VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"Jnana Sangama", Belagavi-590 018

Project Report

on

"ARDUINO BLUETOOTH CONTROLLED ROBOT WITH OBSTACLE DETECTION AND GPS TRACKING"

Submitted in partial fulfillment of the requirements for the award of the Degree of

BACHELOR OF ENGINEERING

IN

ELECTRICAL & ELECTRONICS ENGINEERING

Submitted by

AMRUTHA G	**1MV19EE015**
HARINI P	**1MV19EE036**
HARISH C	**1MV19EE037**
M SMRITI	**1MV19EE049**

Under the Guidance of

Dr. R Sivapriyan

Associate Professor

SIR MVIT, Bengaluru.

Department of Electrical & Electronics Engineering

Sir M VISVESVARAYA INSTITUTE OF TECHNOLOGY

(Approved by AICTE New Delhi, Affiliated to VTU, Belagavi, ISO 9001:2008 Certified)

Off International Airport Road, Krishnadevaraya Nagar, Bengaluru – 562157

2022 – 2023

Sir M VISVESVARAYA INSTITUTE OF TECHNOLOGY

(Approved by AICTE New Delhi, Affiliated to VTU, Belagavi, ISO 9001:2008 Certified)

Off International Airport Road, Krishnadevaraya Nagar, Bengaluru – 562157

Department of Electrical & Electronics Engineering

CERTIFICATE

Certified that the project work phase-II entitled **"ARDUINO BLUETOOTH CONTROLLED ROBOT WITH OBSTACLE DETECTION AND GPS TRACKING"** carried out by **Ms. AMRUTHA G, USN 1MV19EE015, Ms. HARINI P, USN 1MV19EE036, Mr. HARISH C, USN 1MV19EE037, Ms. M SMRITI, USN 1MV19EE049** bonafide students of **Sir M VISVESVARAYA INSTITUTE OF TECHNOLOGY, Bengaluru** in partial fulfillment for the requirements for the award of the degree of **Bachelor of Engineering** in **Electrical & Electronics Engineering** of the **Visvesvaraya Technological University,** Belagavi during the year **2022-2023.** It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the department library. The Project Work Phase-II report has been approved as it satisfies the academic requirements in respect of project work Phase-II prescribed for the above-mentioned degree.

Signature of Guide	**Signature of HOD**	**Signature of Principal**
Dr. R Sivapriyan	Dr. HL Suresh	Dr. Rakesh S.G

Sir M VISVESVARAYA INSTITUTE OF TECHNOLOGY

(Approved by AICTE New Delhi, Affiliated to VTU, Belagavi, ISO 9001:2008 Certified)

Off International Airport Road, Krishnadevaraya Nagar, Bengaluru – 562157

Department of Electrical & Electronics Engineering

DECLARATION

We hereby declare that the project work phase-1 entitled **"ARDUINO BLUETOOTH CONTROLLED ROBOT WITH OBSTACLE DETECTION AND GPS TRACKING"** carried out by us and submitted in partial fulfillment for the award of **Bachelor of Engineering in Electrical & Electronics Engineering of the Visvesvaraya Technological University, Belagavi** during the year 2022- 2023. The matter embodied in this project report has not been submitted to any other university or institute for the award of any other degree or diploma.

Place: Bengaluru

Date: 04 / 05 / 2023

AMRUTHA G	HARINI P	HARISH C	M SMRITI
1MV19EE015	1MV19EE036	1MV19EE037	1MV19EE049

ABSTRACT

Robotics is a set of technologies that requires movement plus intelligence to generate behavior to simulate or replace man in the development of daily activities or industrial production. Robots are more efficient as they can perform many autonomous functions in many fields. Arduino is a prototyping platform based on easy-to-use hardware and software. Wireless or Bluetooth control cars are developed to simplify our daily life. Today for striving in this modern era it is necessary to use modern technology to simplify our day-to-day activities. The main processing unit consists of Arduino UNO to perform specified operations. Arduino UNO board is used as the main microprocessor of the device. The Arduino car contains an Arduino microcontroller with basic mobility features. We make use of Bluetooth technology to control our machine car. HC-05 Bluetooth Module is used for wireless communication between two devices. The Arduino obstacle-avoiding car uses an Ultrasonic sensor to locate the obstacle using echo locations. The Bluetooth-controlled Arduino car with obstacle detection and GPS tracking has many real-time applications in the field of robotics, automation, and transportation.

TABLE OF CONTENTS

	DECLARATION	**iii**
	ABSTRACT	**iv**
	TABLE OF CONTENTS	**v**
	TABLE OF FIGURES	**vi**
CHAPTER 1	**INTRODUCTION**	**1**
	1.1 Literature Review	2
	1.2 Summary of Literature Review	9
	1.3 Objectives	10
CHAPTER 2	**METHODOLOGY**	**11**
	2.1 Design	11
	2.2 Building the android App for controlling and to get data from the GPS module and Ultrasonic sensor	19
CHAPTER 3	**WORK DONE**	**22**
	3.1 Working Principle	22
	3.2 Experimental Results	24
	APPLICATIONS	**30**
	CONCLUSION	**31**
	FUTURE SCOPE	**32**
	REFERENCES	**33**

TABLE OF FIGURES

Fig	NAME	PAGE NO.
1	Arduino Bluetooth-controlled car with Obstacle Detection and GPS Tracking	1
1.1	Block diagram of Arduino Bluetooth Controlled Car	13
2	Arduino UNO	14
2.1	HC05 Module	15
3	Motor Driver (L298N)	15
3.1	NEO-6M Module	16
4	Ultrasonic sensor	16
4.1	BO Motors	17
5	Jumper Wires	18
5.1	Battery	18
6	Circuit diagram of Arduino Bluetooth Controlled Robot with Obstacle and GPSTracking	23

CHAPTER 1

INTRODUCTION

Robotics is part of today's communication. In today's world ROBOTICS is fast growing and interesting field. It is the simplest way to latest technology modification. Now a day's communication is part of the advancement of technology, so we decided to work in the ROBOTICS field and design something which will make human life simpler in day-to-day aspects. Today, robot systems are developed with the use of artificial intelligence algorithms. The robotics field is one of them. The most important part of the robot is the perception. Perceiving the environment will be important for robot design. For instance, it is very important to identify explosives in a robot to detect a terrorist in the military field by using sensors. A robot has to perceive some variables around it, interpret them, and then decide to act accordingly. Android Bluetooth-controlled robot is a humanoid-assisted robotic system that can be easily controlled by using an Android smartphone instead of any other methods like buttons, gestures, etc. For moving the robot, we just need to touch the forward, backward, right, and left buttons of the app.Also, we can control it using the gesture function which is in-built in the app. In this remote and controlled robotic car has been presented in terms of obstacle detection and avoidance by using sensors. The connection between the robot and the Android device has been established via Bluetooth technology. The incoming data will be processed by Arduino Uno and according to the input value of the user, robot action can be performed. There are two main modes that control the robotic car by Android application (mobile phone). These are user control mode and automatic mode. A menu with buttons has been seen on the screen to select the actions. These buttons will be used to move the robotic car forward, backward, right, and left, stopping the car and switching to automatic mode. By selecting automatic mode, the user leaves the robot control and the robot finds its way without hitting the obstacles.

The Robot detects living beings that are encountered and gives a warning. The robot finds its way without hitting the spot and when it comes to the obstacle it perceives and stops. Concurrently, it makes live detection with the temperature sensor and gives a warning with a red led on it.

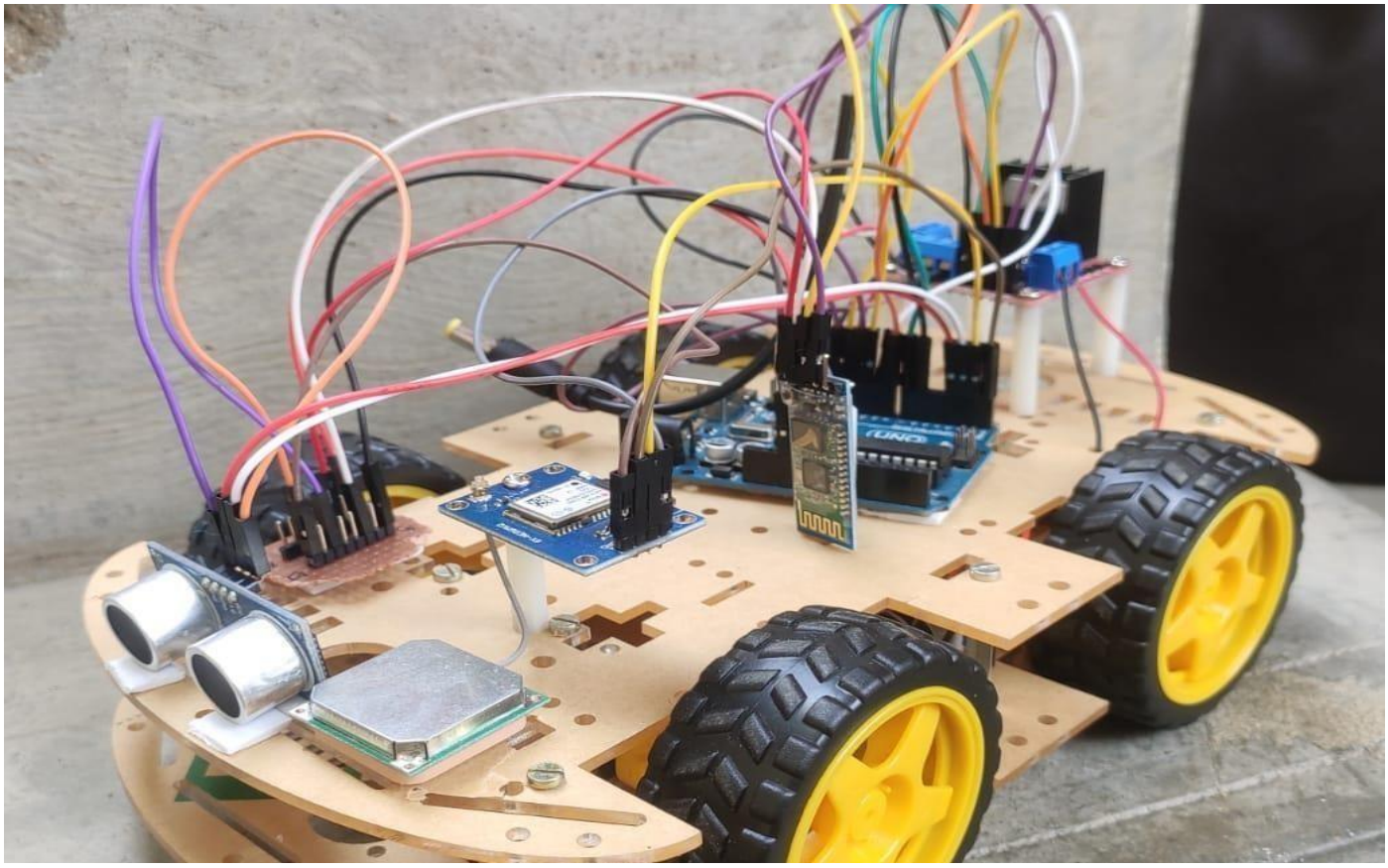

Fig 1: Arduino Bluetooth-controlled car with Obstacle Detection and GPS Tracking

1.1 LITERATURE SURVEY

Rowjatul Zannat Eshita, Tanwy Barua et.al [1] have proposed the project aims in designing a robot that can be operated using Android Apps. The controlling of the Robot is done wirelessly through Android smart phone using the Bluetooth module feature present in it. Here in the project, the Android smart phone is used as a remote control for operating the Robot. Android is a software stack for mobile devices that includes an operating system, middleware and key applications. Android boasts a healthy array of connectivity options, including Wi-Fi, Bluetooth, and wireless data over a cellular connection (for example, GPRS, EDGE (Enhanced Data rates for GSM Evolution), and 3G). Android provides access to a wide range of useful libraries and tools that can be used to build rich applications. Bluetooth is an open standard specification for a radio frequency (RF)-based, short-range connectivity technology that promises to change the face of computing and wireless communication. It is designed to be an inexpensive, wireless networking system for all classes of portable devices, such as laptops, PDAs (personal digital assistants), and mobile phones. The controlling device of the whole system is a Microcontroller. Bluetooth module, DC motors are interfaced to the Microcontroller. The data received by the Bluetooth module from Android smart phone is fed as input to the controller. The controller acts accordingly on the DC motors of the Robot. The robot in the project can be made to move in all the four directions using the Android phone. The direction of the robot is indicated using LED indicators of the Robot system. Android controlled robot project make use of an Android mobile phone for robotic control with the help of Bluetooth technology. This is a simple robotics project using microcontroller. Also, many wireless-controlled robots use RF modules. The control commands available are more than RF modules. The smartphone-controlled robot is superior to all these robots. This project is a Bluetooth-controlled robot. For this, the android mobile user has to install an application on her/his mobile. Then user needs to turn on the Bluetooth in the mobile. The wireless communication techniques used to control the robot is Bluetooth technology. move right. These commands are sent from the Android mobile to the Bluetooth receiver.

Smita Bhuyarkar and Harshad Ghonge et.al [2] have proposed, the project aims in designing a robot that can be operated using Android App. The controlling of the Robot is done wirelessly through an Android smartphone one using the Bluetooth module feature. Here in the project, the android smartphone is used as a remote control for the Robot and have key applications. Bluetooth is an open standard specification for a radio frequency (RF)-based and have a short-range connectivity technology that promises to change the face of computing and wireless communication. The controlling device of the whole system is a Arduino. Bluetooth module, DC motors are interacted to the Arduino. The data received by the Bluetooth module from the Android smartphone is fed as inputto the controller. The micro-controller acts accordingly on the DC motors of the Robot. The robot in the project can be made to move in all four directions using the Android phone. The direction of the robot is indicated using LED indicators of the Robot system. Robot is also controlled with gesture control. In achieving the task, the controller is loaded with a program written using Embedded 'C' language. Mobile-controlled robot projects make use of an Android mobile phone for robotic control with the help of Bluetooth technology. This is a simple robotics project using Arduino and run with the help of gesture mode also. We have already seen Mobile Controlled Robots using Bluetooth technology, which uses call, base methods to control the robot. It also have many wireless-controlled robots use RF modules. Today, a Bluetooth-powered robotic robot is a relatively inexpensive, easy- to-use and efficient way to go. The aim of the project is to design an Arduino bot system and write a program on Arduino Microprocessor. The Arduino robot contains an Arduino with basic navigation features. . Arduino car contains Arduino microcontroller with basic mobility features. Arduino programs contains instructions mediating between android controller and Arduino car. Android mobile controller uses different mobile sensors to supervise motion. An appropriate program in the arduino microprocessor to interact with the android controller has to be created. The program has been successfully complied through arduino IDE to the arduino microprocessor & loaded in to it after proper checking of logic to decrease any loss/damage of hardware.

Souvik Paul, Saumedhik Biswas et.al [3] have proposed, the project aims is to design an android interface, Arduino bot and write program in to the arduino microprocessor. Arduino car contains Arduino microcontroller with basic mobility features. Arduino programs contains instructions mediating between android controller and Arduino car. Android mobile controller uses different mobile sensors to supervise motion. An appropriate program in the Arduino microprocessor to interact with the android controller has to be created. The program has been successfully complied through Arduino IDE to the arduino microprocessor & loaded in to it after proper checking of logic to decrease any loss/damage of hardware. We have to create an android application that will provide user an interface to interact with the Arduino powered car. The interface is easy to use and provide feedback from the arduino microprocessor through the Bluetooth after giving instruction to arduino for various actions through interface via Bluetooth module. The android application is to create with the help of android studio that provide us with more capability & stability. After doing all of this we have test this project thoroughly and find the maximum no. of error & wrong logic in the microprocessor program. After doing this only we can say that we have been able to create as per described.

Here we work on common mode and when we want to change settings of HC-05 Bluetooth module like change password for connection, baud rate, Bluetooth device ‘s name etc. To do this, HC-05 has AT commands. To use HC-05 Bluetooth module in AT command mode, connect ―Key pin to High (VCC). Default Baud rate of HC05 in command mode is 38400bps. Following are some AT command generally used to change setting of Bluetooth module. To send these commands, we have to connect HC-05 Bluetooth module to the PC via serial to USB converter and transmit these to PC.

S.A.M. Nasik and T.Arudchelvam et.al [4] have proposed, electronic devices including mobile phones are considered as essential things at present. Robots are also used for several tasks. With the development of both the electronic engineering and computer science fields, the robots are designed by researchers and businessmen with well advanced features. Some robots are designed for some specific tasks and some are not. All those robots are very expensive. A normal person cannot buy such robots. As such, though some robots are designed with obstacle avoiding features, they are also expensive. The aim of this project is to design a low-cost obstacle avoiding robot which can be controlled by voice and mobile phones. Further, Arduino microcontroller, motor drivers, a Bluetooth module, Ultrasonic sensor and SQ11 mini DV camera are used in this work. This robot could be controlled by voice and Android smartphones. It is obvious that the Bluetooth facility should be available in the android smartphone. Using the android phone, the movement of the robot could be controlled using selected keys. Likewise, the movement of the robot could be controlled by voice (Selected words) as well. It should be noted that this robot can change its path if it finds an obstacle on its path. To avoid the obstacle, the robot could be controlled by voice or smartphone as well. Therefore, the specific features of this robot are that while this could automatically avoid obstacles, it could be controlled by voice and smartphones at the same time and it is very cheap.

The compiled application is then installed on the Android phone. Next, the communication between the Arduino microcontroller used for the robot control with the Bluetooth protocol and the Android application is established. The accuracy of the data dispatched to the Arduino is tested on the serial connection screen. It is validated that the data from the Android application is transferred to Arduino smoothly. At the end of this study, the manual and automatic controls of the proposed mobile robot are performed experimentally and success of the coordination.

June Myint, Khin, Dr. Nyein et.al [5] have proposed, Vehicle tracking system is a well-established technology in this era which is used by fleet system and owner of vehicle all over the world. It is a very safe and reliable technology. In this paper a real time tracking system is proposed. It is going to design a system which is used for tracking and positioning of any vehicle by using Global Positioning System (GPS) and Global System for Mobile Communication (GSM). The design is an embedded application, which will continuously monitor a moving vehicle and report the status of vehicle on demand. Tracking device used in real time vehicle location tracking is made up with Arduino Uno R3, SIM800A module and NEO 6M GPS module. For doing so the Arduino Uno R3 is interfaced serially to a GSM module and GPS module. The GSM module is used to continuously send the position of the vehicle from remote place. The GPS module that uses satellite technology for its navigation system will continuously give data like longitude, latitude, speed, distance travelled etc. Google map is used to view the position of vehicle on a digital mapping. The mysql database is used to store all the data of the GPS and Google Map API is used to display the location information through a Google Map.. Internet of Things or IoT for short has not only revolutionized our lives but also has limitless possibilities. Everything from our kitchen appliances to our vehicles is connected to a huge network of devices all talking and sharing not only information but also resources with each other. In this paper, we will be focusing on how we can use a Arduino UNO or a NodeMCU board and a GPS module to track vehicles and relay its exact location with the help of Google Maps, which can help us in several ways.

V A Zhmud, N O Kondratiev et.al [6] have proposed, the principle of the ultrasonic rangefinders is to measure the time during which that signal propagates at the distance from the transmitter to the receiver. The propagation speed of the signal is known. The ultrasonic range finder HC-SR04 is considered in this paper. The sensor consists of a transmitter that generates ultrasonic waves, a receiver that perceives the echo, and auxiliary nodes for normal operation of the module. The ultrasonic rangefinder HC-SR04 is shown in Figure 1, where the transmitter and the receiver are designated as T and R, respectively. The rangefinder generates sound waves at a frequency of 40 kHz. The sound waves reflects from the object and returns to the receiver, the sensor gives the information about the time, which was demanded to sound waves for propagation from the sensor to the object and back. Robotic devices are very relevant and various. The development of such devices is important also for training of the future engineers and scientist. It is very important for students to be able to develop robots independently, beginning from simple robots, using cheap sensors and driving devices. This demands the use of modern methods resulting from the developments in the field of automatics and in various relative fields of knowledge, such as identification, techniques for measuring, and others. Most robots require accurate information about the location of surrounding objects. Optical sensors (including laser sensors and sensors based on the stereoscopic effect with the help of two or more photo or video cameras with additional illumination or without it) are most effective for this purpose, as well as sound locators and electromagnetic locators. . Ultra Sonic sensors are widely used for distance measurement purposes. They offer low cost and a precision of less than 1 cm in distance measurements of up to 6m [1, 4]. However, the most popular method used in these measurements is based on the time of flight (ToF) measurement. This ToF is the time elapsed between the emission and subsequent arrival after reflection of an Ultrasonic pulse train travelling at the speed of sound. This causes large response times for a single measurement.

Gregorio andria, Nicola Giaquinto et.al [7] have proposed digital signal processing techniques for obtaining high accuracy in ultrasonic distance measurements are presented. The proposed methodologies employ a suitable time–frequency representation (Wavelet Transform or Short Time Fourier Transform) to extract the envelope of the reflected pulse echo, together with a suitable pulse detection algorithm (threshold or correlation) for time-of-flight estimation. A complete meteorological characterization of the methods, in terms of systematic and random errors, is achieved, demonstrating the high overall performance. A number of industrial applications involve, as a key issue, the problem of performing non-contact distance measurements. Ultrasonic sensors are a state-of-the-art powerful tool to effectively address this kind of problems from the viewpoint of performance and cost as well. Many examples can be found in different engineering fields, such as chemical analysis, waste water treatment, medical imaging, robot navigation, non-destructive testing of materials, flow velocity, fluid level measurement and so on. Depending on the specific application, different kinds of measuring systems and sensors have been used, but the problems related to echo detection are quite the same in every case: attenuation and beam spreading, presence of noise and interference, sensitivity to temperature and humidity, poor resolution. The distance measurement uncertainty depends on that affecting v and T_f. The first quantity depends above all on the relative humidity and the temperature, and also on some chemical and physical parameters of the fluid. Since these effects can be satisfactorily compensated and different techniques have been successfully proposed to determine the current speed, the critical point of the whole measurement procedure is the ToF estimation. Various methods have been developed to improve the ToF measurement accuracy. They can be based on the proper design of the transmitting–receiving system, or on the generation of signals with good time localization, or, finally, on the use of sophisticated digital techniques.

Arun Francis G, Arulselvan M et.al [8] have proposed, 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 neighboring country's Navy. They are getting caught while fishing near the neighboring 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.

From 2cm to 40cm, the Ultrasonic ranging moduleHC-SR04 varies and the ranging accuracy is of 3mm. The transmitter in the Ultrasonic Sensor spreads ultrasonic waves in a particular direction and the timing will be started when the waves are emitted. In the air, the ultrasonic waves are spread and the waves gets returned immediately once it encounters any object in its path. When the reflected wave is received, the receiver in the ultrasonic sensor stops the timing that is started by the transmitter. The distance between the intended target and the transmitter is calculated by using the formula, s=340t/2, as the velocity of ultrasonic waves is 340m/s. This is called as the time difference distance measurement principle. The known air spreading velocity, i.e. by measuring the time for the waves from the time of transmitting to the receiving of the waves after the contact with the target and the distance is calculated by using time and velocity of the waves is the principle of ultrasonic distance measurement.

Ni Ni San Hlaing, Ma Naing et.al [9] have proposed, A vehicle tracking system is very useful for tracking the movement of a vehicle from any location at any time. An efficient vehicle tracking system is designed and implemented for tracking the movement of any equipped vehicle from any location at any time. The proposed system made good use of popular technology that combines a smartphone with an Arduino UNO. This easy to make and inexpensive compared to others. The designed in vehicle device works using Global Positioning System (GPS) and Global System for Mobile Communication (GSM) technology that is one of the most common ways for vehicle tracking. The device is embedded inside a vehicle those positions is to be determined and tracked in real time. An Arduino UNO is used to control the GPS receiver and GSM module. The vehicle tracking system uses the GPS module to get geographic coordinates at regular time interval. The GSM module is used to transmit and update the vehicle location to a database. This paper gives minute by minute update about vehicle location by sending SMS through GSM modem. This SMS contain latitude and longitude of the location of vehicle. Arduino UNO gets the coordinates from GPS modem and then it sends this information to user in text SMS. GSM modem is used to send this information via SMS sent to the owner of the vehicle. Location is displayed on LCD. And then Google map displays location and name of the place on cell phone. Thus, user able to continuously monitor a moving vehicle on demand using smartphone and determine the estimated distance and time for the vehicle to arrive at a given destination.

Global System for Mobile Communication (GSM) and Global Positioning System (GPS) based vehicle location and tracking system provided effective, real time vehicle location, mapping and reporting this information value and add by improving this level of service provided. The GPS based vehicle tracking system is designed to find out the exact location of any vehicle and intimate the position to the concerned authority about through an SMS. The system includes a GPS modem that it retrieves the location of a vehicle in terms of its longitude and latitude. The system uses geographic position and time information from the GPS.

Anil, V. K. Shukla V. Naranje et.al [10] have proposed, As the world around us is continuously evolving and, we are seeing new and more advanced forms of technology, which people could only dream of before and were usually, only seen in movies. However now, things have changed. We are seeing anything and everything around us being interconnected to each other and us in some way or form. This is all mainly possible due to the introduction of the internet into the everyday life. With the help of internet, many people are able to explore, connect and even gain knowledge from anywhere in the world further making not only the devices that have the capability of using the internet smart but also the people using it to further increase their knowledge as well. The invention of the internet made it possible for the concept of IoT to be a possibility. Internet of Things or IoT for short has not only revolutionized our lives but also has limitless possibilities. Everything from our kitchen appliances to our vehicles is connected to a huge network of devices all talking and sharing not only information but also resources with each other. In this paper, we will be focusing on how we can use a Arduino UNO or a Node MCU board and a GPS module to track vehicles and relay its exact location with the help of Google Maps, which can help us in several ways.

1.2 SUMMARY OF LITERATURE REVIEW

The papers reviewed discuss various aspects of wireless control as one of the most important basic needs for all people all over the world. Bluetooth is one of the most used wireless technologies. A Bluetooth control car is such a car that can be controlled wirelessly using a Bluetooth control system and Arduino. With the combination of Arduino, and Bluetooth we can control many other things, like home Lighting, air conditioners, and many more through our cell phones. The Arduino can also contribute at large to the Smart Home system. Nowadays it has made us easier to convert digital signals into physical movements with such microcontrollers. Today people are using autonomation in every sector. There are many benefits, for example, it reduces the risk of injury, it is fast, it can work day long, it is reliable, etc. This Bluetoothcontrol car is just an example of autonomation. This type of car is used in law enforcement and military engagements for some the reasons like Hazard exposure which is controlled from a location of relative safety. Such vehicles are used by many police department bomb squads to defuse or detonate explosives. And Many of the giant factories have their transportation which is remotely controlled. Here we have connected this 4-wheeler with Arduino and Bluetooth Module. There is an Android application that is already installed in the remote device. We send our instruction to the vehicle with that application, that application is connected with the module in the vehicle. Bluetooth module transfer that instruction as a signal to the Arduino, and Arduino works with that signal. This car does not have advanced features but we can attach any kind of features like line detecting, or obstacle detecting, even though we can attach the camera to the vehicle and watch it with the remote.This one is just a basic prototype of a remote- control car, we can add a lot of advanced features andget an armed/especially capable RC Car. This project aimed to design an automated vehicle prototype built with Arduino and controlled with software developed on Android that can perform manual or automatic paths.

1.3 OBJECTIVE

The project titled "**ARDUINO BLUETOOTH CONTROLLED ROBOT WITH OBSTACLE DETECTION AND GPS TRACKING**" has the following objectives:

- To design a mobile robot that can navigate autonomously and avoid obstacles.
- To implement GPS tracking functionality in the robot for real-time position tracking.
- To use Bluetooth technology to enable wireless control of the robot using a mobile device.
- To create a reliable and efficient power supply system for the robot.
- To develop software algorithms for obstacle detection and avoidance using ultrasonic sensors.
- To optimize the robot's motion control for smooth and accurate movement.
- To provide an intuitive user interface for controlling the robot and displaying GPS data.
- To test the robot's performance under various conditions and refine the design accordingly.
- To ensure the robot's safety by implementing fail-safe mechanisms in case of systemfailures.
- To demonstrate the practical applications of robotics and IOT technology in real-world scenarios.

CHAPTER 2

METHODOLOGY

2.1 DESIGN

ARDUINO PIN CONNECTION

ARDUINO UNO	L298N MOTOR DRIVER
6	ENA
7	IN1
8	IN2
10	IN3
11	IN4
9	ENB

ARDUINO UNO	HC05 BLUETOOTH MODULE
13	RXD
12	TXD
5V	VCC
GND	GND

ARDUINO UNO	HC SR-04 ULTRASONIC SENSOR
2	TRIG
3	ECO
5V	VCC
GND	GND

ARDUINO UNO	NEO 6M GPS MODULE
0(RXD)	TX
1(TXD)	RX
3.3	VCC
GND	GND

Fig 2 Arduino pin configuration

HARDWARE REQUIREMENTS

- Arduino UNO
- HC05 Module
- L298N Motor driver
- Lithium-ion battery (11.1V, 2600MAH)
- NEO-6M Module
- Ultrasonic Sensor
- BO Motors with wheels
- Single Strand Wires of various colors

SOFTWARE REQUIREMENTS

- Arduino ide
- MIT App Inventor

BLOCK DIAGRAM

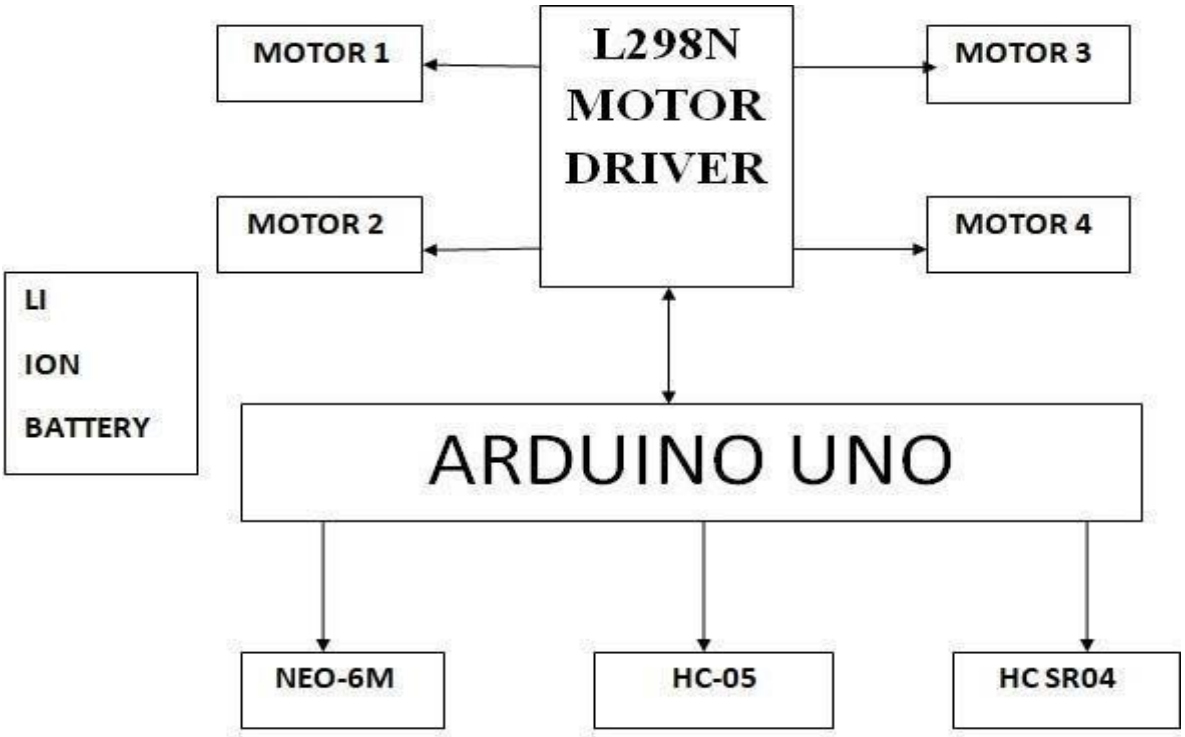

Fig 2.1 Block Diagram of Arduino Bluetooth Controlled Car

The basic block diagram of the Arduino Bluetooth controlled car is shown in above Fig 2.1. Mainly this block diagram consists of the following essential blocks.

1. Arduino uno
2. HCO5 Module
3. Motor driver (L298N)
4. NEO-6M Module
5. Ultrasonic Sensor

ARDUINO UNO

Fig 2.2 Arduino UNO

The Arduino Uno is a popular microcontroller board that is widely used by hobbyists, educators, and professionals in the field of electronics and programming as shown in Fig 2.2. Developed by the Italian company Arduino, the Uno is based on the ATmega328P microcontroller and features 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal oscillator, a USB connection, and a power jack. It is designed to be easy to use, even for beginners, and is compatible with a wide range of sensors, actuators, and other electronic components. The Uno is also open-source hardware and software, meaning that anyone can modify or enhance it to suit their needs. Its versatility, low cost, and ease of use have made it a popular choice for projects ranging from simple LED blinking to complex robotics and automation systems. And it is programmable with the ArduinoIDE (Integrated Development Environment), via a type B USB cable. It can be powered by a USB cable ora barrel connector that accepts voltages between 7 and 20 volts. The Arduino Uno has a number of facilities for communicating with a computer, another Arduino board, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

HCO5 MODULE

Fig 2.3 HC05 Module

Wireless communication is swiftly replacing the wired connection when it comes to electronics and communication. Designed to replace cable connections HC-05 uses serial communication to communicate with the electronics. Usually, it is used to connect small devices like mobile phones using a short-range wireless connection to exchange files. It uses the 2.45GHz frequency band. The HC-05 module can be operated within 4-6V of power supply. It supports baud rate of 9600, 19200, 38400, 57600, etc. Most importantly it can be operated in Master-Slave mode which means it will neither send or receive data from external sources. The Bluetooth module is shown in Fig 2.3.

Command Mode

In Command Mode, you can communicate with the Bluetooth module through AT Commands for configuring various settings and parameters of the Module like get the firmware information, changing Baud Rate, changing module name, it can be used to set it as master or slave. A point about HC-05 Module is that it can be configured as Master or Slave in a communication pair. In order to select either of the modes, you need to activate the Command Mode and sent appropriate AT Commands.

Data Mode

Coming to the Data Mode, in this mode, the module is used for communicating with other Bluetooth device i.e., data transfer happens in this mode.

MOTOR DRIVER (L298N)

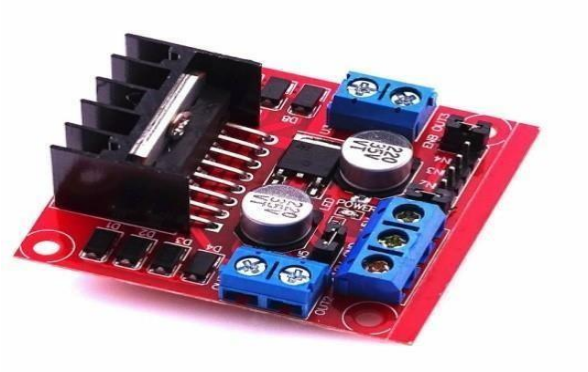

Fig 2.4 Motor Driver (L298N)

L298N module is a high voltage, high current dual full-bridge motor driver module for controlling DC motor and stepper motor. It can control both the speed and rotation direction of two DC motors. This module consists of an L298 dual-channel H-Bridge motor driver IC. This module uses two techniques for the control speed and rotation direction of the DC motors. These are PWM – For controlling the speed and H-Bridge – For controlling rotation direction. These modules can control two DC motor or one stepper motor at the same time.

L298 is a high voltage, high current dual full-bridge motor driver IC as shown in Fig 2.4. It accepts standard TTL logic levels (Control Logic) and controls inductive loads such as relays, solenoids, DC and Stepper motors. This is a 15 pin IC. According to the L298 datasheet, its operating voltage is +5 to +46V, and the maximum current allowed to draw through each output 3A. This IC has two enable inputs, these are provided to enable or disable the device independently of the input signals.

The module has an on-board 78M05 5V Voltage regulator. This Voltage regulator will be performed only when the 5V Enable jumper is placed. When the power supply is less than or equal to 12V, then the internal circuitry will be powered by the voltage regulator, and the 5V pin can be used as an output pin to power the microcontroller or other circuitry.

NEO-6M MODULE

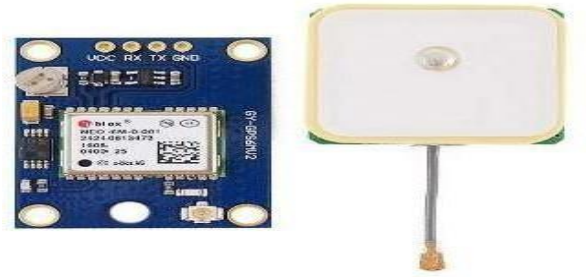

Fig 2.5 NEO-6M Module

This is a complete GPS module that is based on the NEO-6M. This unit uses the latest technology to give the best possible positioning information and includes a larger built-in 25 x 25mm active GPS antenna with a UART TTL socket. A battery is also included so that you can obtain a GPS lock faster. This is an updated GPS module that can be used with ardupilot mega v2. This GPS module gives the best possible position information, allowing for better performance with your Ardupilot or other Multirotor control platform.

The NEO-6M GPS engine on this board is a quite good one, with the high precision binary output as shown in Fig 2.5. It has also high sensitivity for indoor applications. NEO-6M GPS Module has a battery for power backup and EEPROM for storing configuration settings. The antenna is connected to the module through a UFL cable which allows for flexibility in mounting the GPS such that the antenna will always see the sky for best performance. This makes it powerful to use with cars and other mobile applications.

The NEO-6M is a compact GPS module that allows for easy integration of GPS functionality into electronic projects. It uses the latest U-blox 6 positioning engine with a high level of sensitivity and accuracy, and is capable of tracking up to 22 satellites on 50 channels. With its small size, low power consumption, and high performance, the NEO-6M is an ideal choice for applications requiring GPS positioning, such as navigation systems, tracking devices, and robotics.

ULTRASONIC SENSOR

Fig 2.6 Ultrasonic sensor

Ultrasonic sensors are electronic devices that calculate the target's distance by emission of ultrasonic sound waves and convert those waves into electrical signals. The speed of emitted ultrasonic waves traveling speed is faster than the audible sound. There are mainly two essential elements which are the transmitter and receiver. Using the piezoelectric crystals, the transmitter generates sound, and from there it travels to the target and gets back to the receiver component to know the distance between the target and the sensor, the sensor calculates the amount of time required for sound emission to travel from transmitter to receiver. Ultrasonic sensor working principle is either similar to sonar or radar which evaluates the target/object attributes by understanding the received echoes from sound/radio waves correspondingly. These sensors produce high-frequency sound waves and analyze the echo which is received from the sensor. The sensors measure the time interval between transmitted and received echoes so that the distance to the target is known. Ultrasonic sensors are commonly used in robotics and automation for distance measurement and obstacle detection as shown in Fig 2.6. They work by emitting high-frequency sound waves that bounce off objects and return to the sensor. The time taken for the sound wave to travel to the object and back to the sensor can be used to calculate the distance to the object. Ultrasonic sensors can operate at a range of distances and are relatively inexpensive, making them popular for use in robotics projects.

BO MOTORS

Fig 2.7 BO motors

Operating voltage: 3v ~ 12v

DC Rpm: Approximately 150 rpm

No load current: 40 ~ 80ma

Package Content - 1pcs Material Metal

An Electric DC motor is a machine which converts electric energy into mechanical energy. The working of DC motor is based on the principle that when a current carrying conductor is placed in amagnetic field, it experiences a mechanical force. The direction of mechanical force is given by Fleming's Left-hand Rule and its magnitude is given by F = BIL Newton. DC motors are seldom used in ordinary applications because all electric supply companies furnish alternating current. The BO motor used is shown in the Fig 2.7.

JUMPER WIRES

Fig 2.8 Jumper Wires

A Jump wire shown in Fig 2.8 (also known as jumper, jumper wire, DuPont wire) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"),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.

Though jumper wires come in a variety of colors, the colors don't actually mean anything. This means that a red jumper wire is technically the same as a black one. But the colors can be used to your advantage in order to differentiate between types of connections, such as ground or power. Jumper wires typically come in three versions: male-to-male, male-to-female and female-to-female. The difference between each is in the end point of the wire. Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into. Male-to-male jumper wires are the most common and what you likely will use most often. When connecting two ports on a breadboard, a male-to-male wire is what you'll need.

BATTERY

Fig 2.9 Battery

Li-ion batteries are the powerhouse for the digital electronic revolution in this modern mobile society, exclusively used in mobile phones and laptop computers. The success of commercial Li-ion batteries in the 1990s was not an overnight achievement, but a result of intensive research and contribution by many great scientists and engineers. Then much efforts have been put to further improve the performance of Li-ion batteries, achieved certain significant progress. To meet the increasing demand for energy storage, particularly from increasingly popular electric vehicles, intensified research is required to develop next-generation Li-ion batteries with dramatically improved performances, including improved specific energy and volumetric energy density, cyclability, charging rate, stability, and safety. There are still notable challenges in the development of next-generation Li-ion batteries. The operating voltage of the Li-ion battery is 11.1V as shown in Fig 2.9.

2.2 BUILDING THE ANDROID APP FOR CONTROLLING AND TO GET DATA FROM GPS MODULE AN ULTRASONIC SENSOR

Building the Android application was with the MIT app inventor. First, we started by designing the user interface. In the logical part, there is nothing much. We use standard app inventor methods to connect to the HC-05 Bluetooth and once the connection is done, we just send some specific commands to move the robot and get the GPS module data and Ultrasonic sensor data from the robot. The mobile application developed using MIT App Inventor is shown in Fig 2.10.

MOBILE APPLICATION DESIGN:

Fig 2.10 Mobile application

FUNCTIONAL BLOCKS USED IN APPLICATION:

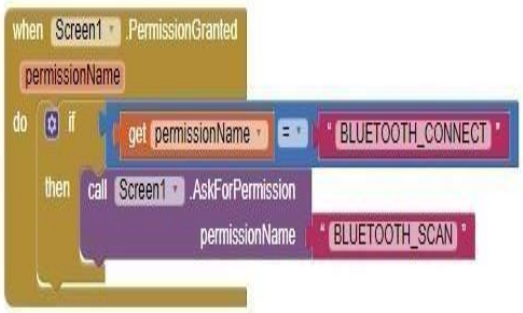

Fig 2.11 Functional Blocks

CHAPTER 3

3.1 WORKING PRINCIPLE

WORK DONE

The working of this circuit is very simple and easy to understand. First, we have the Arduino which is working as the brains of the circuit. Next, we have the Bluetooth module (HC05). The Bluetooth module is connected to pin 12and 13 of the Arduino that we are using as the software serial. Next, we are using pins 2 and 3 to connect our Ultrasonic sensor. Next, we are using pins 0 and 1 to connectour Neo-6m module. Finally, we are using pins 6,7,8,9,10 and 11 to connect the L298N motor driverIC that is driving four of our motors. Finally, to power it all up, we are using a 12 V battery. As mentioned above App Logic Command are processed by phone. The command is then sent to the receiver side via Bluetooth. Command received via Bluetooth is forwarded to Arduino Uno board using UART serial communication protocol. Arduino code checks the commands received. Whenever the command is a matching string, Arduino controls the movements of the robot accordingly in forwarding, backward, Turning Right, Turning Left & Stop. This Bluetooth controlled robot is operated simply using Bluetooth technology and also with the user command. The user has to install an app on his/her smartphone for controlling this robot. After pairing with a smartphone and Bluetooth controlled robot, the user can operate it via commands like forward, backward, right, left, and stop. Also, it has some features like forward and backward light indicators, a horn and speed control. Also it has some extra features like obstacle distance detection and GPS latitude and longitudinal data display.

Bluetooth Robot controller car app is used to send the signals and to receive signals in between Smartphone and Arduino hardware. Here Arduino acts as main controller of the device which

receives signal or commands and sends these commands to motors and motor drivers to perform a particular task. Robot controlled car made up of 2 motors and 1 motor driver which move the car in 4 directions, So here Arduino controls whole system. These all components are attached to robot chassis. To code the Arduino Ide (Arduino) software is used. Arduino is associated to computer or laptop using data cable to upload the code and once coding is uploaded then I remove the cable. These commands or instructions will transfer the data or information to the Arduino to communicate with the remote (Smartphone).

These all commands are sent to the Bluetooth receiver from the smartphone. After receiving the command through the Bluetooth receiver, it sends the analog signal to the Arduino for decoding the code. And then after processing the right code the Arduino controls the motors and other components of the robot. The functional blocks which we have used in the development of mobile application is shown in the Fig 2.11.

CIRCUIT DIAGRAM

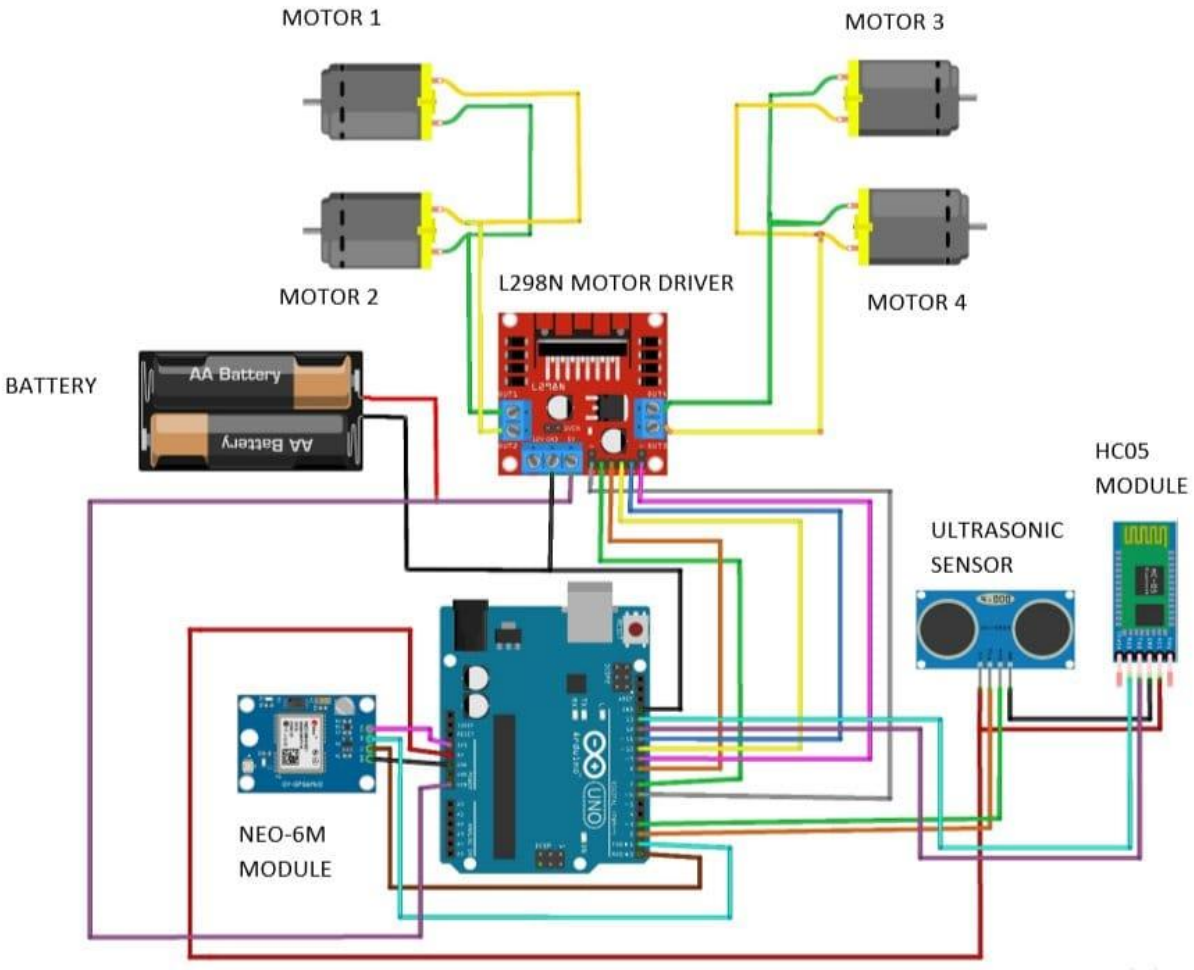

Fig 3 Circuit Diagram of Arduino Bluetooth Controlled Robot with Obstacle Detection and GPS Tracking

WORKING

In this project we use the micro controller Arduino uno as the main functioning and controlling block of the car. Arduino can take the analog input signal from the user and then it sends the digital data to the motor driver of the car. For this project we use the L298N motor driver. This motor driver can run four dc motors at the same time. It can be easily mounted on Arduino uno. Because of this no extra wiring is needed. The motor driver further commands the motors to rotate. And this is how an Arduino car works. In a Bluetooth controlled car, a Bluetooth module is connected to the Arduino to receive the data from the user. In serial communication we often use the Bluetooth module hc-05. This Bluetooth module is easy to use and can easily available in the market. There are various steps which are required to make this Bluetooth car.

The circuit diagram of the project is shown in the Fig 3.

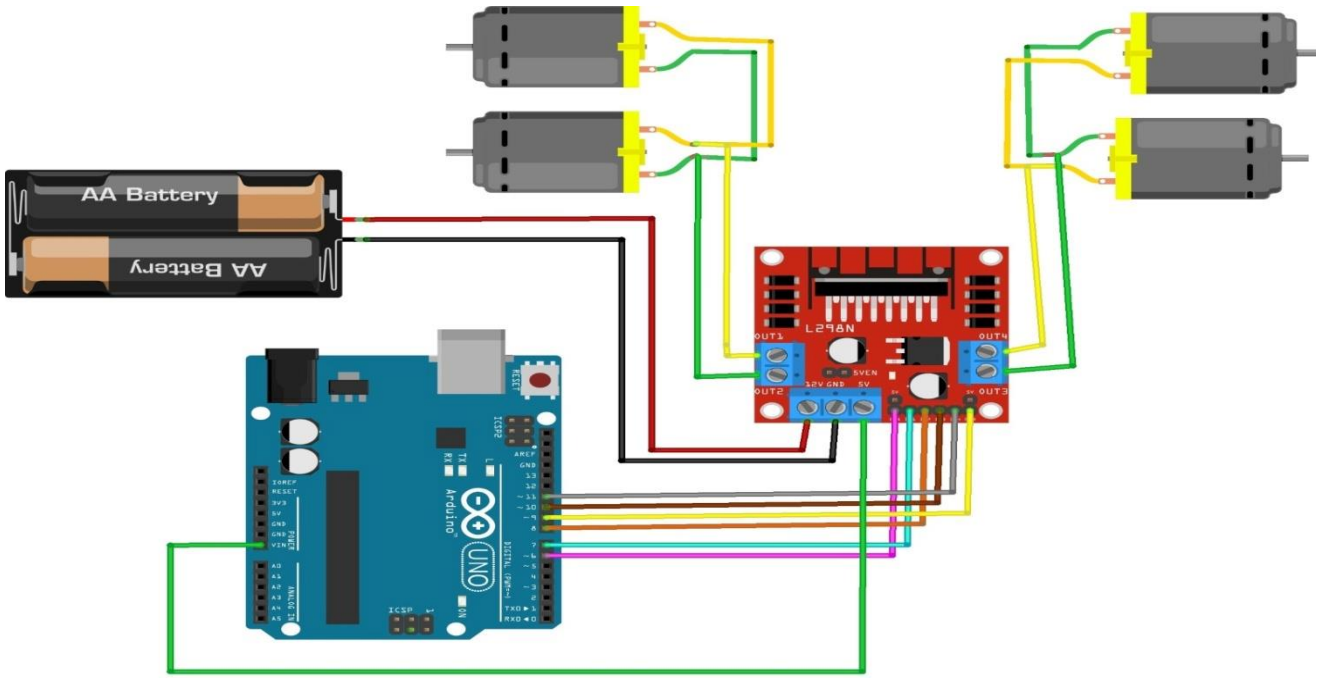

Fig 3.1 Circuit Diagram of Arduino Bluetooth Controlled Robot

Now we have to make the circuit for the car. For this we need three major components which are Arduino uno, L298N motor driver and Bluetooth module hc-05. Firstly, take the Arduino uno and then fix it on the middle of the car. After this take the L298N motor driver and mount it over the Arduino uno. Now the next thing is to connect the dc motors with your motor driver. Take the dc motors one by one and connect it with the motor driver as shown in Fig 3.1.

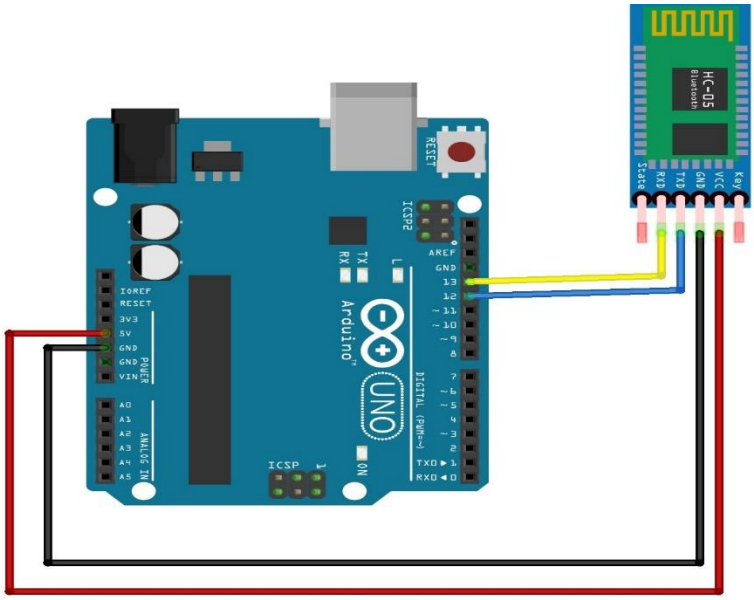

Fig 3.2 Arduino and Bluetooth Connection

After connecting all the motors take the Bluetooth module hc-05 and connect it with the Arduino uno. The connection of ARDUINO UNO with HC05 is shown in the Fig 3.2. Connect the VCC pin of the Bluetooth module with the +5 Volt pin of motor driver. Then connect the ground pin of the Bluetooth module with the ground pin of motor driver. Now connect the RX pin of Bluetooth module with the TX pin of Arduino uno. Again, connect the TX pin of Bluetooth module with the RX pin of Arduino uno. Lastly, we have to give the supply to the circuit. The NEO-6M GPS engine on this board is a quite good one, with the high precision binary output. It has also high sensitivity for indoor applications. NEO-6M GPS Module has a battery for power backup and EEPROM for storing configuration settings.

The antenna is connected to the module through a UFL cable which allows for flexibility in mounting the GPS such that the antenna will always see the sky for best performance. This makes it powerful to use with cars and other mobile applications. The connection of ARDUINO UNO with GPS module is shown in Fig 3.3.

The NEO-6M is a compact GPS module that allows for easy integration of GPS functionality into electronic projects. It uses the latest U-blox 6 positioning engine with a high level of sensitivity and accuracy, and is capable of tracking up to 22 satellites on 50 channels. With its small size, low power consumption, and high performance, the NEO-6M is an ideal choice for applications requiring GPS positioning, such as navigation systems, tracking devices, and robotics.

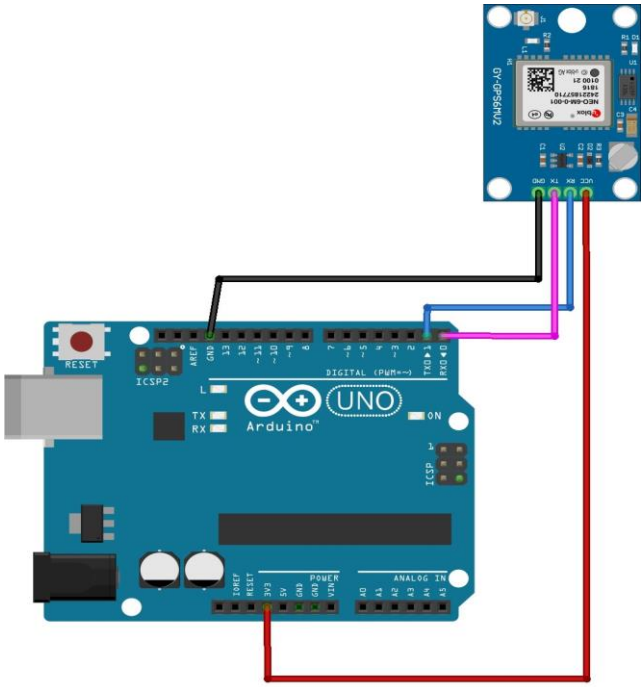

Fig 3.3 Arduino and GPS module connection

The HC-SR04 ultrasonic sensor uses SONAR to determine the distance of an object just like the bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package from 2 cm to 400 cm. The operation is not affected by sunlight or black material, although acoustically, soft materials like cloth can be difficult to detect. It comes complete with ultrasonic transmitter and receiver module. GPS used to detect the Latitude and Longitude of any location on the Earth, with exact UTC time (Universal Time Coordinated). This device receives the coordinates from the satellite for each and every second, with time and date. GPS offers great accuracy and also provides other data besides position coordinates. The connection of ARDUINO UNO with ultrasonic sensor module is shown in Fig 3.4.

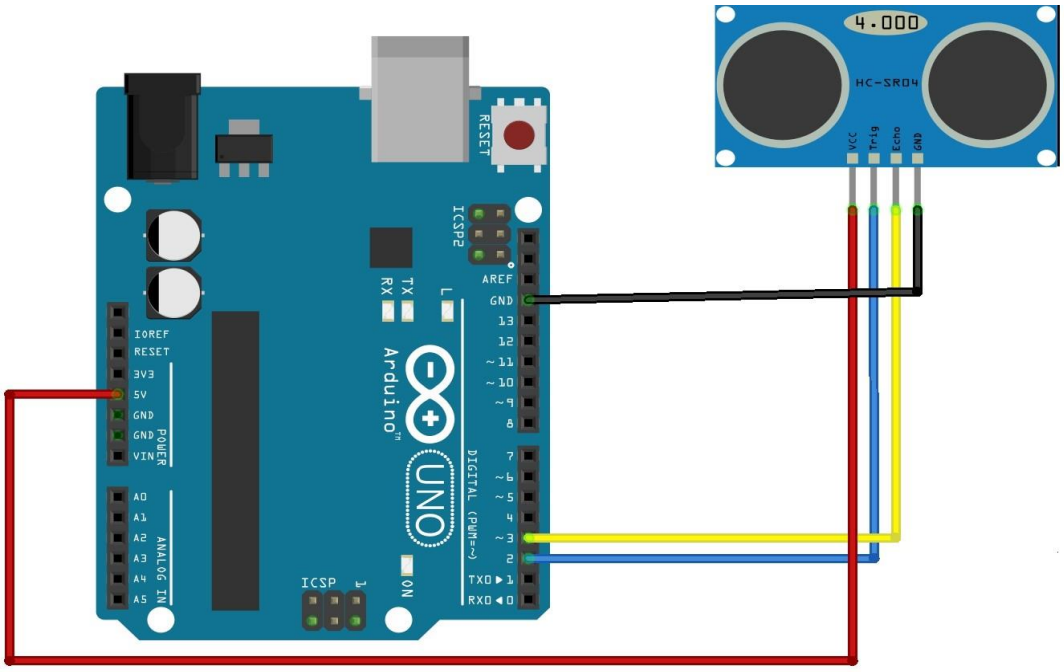

Fig 3.4 Arduino and Ultrasonic sensor connection

The working of this circuit is very simple and easy to understand. First, we have the Arduino which is working as the brains of the circuit. Next, we have the Bluetooth module (HC05). The Bluetooth module is connected to pin 12and 13 of the Arduino that we are using as the software serial. Next, we are using pins 2 and 3 to connect our Ultrasonic sensor. Next, we are using pins 0 and 1 to connectour Neo-6m module. Finally, we are using pins 6,7,8,9,10 and 11 to connect the L298N motor driverIC that is driving four of our motors. Finally, to power it all up, we are using a 12 V battery. Bluetooth Robot controller car app is used to send the signals and to receive signals in between Smartphone and Arduino hardware. Here Arduino acts as main controller of the device which receives signal or commands and sends these commands to motors and motor drivers to perform a particular task. Robot controlled car made up of 2 motors and 1 motor driver which move the car in 4 directions, So here Arduino controls whole system. These all components are attached to robot chassis. To code the Arduino Ide (Arduino) software is used. Arduino is associated to computer or laptop using data cable to upload the code and once coding is uploaded then I remove the cable. These commands or instructions will transfer the data or information to the Arduino to communicate with the remote (Smartphone).

EXPERIMENTAL RESULTS

This is a simple Micro-controller-based Bluetooth controlled car. The Micro-Controller is connected in the car. The Arduino is doing all this job. For receiving data wirelessly, we are using the HC-05 Bluetooth module. To begin with, for this Bluetooth controlled robot, we have utilized forward, backward, left, right andstop buttons. At the point when a key is pressed by the user, the comparing information is transmittedto the Bluetooth module from the smartphone over Bluetooth serial communication. In the Arduino code, the Arduino gets any of this information from the Bluetooth module (according to the key mapping) and plays out a simple switch case activity, where each case is related with directions. The robot can track its position using the NEO 6M GPS module and transmit the location data via Bluetooth to a mobile app. The accuracy of GPS tracking could be measured by comparing the robot's reported position with its actual position using a mapping tool. The Ultrasonic sensor, on the other hand, uses sound waves to detect obstacles in the robot's path. Bymeasuring the time, it takes for the sound waves to bounce back, the sensor can calculate the distance to the obstacle and trigger the robot to take evasive action.

APPLICATIONS

The Bluetooth-controlled Arduino car with obstacle detection and GPS tracking has many real-time applications in the field of robotics, automation, and transportation. Here are some of the real-time applications of this project:

1. This project can be used as the foundation for developing an autonomous car that can navigate through obstacles and follow a given path. By integrating this project with machine learning algorithms and advanced computer vision techniques, the car can be made to learn and adapt to newenvironments.
2. The car can be used as a remote-controlled vehicle for monitoring and surveillance purposes in areas that are difficult or dangerous for humans to access.
3. The car can be used in rescue operations, such as finding and rescuing people in disaster-struck areas. The GPS tracking system and obstacle detection sensors can help in identifying the location of people and navigating through obstacles to reach them.

CONCLUSION

The project titled "**ARDUINO BLUETOOTH CONTROLLED ROBOT WITH OBSTACLE DETECTION AND GPS TRACKING**" has the following conclusion:

- The Bluetooth-controlled Arduino car with obstacle detection and GPS tracking is a versatile and useful project that can be used in many real-time applications. The project combines the features of obstacle detection and GPS tracking, which allows the robot to navigate and avoid obstacles while simultaneously providing its location. The use of the Neo 6M module and Ultrasonic sensor enhances the accuracy of the GPS tracking and obstacle detection, respectively.
- It demonstrates the understanding of Arduino programming, Bluetooth communication, and sensor integration, and highlights the ability to develop practical and useful solutions using these technologies.
- With the Arduino Robot, we learnt about electronics, mechanics, and software. It is a tiny computer on wheels. Furthermore, the project allows for wireless control of the robot via Bluetooth, providing greater mobility and flexibility. The use of a rechargeable lithium-ion battery also ensures that the robot has a longer operating time.
- Overall, while there may be some limitations and disadvantages to the project, such as the limited range of Bluetooth communication and the potential for inaccuracies in the GPS tracking and obstacle detection, it remains a valuable tool for various applications. The Arduino Bluetooth controlled robot with obstacle detection and GPS tracking project offers an excellent platform for learning and experimentation in robotics, GPS technology, and wireless communication.

FUTURE SCOPE

In the future, we hope to incorporate additional features like such as video recording and object recognition to further enhance the car's functionality.

Currently, the robot relies on manual control via Bluetooth. Future development could involve incorporating machine learning algorithms and computer vision to enable the robot to navigate autonomously.

The GPS module used in this project provides location data, but it could be further integrated with other technologies, such as a compass or a gyroscope, to improve the robot's navigational abilities.

It may be possible to develop a system where multiple Bluetooth-controlled robots can communicateand work together, potentially allowing for more complex tasks to be completed.

Improvements could be made to optimize the power consumption of the robot, such as using a more efficient motor or implementing energy harvesting methods, to extend the operating time of the robot.

REFERENCES

- Rowjatul Zannat Eshita, Tanwy Barua, MTEE, American International University, 2020
- Smita Bhuyarkar, Harshad Ghonge, Utkarsha Dipawale, Department of Electrical Engineering, Nagpur.
- Souvik Paul, Saumedhik Biswas, BCA Department, The Heritage Academy,Kolkata,2020
- Nasik and T. Arudchelvam , Department of Computing and Information Systems, Wayamba University.
- June Myint Mo Khin,Dr. Nyein Nyein , Department of Computer Engineering and Information Technology Yangon Technological University.
- V A Zhmud, N O Kondratiev, K A Kuznetsov, V G Trubin and L V Dimitrov Published under licence by IOP Publishing Ltd.
- Gregoria Andria, Nicola Giaquinto ,Department of Electrical and Electronics , Italy
- Arun Francis G, Arulselvan M, Elangkumaran P International Journal of Innovative Technology and Exploring Engineering.
- Ni Ni San Hlaing, Ma Naing rukuri , Department of Electronic Engineering, Technological University, Kyaukse, Myanmar.
- A. Anil, V. K. Shukla and V. Naranje, "Tracking Vehicles through GPS Module and Arduino UNO," 2021 9th International Conference on Reliability.