technology aims to exchange data wirelessly at a short distance using radio wave transmission comprising features to create ease, perception and controllability. In this paper we have designed a robot that can be controlled using an application running on an android phone. It sends control command via Bluetooth which has certain features like controlling the speed of the motor, sensing and sharing the information with phone about the direction and distance of the robot from the nearest obstacle.

[15]. Soniya Zope, Preeti Muluk, Rupali Mohite, Aishwarya Lanke, Megha Bamankar "Voice Control Robot Using Android Application" DOI:10.1109/ICESC48915.2020.9155989.

Controlling the robotic device or vehicle through the voice commands and remote operation control in the manual method is designed in the project. The microcontroller ATMEGA32 and Bluetooth device is used incorporating interfacing of control unit and sense the signals which will be sent by the android app. The Android app sends the serial data received from the Bluetooth module which is interfaced to the ATMEGA32. The paper deliberates the controlling of robot car making use of Wi- Fi module and android application of the smartphone.

[16]. Snezhana Georgieva Pleshkova, Aleksander Bogdanov Bekyarski and Zahari Todorov Zahariev "Lab VIEW Model of Voice Commands for Mobile Robot Motion Control using Internet of Thinks Module"DIO: 10.1109/ELECTRONICA.2019.8825618 .

The interaction of the people with the robots are been satisfied through

many mobile robot methodologies done by many of the researchers. In all the methodologies, commonly the voice commands are the interaction domain. This is required for operating the motion of the mobile robot. This is accomplished in this article by proposing a creation of LabVIEW model for the reception and recognition of voice commands which is transmitted from the person to the mobile robot. The experimentation and testing of LabVIEW model is carried out in the Internet of Thinks which is sophistically adopted on the mobile robot domain.

Chapter 3

Component Description

This chapter gives us insight into the technical details of our project such as the software requirement specification, hardware requirement specifications, high-level design,etc.

3.1 Hardware Requirements

1. ESP 32
2. L298N Motor driver
3. Ultrasonic sensor
4. Power supply
5. Micro SD card
6. DC Motor
7. Wheels
8. MP3 Player
9. Speaker
10. Battery
11. Jumper wires

3.2 Software requirements

1. Arduino IDE

3.3 Description of Hardware used

3.3.1 ESP32

Figure 3.1 shows ESP32 module.It is a series of low cost,low power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth.It is especially aimed to provide versatility,robustness and reliability in many applications.

Specifications:

- Single or Dual-Core 32-bit LX6 Microprocessor with clock frequency up to 240 MHz.
- 520 KB of SRAM, 448 KB of ROM and 16 KB of RTC SRAM.
- Supports 802.11 b/g/n Wi-Fi connectivity with speeds up to 150 Mbps and also support for both Classic Bluetooth v4.2 and BLE specifications.
- 34 Programmable GPIOs.
- Up to 18 channels of 12-bit SAR ADC and 2 channels of 8-bit DAC
- Serial Connectivity include 4 x SPI, 2 x I2C, 2 x I2S, 3 x UART.
- 1 Host controller for SD/SDIO/MMC and 1 Slave controller for SDIO/SPI.
- Motor PWM and up to 16-channels of LED PWM.
- Secure Boot and Flash Encryption.

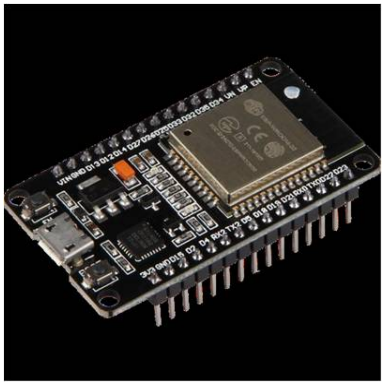

Figure 3.1: ESP32

There are many ESP32 Boards based on ESP-WROOM-32 Module available in the market. The layout, pinout and features vary from board to board. The board which we have used has 30 Pins (15 pins on each side). There are some board with 36 Pins and some with slightly less Pins.Figure 3.2 is ESP-WROOM-32 which has 30 pins.

Figure 3.2: ESP-WROOM-32

3.3.1.1 Pin out of ESP-WROOM 32

One popular ESP32 Development Board available is 30-pin version shown in figure 3.2.It consists of ESP-WROOM-32 as the baseboard and additionally few pins and components to easily interact with ESP32.
Figure 3.3 shows the pinout of a 30-pin ESP32 DevKit Development Board.

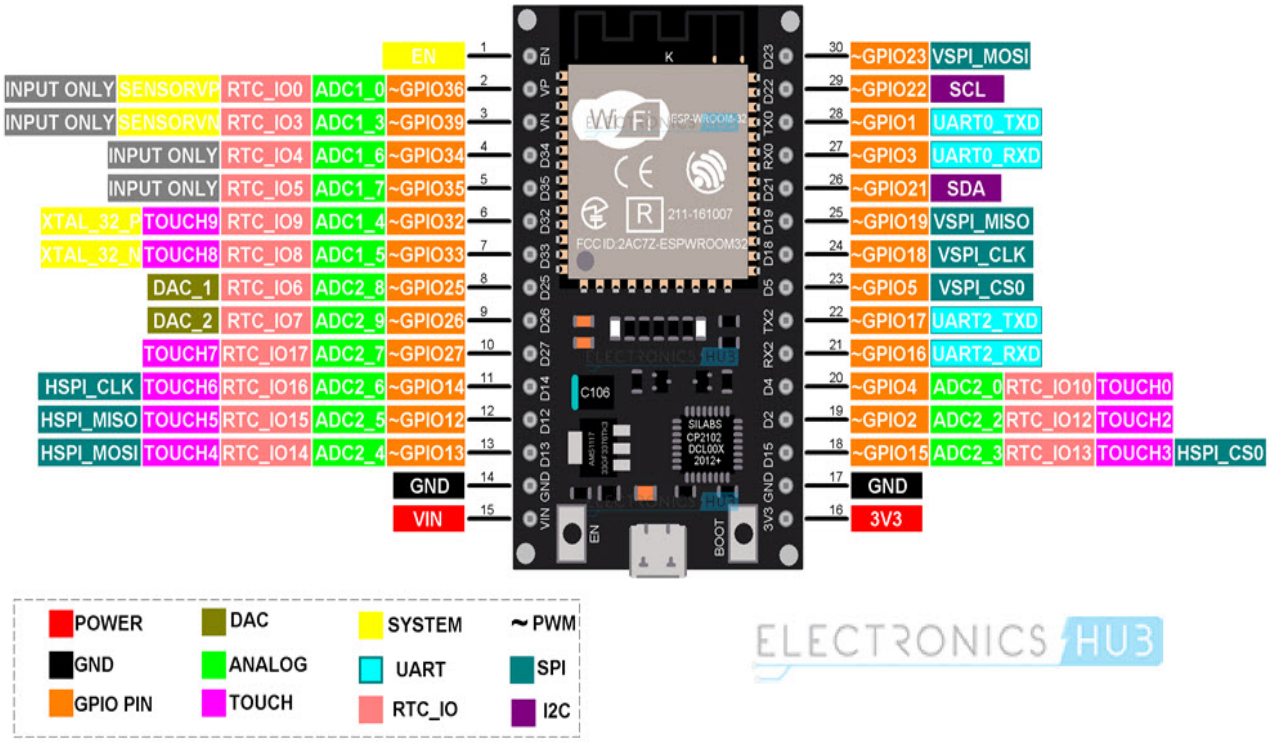

Figure 3.3: ESP32-Pinout

Pin description :

- **GPIO** means General Input and Output. In the 30 pin ESP32 board, 25 GPIO pins are available to connect with external circuits. It also has some other GPIO pins that are connected internally with some ports and ICs. The GPIO pins are also used for other functions such as ADC, DAC, RTC, etc. But, only one

function work at a time. So, we can configure the GPIO pin as an ADC or a UART in the program. You can see in the above diagram, the pin no 2 to 13 and pin no 18 to 30 have GPIO functions.

- **ADC** means Analog to Digital Converter. The ADC pins help to connect external analog devices and components with this board. So, it can measure analog voltage, current. These ADC pins are also be used in the sleep mode for low power consumption. The pin no 2 to 13 and 18 to 20 have ADC functions.

- **DAC** means Digital to Analog. Digital to Analog or DAC helps to convert the digital signal into an analog signal. These are used for analog output purposes. These pins are comes in the use for voltage control, PWM control, etc. The GPIO 25 and 26 or pin no 8 and 9 have DAC functions.

- **PWM** means Pulse Width Modulated. There is a difference signal normal digital signal and pulse width modulated or PWM signal although they look like same. The digital signal has a constant or fixed time period and frequency whereas PWM signal has variable time period and frequency. The PWM function comes for very useful applications such as motor control or variable load controls. In the ESP32 board, almost all the pins are PWM enabled except pin no 1, 14, 15, 16, 17.

- The 30 pin ESP32 board has 9 numbers touch sensor pins. The pin no 6, 7, 11, 12, 13, 18, 19, 20 the touch sensor pins. These pins are can be used to implement a capacitive touch sensor or touchpad without any external hardware.

3.3.2 L298N Motor driver

Figure 3.4 shows L298N motor driver,it is a dual H-bridge motor driver. Motor drivers act as current amplifiers since they take a low-current control signal and supply a higher-current signal. This higher current signal is employed to drive the motors. L2938 contains 2 inherent H-bridge driver circuits. In its common mode of operation, 2 DC motors can be driven at the same time, each in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 and 7 and 10 and 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

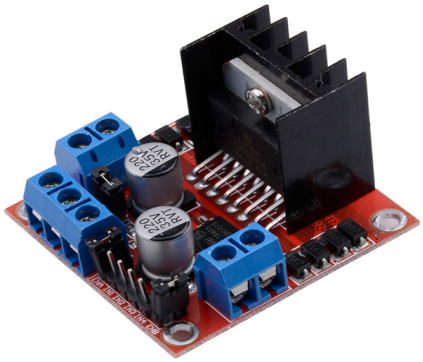

Figure 3.4: L298N

Pin description of L298N:

- **VCC** pin supplies power to the motor. Voltage anywhere between 5 to 35V can be applied. Remember, if the 5V-EN jumper is in place, you need to supply 2 extra volts than the motor's actual voltage requirement, in order to run the motor at its maximum speed.
- **GND** is the common ground pin.
- **5V** pin supplies power to the switching logic circuitry inside the L298N IC. If the 5V-EN jumper is in place, this pin acts as output and can be used to power up the Arduino. If the 5V-EN jumper is removed, you need to connect it to the 5V pin on Arduino.
- **ENA** pins are utilized to control the speed of Motor A. Supplying this pin with HIGH logic makes the Motor A rotate, supplying it with LOW logic causes the motor to stop. Removing the jumper and connecting this pin to the PWM input let us control the speed of the Motor A.
- **IN1 and IN2** pins are used to control the direction of Motor A. If IN1 is HIGH and IN2 is LOW, Motor A spins in a certain direction. To change the direction, make IN1 LOW and IN2 HIGH. If both the inputs are either HIGH or LOW, the Motor A stops.
- **IN3 and IN4** pins are used to control the direction of the Motor B. If IN3 is HIGH and IN4 is LOW, Motor B spins in a certain direction. To change the direction, make IN3 LOW and IN4 HIGH. If both the inputs are either HIGH or LOW, the Motor B stops.
- **ENB** pin can be used to control the speed of Motor B. Supplying this pin with the HIGH signal makes the Motor B turn, supplying it LOW cause the motor

to stop. Eliminating the jumper and interfacing this pin to PWM information let us control the speed of Motor B.

- **OUT1 and OUT2** pins are connected to Motor A.
- **OUT3 and OUT4** pins are connected to Motor B.

Specifications:

- Driver Model: L298N 2A
- Chip: Double H Bridge L298N
- Motor Supply Voltage (Maximum): 46V
- Motor Supply Current (Maximum): 2A
- Logic Voltage: 5V
- Driver Voltage: 5-35V
- Driver Current:2A
- Logical Current:0-36mA
- Maximum Power (W): 25W
- Current Sense for each motor
- Heatsink for better performance
- Power-On LED indicator

3.3.3 Ultrasonic sensor

Figure 3.5 shows an ultrasonic sensor that is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emission of the sound by the transmitter to its contact with the receiver. The formula for this calculation is D = $\frac{1}{2}$ T x C (where D is the distance, T is the time, and C is the speed of sound 343 meters/second).

Figure 3.5: Ultrasonic sensor

Ultrasonic sensors are used primarily as proximity sensors. They can be found in automobile self-parking technology and anti-collision safety systems. Ultrasonic sensors are also used in robotic obstacle detection systems, as well as manufacturing technology.

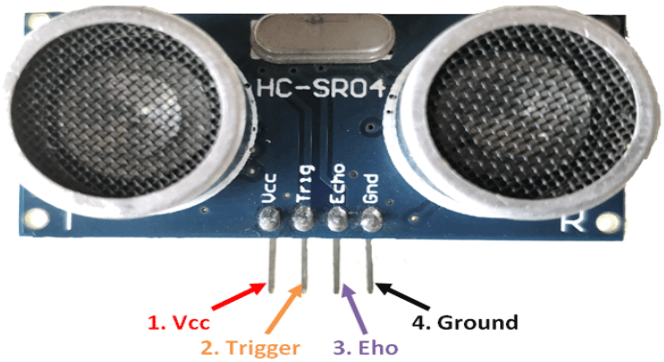

Figure 3.6: Ultrasonic sensor pinout

Figure 3.6 shows the pinout of ultrasonic sensor.Pin description of these pins are given below:

Pin description :

- **Vcc** - The Vcc pin powers the sensor, typically with +5V.
- **Trigger** - Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.
- **Echo**- Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
- **Ground** - This pin is connected to the Ground of the system.

Applications of Ultrasonic Sensor:

- Automatic change over's of traffic signals
- Intruder alarm system
- Counting instruments access switches parking meters
- Back sonar of automobiles

Features of Ultrasonic Sensor:

- Compact and light weight
- High sensitivity and high pressure
- High reliability
- Power consumption of 20mA
- Pulse in/out communication
- Narrow acceptance angle
- Provides exact, non-contact separation estimations within 2cm to 3m
- The explosion point LED shows estimations in advancement
- 3-pin header makes it simple to connect utilizing a servo development link

3.3.4 Power supply

Figure 3.7 shows LM117 adjustable regulator, this LM117 series of adjustable 3-terminal positive voltage regulators is capable of supplying in excess of 1.5A over a 1.2V to 37V output range. They are exceptionally easy to use and require only two external resistors to set the output voltage. Further, both line and load regulation are better than standard fixed regulators. Also, the LM117 is packaged in standard transistor packages which are easily mounted and handled.
In addition to higher performance than fixed regulators, the LM117 series offers full overload protection available only in IC's. Included on the chip are current limit, thermal overload protection and safe area protection. All overload protection circuitry remains fully functional even if the adjustment terminal is disconnected.
Normally, no capacitors are needed unless the device is situated more than 6 inches from the input filter capacitors in which case an input bypass is needed. An optional output capacitor can be added to improve transient response.]

Figure 3.7: LM117

The adjustment terminal can be bypassed to achieve very high ripple rejection ratios which are difficult to achieve with standard 3-terminal regulators.Besides replacing fixed regulators, the LM117 is useful in a wide variety of other applications. Since the regulator is "floating" and sees only the input-to-output differential voltage, supplies of several hundred volts can be regulated as long as the maximum input to output differential is not exceeded, i.e., avoid short-circuiting the output.

3.3.5 Micro SD Card

Figure 3.8 shows a microSD card which is a type of very small memory card typically used in mobile phones and other portable devices.MicroSD cards are more commonly used to expand the storage system of smartphones, drones, gaming devices and cameras.

Figure 3.8: MicroSD Card

The microSD removable miniaturized Secure Digital flash memory cards were originally named T-Flash or TF, abbreviations of TransFlash. TransFlash and microSD cards are functionally identical allowing either to operate in devices made for the other.MicroSD (and TransFlash) cards are electrically compatible with larger SD cards and can be used in devices that accept SD cards with the help of a passive adapter, which contains no electronic components, only metal traces connecting the

two sets of contacts. Unlike the larger SD cards, microSD does not offer a mechanical write protect switch, thus an operating-system-independent way of write protecting them does not exist in the general case.

3.3.6 DC Motor

For a remote control car, we use Geared DC Motors.Figure 3.9 shows a geared DC motor,it is a low torque, high RPM motor which has to be geared down to reduce the speed and increase the torque. The gearing is done internally in motors available in the market. Motors convert electrical energy of the batteries to mechanical energy, which is used to drive the wheels.By far the most common DC motor types are the brushed and brushless types, which use internal and external commutation respectively to create an oscillating AC current from the DC source, so they are not purely DC machines in a strict sense.

Figure 3.9: DC Motor

TYPES OF DCMOTORS

- Brushed DC Motors
- Brushless DC motors
- Coreless DC motors

WORKING PRINCIPLE OF DC MOTOR

A dc motor simple words is a device that converts direct current (electrical energy) into mechanical energy. The very basic construction contains a current carrying armature which is connected to the supply end through commutator segments and brushes and placed within the north south poles of a permanent or an electro-magnet as shown in the Figure 3.10

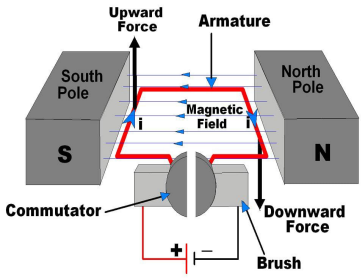

Figure 3.10: DC Motor Conceptual Diagram

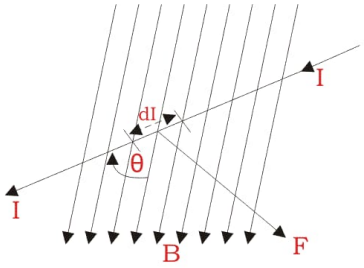

Figure 3.11: Magnitude of the Force for DC Motor

Figure 3.11 is a magnitude of force for dc motor.We know that when an infinitely small charge dq is made to flow at a velocity 'v' under the influence of an electric field E, and a magnetic field B, then the Lorentz Force dF experienced by the charge.

3.3.7 Wheels

Figure 3.12: Wheels

Figure 3.12 is a wheel.Wheels are mainly of two types in this basic car, one is the type attached to the motors at the back, which are used for steering, and another trolley (castor) wheel in front, which allows 360 degrees free rotation and avoids

friction on the ground. The wheels can be put on the shafts either by using screws or by wrapping the shaft with masking tape first.

3.3.8 MP3 Player

Figure 3.13 shows a mini MP3 Player Module or otherwise called the DFPlayer, with simplified output, is a compact, low cost MP3 module which can be directly connected to the speaker. The Mini MP3 Player Module can be used as a stand alone module with attached battery, speaker and push buttons. Or you could interface it with an Arduino UNO or any other with RX/TX capabilities.
The Mini MP3 Player Module features hardware decoding and supports common audio formats such as MP3, WAV and WMA. Audio files can be played directly from a microSD card, FAT16 and FAT32 file systems are supported. To command and control the player is easy via serial port, without any tedious effort.

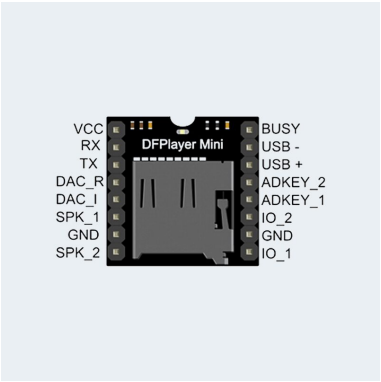

Figure 3.13: DFPlayer

Specifications:

- Supported sampling rates (kHz): 8/11.025/12/16/22.05/24/32/44.1/48
- 24 -bit DAC output, support for dynamic range 90dB , SNR support 85dB
- Fully supports FAT16 , FAT32 file system, maximum support 32G of the TF card, support 32G of U disk, 64M bytes NORFLASH
- A variety of control modes, I/O control mode, serial mode, AD button control mode
- Audio data sorted by folder, supports up to 100 folders, every folder can hold up to 255 songs
- 30 level adjustable volume, 6 -level EQ adjustable

3.3.9 Speaker

Figure 3.14 shows the speaker which converts the electric signal of the microphone into the corresponding sound wave. 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 sound waves.Figure 3.14 shows the speaker.

Figure 3.14: Speaker

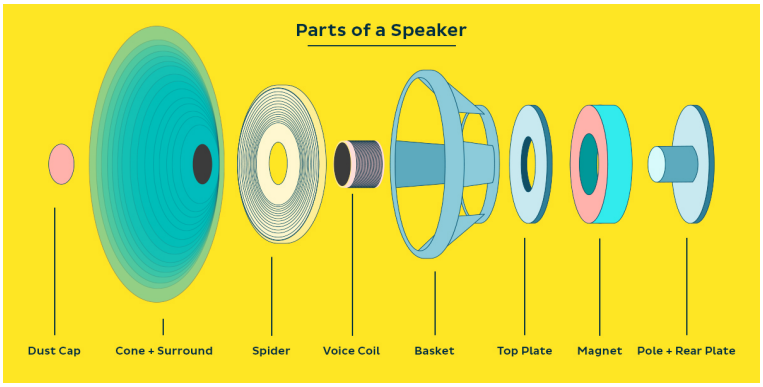

Figure 3.15: Parts of Speaker

Figure 3.15 shows the parts of speech.

The parts of a speaker are:

- The cone and the dust cap (the parts that move air and produce sound)
- The spider and the surround (also called the suspension, these are the parts that hold the cone in place while still allowing them to move)
- The magnet and the voice coil (the parts that interact to convert electric energy into motion)

- The basket
- The pole and top plate
- And finally the frame that mounts everything together

3.3.10 Battery

Figure 3.16: Battery

Figure 3.15 shows a Battery.Usually Batteries are used for supplying power to a remote controlled car, rechargeable batteries are usually the best ones. Otherwise a standard 300-500 RPM motor runs well between 9 to 12 volts, and alkaline batteries of the brand Camelot or Zinc carbon batteries of brand Hi Watt. The appropriate series parallel combination can be used to provide more power than a standard battery can provide.

3.3.11 Jumper wires

Figure 3.17: Jumper wires

Figure 3.17 shows jumper wires,it is an electrical wire, or group of them in a cable, with a connector or pin at each end, which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

3.4 Description of Software used

3.4.1 Arduino IDE

3.4.1.1 Introduction

In this section,the software system used and therefore the language within which the program code is outlined is mentioned and therefore the program code selling tools square measure explained.The section additionally documents the event of the program for the applying.

3.4.1.2 Description of software

The open-source Arduino environment makes it easy to write code and upload it to the I/O board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing, avr-gcc, and other open source software. The screen shot of Arduino 1.6.8 is shown in figure 3.18.

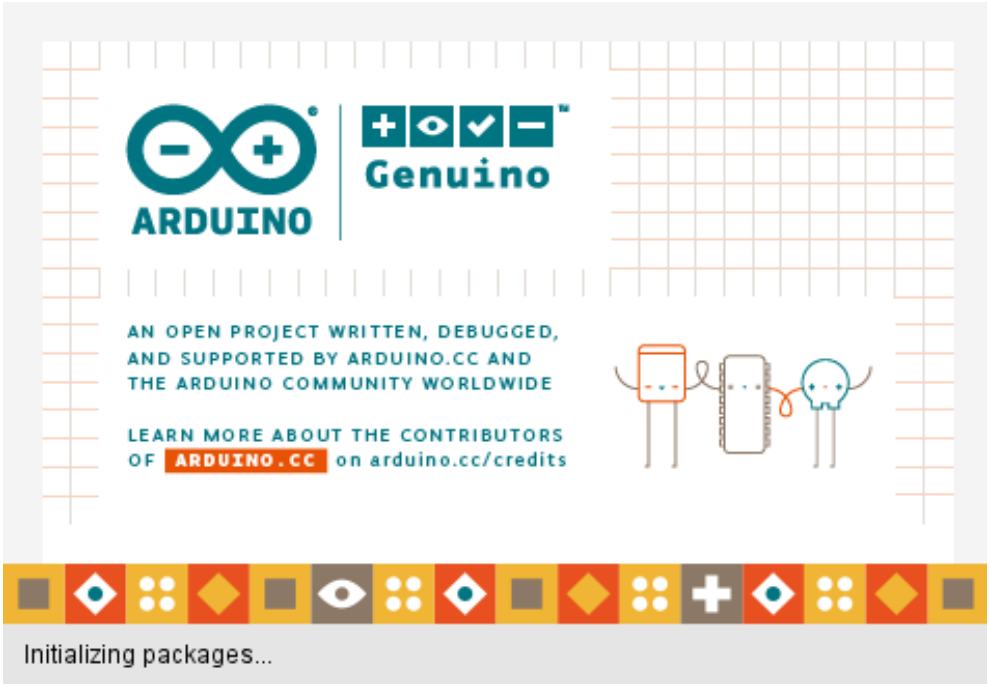

Figure 3.18: Arduino IDE

The Arduino IDE comes with a C/C++ library called "Wiring" (from the project of the same name),which makes many common input/output operations much easier. Arduino programs are written in C/C++, although users only need define two functions to make a runnable program:
setup() : a function run once at the start of a program that can initialize settings

loop() : a function called repeatedly until the board powers off

Figure 3.19 shows the window of Arduino IDE 1.6.8.

Figure 3.19: Arduino IDE Window

3.5 Andriod Application

3.5.1 App Inventor

MIT App Inventor(V2) is the best incipient version of App Inventor. MIT App Inventor is a free platform from Google for creating applications for smart-phone which can use the Android OS. App Inventor peregrinate to MIT in 2012. To get free feel for the types of things you can engender with App Inventor optically discern http://gallery.appinventor.mit.edu/. In App Inventor(V2) only need a browser (not Internet Explorer) and a cyberspace affiliation to arouse apps for Android contrivances.It feasibility work on Chrome, Safari, and Fire-Fox. The MIT App Inventor interface is easily Design and program your app using Blocks.Figure 3.20 shows block diagram of MIT inventor app.The data is stored on the cloud storage. App Inventor comes with a phone emulator, so we didn't have an Android contrivance to test our application. But, if we have an Android contrivance we can download our apps onto it using wireless network.

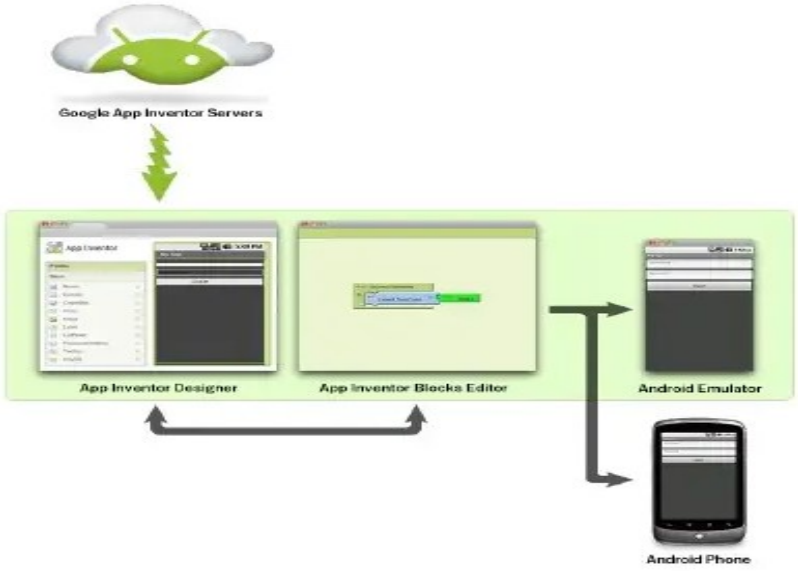

Figure 3.20: Block diagram of MIT Inventor App

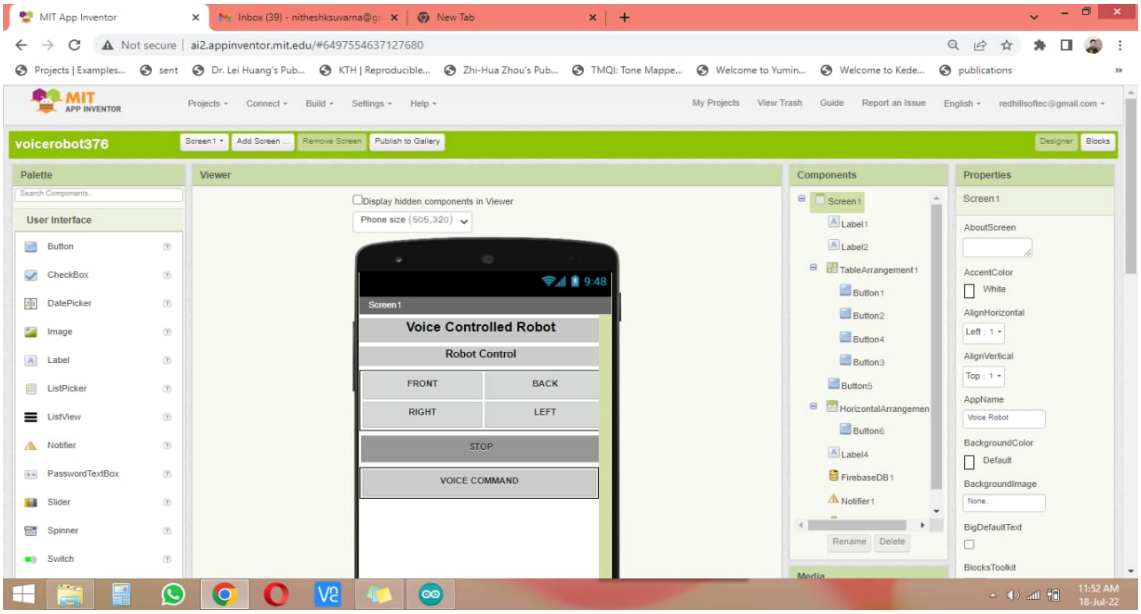

Figure 3.21: Design View Of MIT App Inventor

Figure 3.21 is the design view of MIT inventor app. In this first, We will be adding an image to the design for our app. So, all the horizontal arrangement are drag and drop component for the layout palette into a designer screen and change each with you fill palette so that it can occupy the entire space of the screen horizontally. Then go to the user interface and add the image component inside the horizontal. In order to change the position the image, click on the horizontal alignment under

the component tab which is beside the property and change the align horizontal to center.

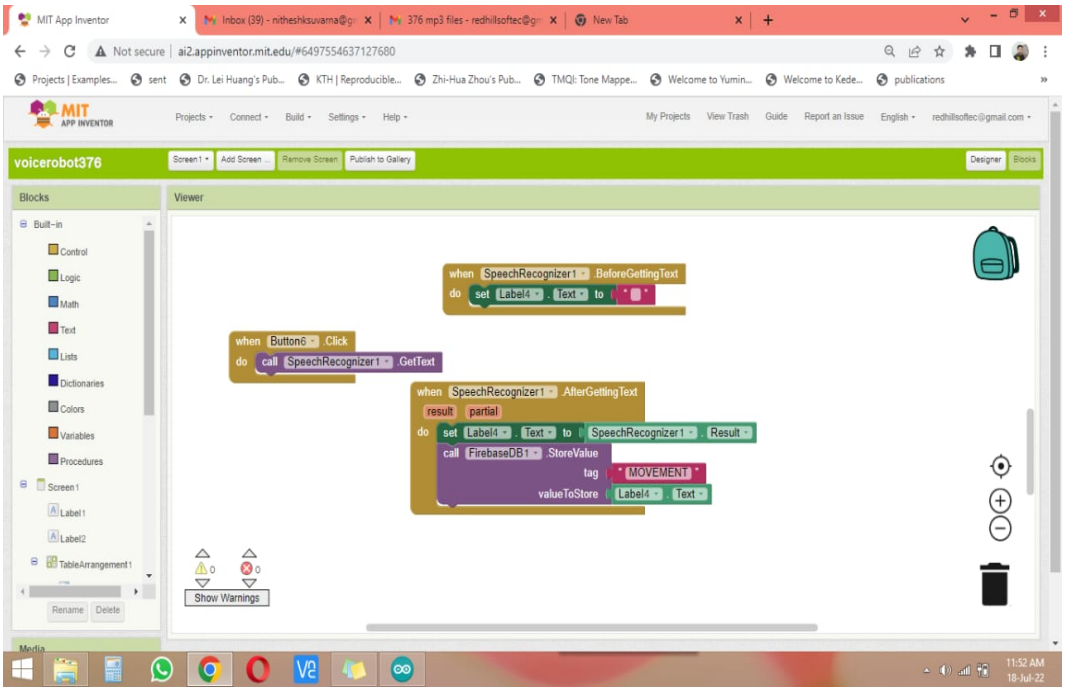

Figure 3.22: Blocks View Of MIT App Inventor

Figure 3.22 gives the block view of MIT inventor app.Now lets began with describing the functionality of our app. On clicking the button, the speech recognizer must pop up and convert the speech to text. For this we will began input an event handler for speech conversion button. When the button is clicked the speech recognizer component of the application is called which convert it speech to text and stored it in memory. Here also adding another code block to show empty text in the label before the speech recognizer component has been called this we have built our speech to text conversion application. Now we can compile and build the .apk file for the application which can be saved in computer or directly installed in your phone by scanning the QR code.

3.5.2 Mobile view of voice controlled robot

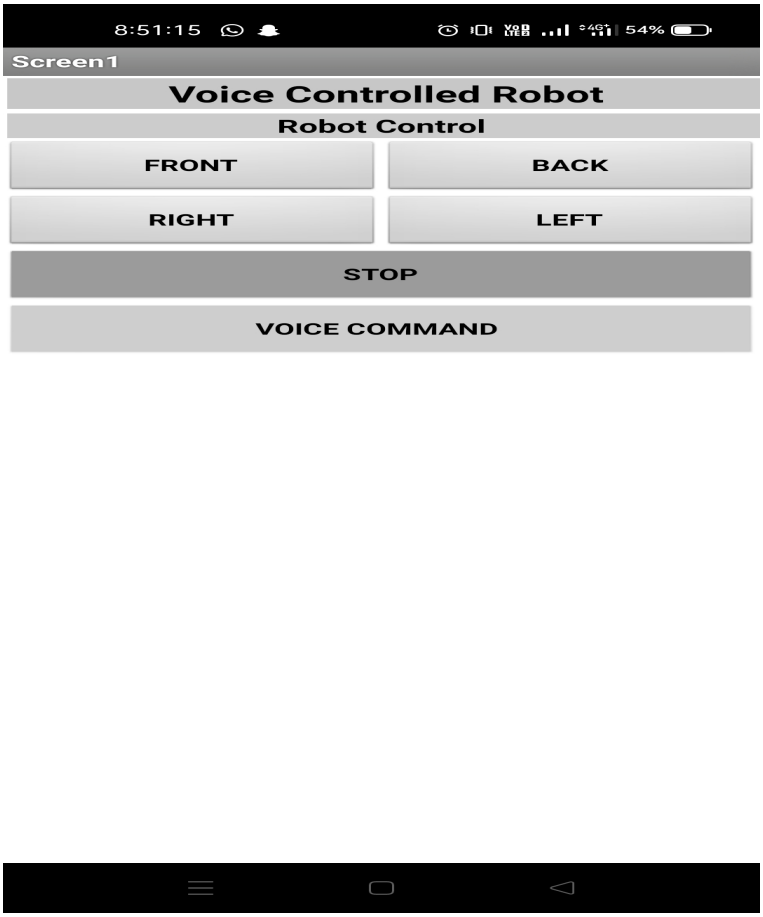

Figure 3.23: Front view of Android App

Figure 3.23 is the front end page of our andriod app.We can give voice command using voice command option or we can give commands by clicking the buttons such as left,right,front and back.

3.6 Firebase

Firebase is a Backend-as-a-Service which act as server, APIs and datastore all written so generically that it can be modify to suit our needs.

Firebase Features

- Real-time Database - Firebase supports JSON data and all users connected to it receive live updates after every change.
- Authentication – We can use anonymous, password or different social authentications.

- Hosting – The applications can be deployed over secured connection to Firebase servers.

Firebase Advantages

- It is simple and user friendly. No need for complicated configuration.
- The data is real-time, which means that every change will automatically update connected clients.
- Firebase offers simple control dashboard.
- There are a number of useful services to choose.

Firebase Limitations

- Firebase free plan is limited to 50 Connections and 100 MB of storage.

Figure 3.24 shows the real time database of Voice Controlled Robot.Whenever the command is given through an android app, the data gets updated in database automatically.

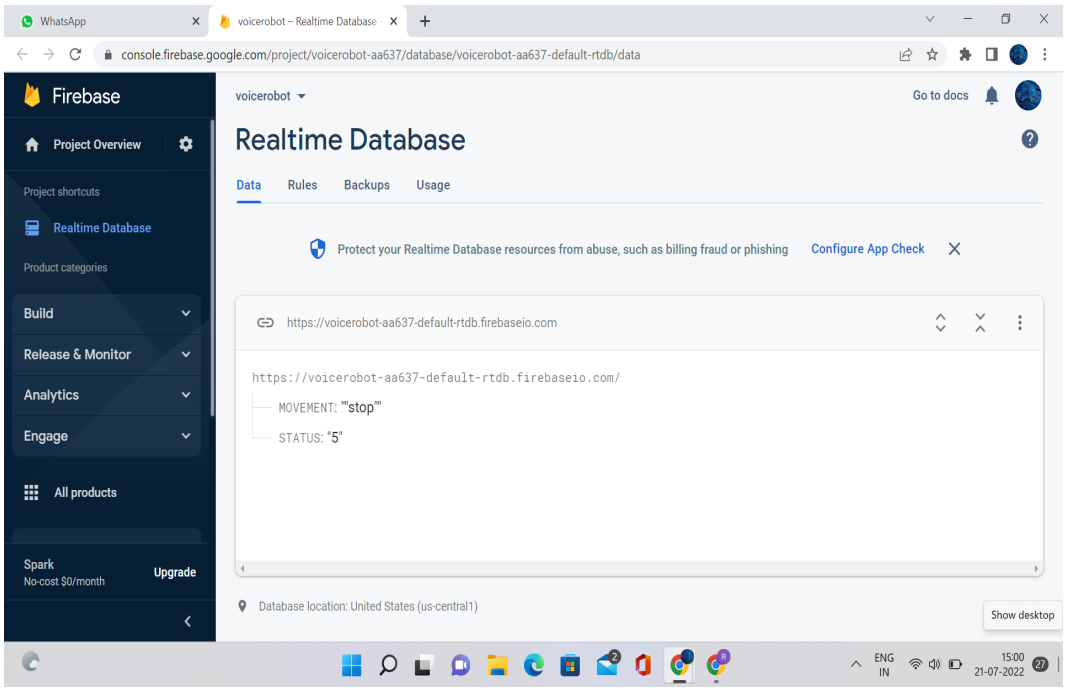

Figure 3.24: Real time data base of Voice Controlled Robot

Chapter 4

Implementation

This chapter elaborates the whole process behind the implementation of the project in a step-by-step process and provides insight into programming coding guidelines used during the making of our project. In this section we will be learning about the functionality used in the project.

4.1 Flowchart

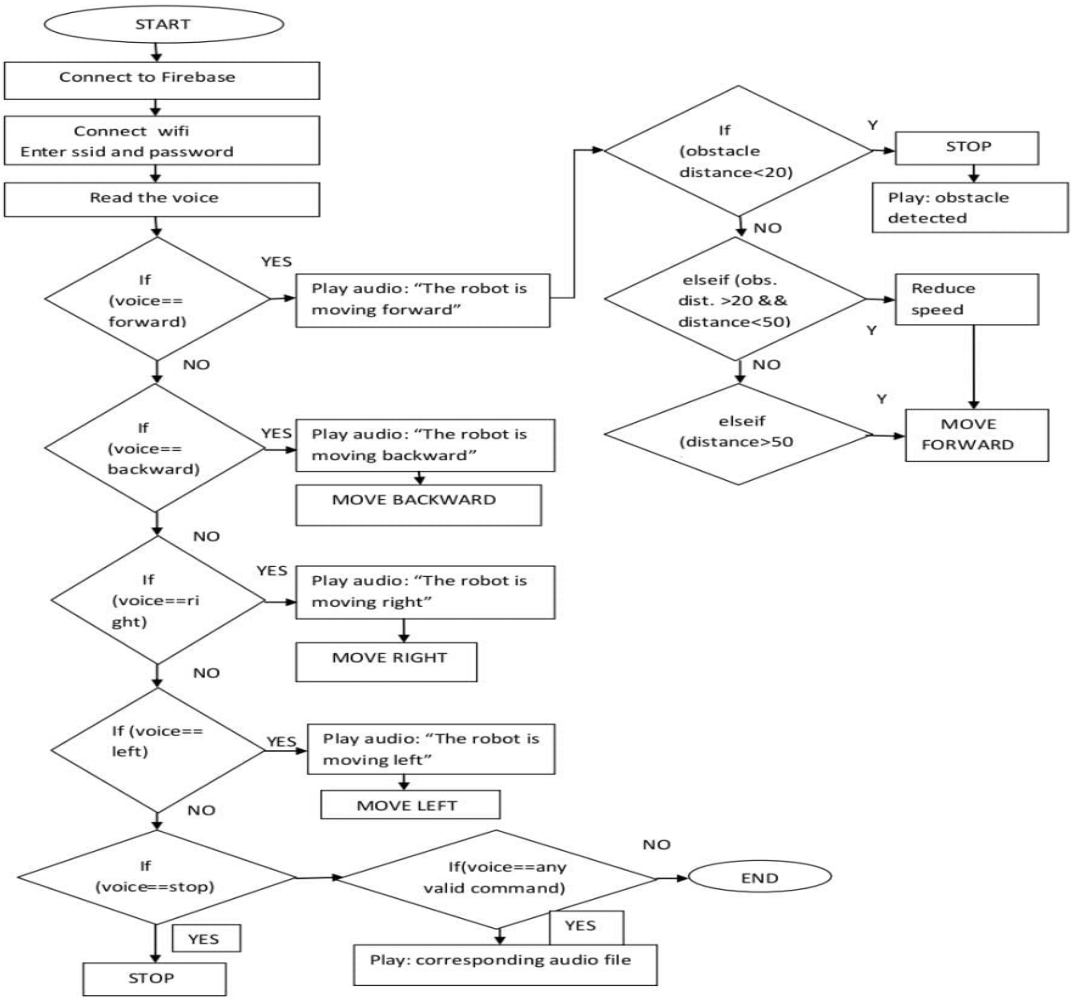

Figure 4.1: Flow chart of program

ESP32 is programmed using Arduino IDE in c programming language.The flow chart of the program is shown in figure 4.1.This flow chart gives a clear picture of the program flow.

4.2 Circuit Diagram

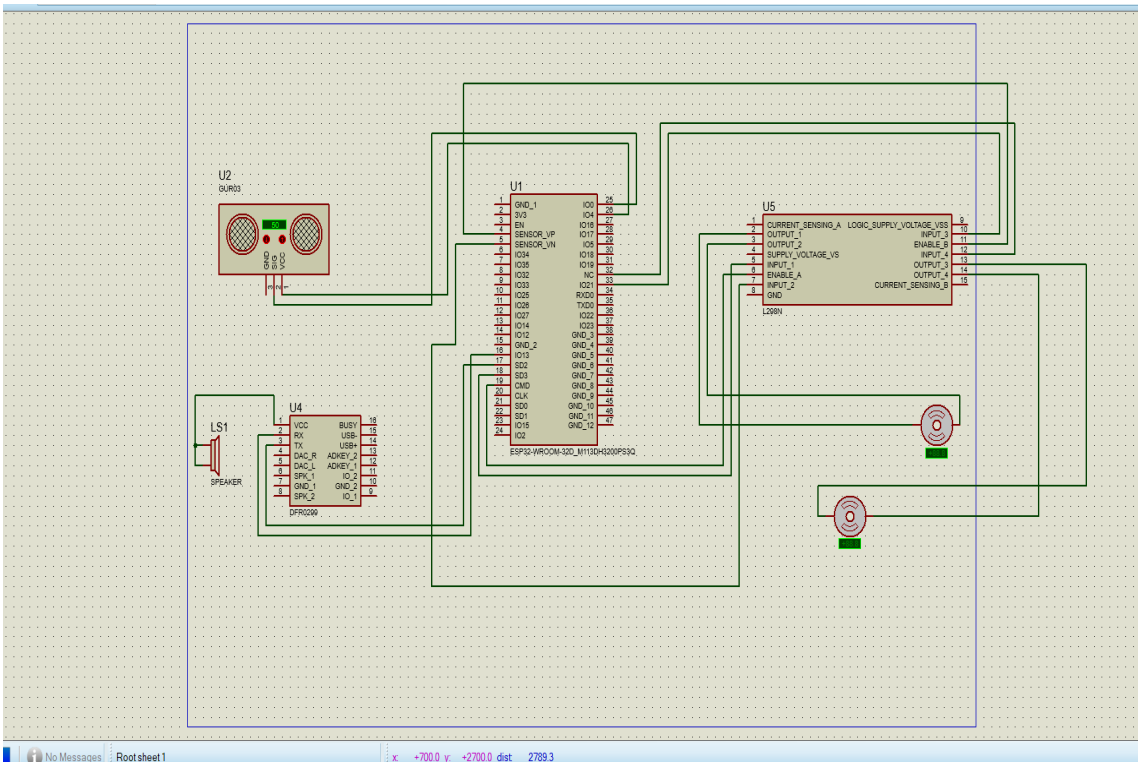

Figure 4.2: Circuit Diagram Of Proposed Robot

Circuit diagram of proposed robot is shown in figure 4.2.Pin connection of this circuit is explained in section 4.2.1.

4.2.1 Pin Connection

Pin trig of ultrasonic sensor is connected to pin26 of ESP32 and pin Echo is connected to pin25 of ESP32. One terminal of speaker is connected to positive terminal of DFplayer and another terminal of speaker is connected to negative terminal of DFplayer. Transmitter of DFplayer is connected to pin17 of ESP32 and Receiver of DFplayer is connected to pin16 of ESP32. Pin19 of ESP32 is connected to EN1 of L298N motor driver. Pin18 of ESP32 is connected to IN1 of L298N motor driver. Pin5 of ESP32 is connected to IN2 of L298N motor driver.Pin4 of ESP32 is connected to EN2 of L298N motor driver. Pin33 of ESP32 is connected to IN3. Pin32 of ESP32 is connected to IN4 of L298N motor driver.The output1 and output2 of L298N motor

driver is connected to left DC Motor.The output3 and output4 of L298N motor driver is connected to right DC Motor.

4.3 Working

The movement of the proposed robot will be controlled by the voice command of the user.When we give any command through the android app which is developed using MIT Inventor App it converts speech to text and store that command in database using WiFi and further the command is being read by ESP32 .In google firebase,whenever command is given,the data is stored and updated in database automatically.

After giving the command robot will first speak the sentence through DFPlayer and then it will act according to the command.For driving the robot there will be two geared DC motors with gripped tyre which will be operated by the help of DC motor driver(L298N).Whenever the command is given,the motor will rotate clockwise or anticlockwise to move in that particular direction.

The ultrasonic sensor placed in forward direction provides data about any obstacle present in front of robot , it sends the ultrasonic waves to measure the distance of the object and if there is any object found the robot will have the following movements within a specific range of distance:-

- For less than 20cm(very nearer), the robot will be stopped.
- For distance more than 20cm and less than 50cm,the robot will reduce it's speed automatically.
- For distance more than 50cm ,the robot will move normally with specified speed.

After power up the robot, it will greet the user by saying "hello" and wait for command for performing its action.According to the command, the robot will move forward, backward, left, right or stop. When user will command for any specific direction, the robot will be saying by generating voice record that the robot is moving for that direction and wait for next command. Until the robot will receive the next direction, it will continue to follow the previous command. Each command robot will receive, it will generate sound of every sentences defined for its each actions.

For example, for backward command, the robot will say "The robot is moving backward".Similarly, robot will speak with every instruction the user will give. The sound will be pre-recorded human voices and stored to a micro SD card.If the current command is same as the last command it will consider it as repeated command and continues to move in the same direction but if current command is different than last

command it will consider it as new command and continues to move in the specified direction. If there is any object present in front of the robot, even if we give the command to move it in forward direction it will not follow the command instead it will say "object ahead" and stops there.

Chapter 5

Result and Discussion

In this chapter, we discuss the outputs rather than the results obtained after completion of our project with the efficiency of the model or the accuracy of making correct predictions by our model.

5.1 Prototype of Voice Controlled Robot

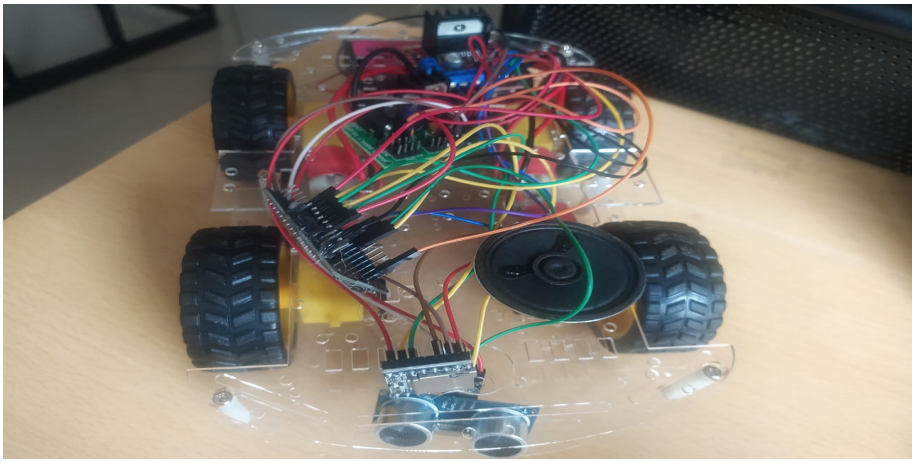

Figure 5.1: Top View Of Voice Controlled Robot

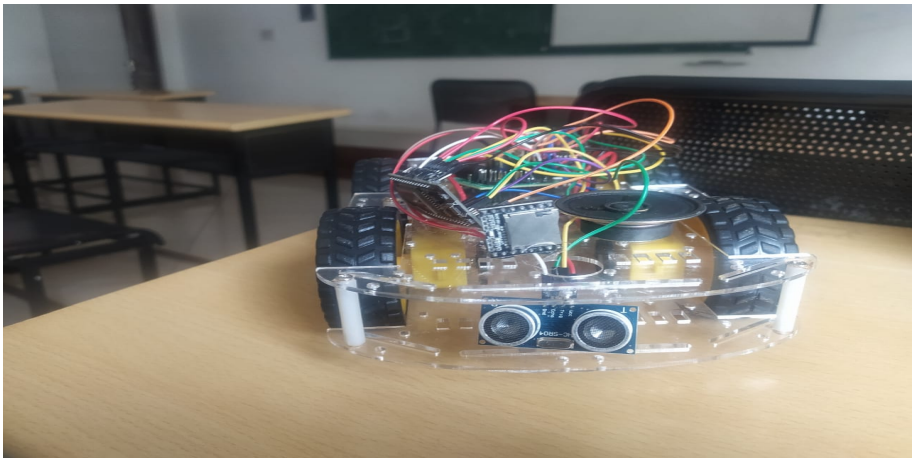

Figure 5.2: Front view Of Voice Controlled Robot

Figure 5.1 and 5.2 shows the top view and front view of voice controlled robot.The robot follows five basic commands right,left,forward,backward and stop .The robot simultaneously interact with user by repeating the commands given by the user.The robot also detects the obstacles in forward direction with help of ultrasonic sensor placed in front of the robot and responds by saying "obstacle ahead".The L298 motor driver is used to drive the motors so that robot can have movement in specified direction. The commands are given through the app developed using MIT App Inventor and whatever the commands are given are stored in database of Firebase using WiFi.

5.2 Results obtained :

1]Speech Recognization Process and Movement of the Robot according to the Voice Command:

By using the android app the textual content was transmitted to Esp32 using wi-fi through google firebase to process the signal and the robot made movement according to voice command. The robot was able to move forward, backward, left and right according to the input given to L298N from esp32 which gave input according to the command received from user. If ultrasonic sensor finds any object in front it will stop and if it finds the object at certain distance it will slow down its speed accordingly.

Drawback:

In our project we have used the motor with high rpm ,whenever it detects the object,it will hit the object and then stops.To overcome this problem we can use motor with low rpm.

2]Interaction with User by generating human voice recording

Speaking ability of the robot was developed using several prerecorded sound of human voice for different interactions and stored in SD card as audio file which were played through DFPlayer when any specific voice command was given.The esp32 was programmed to response by playing the audio files through speaker if any voice command was received.

TABLE 5.1 below is showing different recorded sounds of voice recording of the robot for different voice command.

Voice Command	**Robot Interaction**
Forward	The Robot is moving forward.
Backward	The Robot is moving backward.
Left	The Robot is moving left.
Right	The Robot is moving right.
Stop	The robot has stopped moving.
morning	Good morning
afternoon	Good afternoon

Table 5.1: Different recorded sounds of voice recording

Chapter 6

Conclusion and Future scope

Here we provide the conclusion obtained by our project with the future work which tries to cover the probable loopholes in our project that may occur in the future as the scenario of the future may be different as compared to now.

The robotics is becoming more reliable and adopting many new methods as well as development. In this project development of a prototype is presented although a lot more further future developments and researches are needed to make the developed robot into a complete product for consumers. Commercial production of this robot can be possible of following future researches and updates can be done for more improvement of the robot.The developed robot are able to move in any direction according to the voice command received from the user by android phone and wi-fi .Voice commands has able to control the robot to move forward,backward, left and right. Instant stopping of the robot from any kind of movement can be done by the voice command "Stop" at any time. The developed robot has ability to interact with its user using the prerecorded human voice file. For each command, different individual response's audio files are recorded and stored as mp3 files on SD card.When user will command any instruction the robot will generate the related human voice as response from micro SD card through DFPlayer.Ultrasonic sensor placed in forward direction detects the object and measures the distance of object.Depending on the distance of object from robot,the robot will stop(when object is very nearer),reduce it's speed(at certain distance) and move with normal speed(when no object).

Future Scope

Further future development can be conducted by developing a system which will be able to receive voice command through direct voice recongnization hardware to recognize the voice command and no android app will be needed for controlling the robot.The developed device used prerecorded human voice sound to communicate with user but artificial inteligence can be implemented for interection purpose so that the robot will be able to interact more appropriately by analyzing the testing enviroment and user's behaviours.

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Appendix A

Google firebase

1)Setting up Firebase Console for ESP32

If you are using firebase for the first time then you have to create account for firebase or can directly signup using Google Account:

1. Open your browser and go for https://firebase.google.com
2. At the right top corner click on "Go to Console".
3. Click on "Add Project".
4. Input your project name as you want and click on create project.
5. Now your project is created and click on "Continue".
6. Now you will need host name and authorization key/secret key for this project while programming your ESP32; so now we will see how these parameters can be taken from this.
7. Go to setting icon and click on "Project Setting".
8. Now click on Service accounts and then Database secrets.
9. On clicking on Database Secrets you will find a secret key, copy this key and save it in notepad, this is your firebase authorization key which you will need later.
10. Now click on "Database" at left control bar.
11. Now scroll down and click on "Create database".
12. Now choose "Start in test mode" and click on Enable.
13. Now your database is created and you will have to come here again to control your LED, for now just copy the given URL without slash and http in notepad this is your firebase host which you will be required later.

2)Setting up ESP32 module with Firebase

To work with ESP32 using Google firebase you will need a firebase library so firstly download that library using below link and save it in Arduino library files.

http://github.com/ioxhop/IOXhop-FirebaseESP32// Now open your Arduino IDE and go to Sketch— include Library– Add .ZIP library and add the file you downloaded from the above link. After installing the library you are ready to work with Google firebase using ESP32.

Now go to Tools and select ESP32 Dev board and appropriate COM port and copy the code given below and edit it for network credentials, firebase secret key and firebase host. After editing the upload the code into ESP32 using Arduino IDE.