BLUETOOTH CONTROLLED SMART ROBOTIC CAR

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

This Project titled "**Bluetooth Controlled Smart Robotic Car**", submitted by Shakil Ahmed, Razu Ahmed Nishan and Md. Shakil Khan to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 30 October, 2021.

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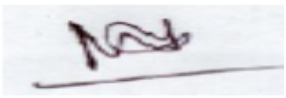

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We hereby declare that, this project has been done by us under the supervision of **Mr. Arif Mahmud, Assistant Professor, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

Robots are made to make human task easier. Line following mode is an amazing feature in a robotic car. Besides, when it is also equipped with more features like manual controlling, voice controlling and obstacle avoiding it becomes more advanced and useful for humans. There are so many task that are very hard or impossible for a human being to complete, but as a robot is a machine it can perform any task according to its capabilities without getting tired. And also robot can work all day long as long as it is getting enough power supply. Besides there's no possibilities of death of a robot while doing any dangerous task as they have no sense of life or felling. It can be damaged, destroyed, broken but also it can be repaired. So a robot is a must needed machine now a day. The robot in this project is equipped with multiple sensors like IR sensor, ultrasonic sensor. It is capable of follow along predefined black lines and also capable of detect obstacles and avoid it. An android app is used to control the whole thing. Every command is sent to the robot by using the app and then the robot behaves according to the command sent by the app. The app and the robot gets connected to each other via Bluetooth as a Bluetooth module has been used on the robot. Besides, it can be controlled by using infrared remote also because the robot is equipped with infrared receiver also. Overall this project is very interesting and very useful in so many ways. It can be used in industries, hospitals, parks, household application, guidance etc. -

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CHAPTER 1
Introduction

5.1 Introduction

Robot is a part of modern technology. As it is helpful in many ways on the other hand it reduces cost also. Our smart robotic car offers multiple features and so many features can be implemented in the future. Our goal is to keep the project simplified and easy to use with multiple features. In manual controlling mode, user can control the direction of the robot as he/she wants. We created an android application on an online platform called MIT app inventor. There are four buttons on the app to control the direction of movement manually. The automatic button puts the robot in automatic mode. In automatic mode, the robot is cable of follow along a predefined black lines. In voice control mode, user can put voice command to control the direction. Lastly in ultrasonic mode, it can move freely by detecting obstacles and avoiding them. We used dc gear motors to make the robot moveable. A very useful feature of DC gear motor is it has less rpm but more torque which is perfect for this project. As this is a Arduino based project, Arduino is the main hardware here. Arduino is an open-source electronic platform based hardware which is able to read input from sensor modules and turn it into an output.

1.2 Motivation

Purpose of robotics is to simplify human task, solving difficult operation, reducing cost. This is the era of modern science and technology. So it can be said that it is impossible to think of a day without robotics now a day. Most of us already has seen rail tracks where a train follows the track to reach its destination, besides it also carries passengers and goods. In addition, we have seen self-driving vehicle such as TESLA which is capable to drive its own without any drivers. So we thought of a smart robotic machine that should be a simplified version of track following system and also be capable to drive its own. Besides it should be equipped with multiple robotics features.

1.3 Objectives

The main objectives of our project is stated below:

1. It is capable of moving by following a predefined line that means self-driving, autonomous robot.
2. Capable of manual and voice over controlling mode.
3. Controlling the robot OTA by using Bluetooth method.
4. The whole project is control by an android app.
5. Detecting obstacle in front of it while moving and ignoring them.

1.4 Expected outcome:

Our approach of this project is to make this robot useful in such a way that it can perform individual tasks that are hard to perform for a human being. If we think about an industry where a common task is to deliver goods from one place to another, our smart robotic car is capable of doing this easily. Besides this line following feature can be implemented in hospitals, hotels, parks, tour guidance etc. Self-driving vehicles could be an another option to implement this line following feature which should help to reduce road accidents. As ultrasonic sensor detects objects, it can also be used to indicate directions to the blind peoples, helping them to cross roads. The manual controlling mode should give user full freedom how he wants to operate the car. In a critical path or tunnel where it is hard or impossible to reach for a human, this robot should be able to easily reach there.

1.5 Report layout:

In chapter 1, we briefly describe the introduction of this project. Basically it is an overview of our full work, our approach towards this projects, where we got the idea to work on this. Then we described objectives of this project. Lastly we described what we expect from this project or where we want to see this project overview. In chapter 2, we discussed about the field of robotics, where we got our ideas or knowledge to work on this projects. We did some research on various paper and acquired some knowledge about this. Later we presented the scope of the problem and some challenges we have to face on this project. Chapter 3 is all about the requirements of hardware and software. We listed all the components, their specifications, working procedure. In chapter 4 we described the

circuit diagram of each element individually like how to connect them with Arduino. Chapter 5 is about the physics behind some of the features of this project. We also showed the mechanical design and final outcome and the interface of our android application. Lastly we calculated the estimated cost of this whole project. Chapter 6 contains the summary of this project and we also listed our future plan regarding this project. In chapter 7 we give some references regarding to this project.

CHAPTER 2
Background

2.1 Background Study

The usage of robot is growing up day by day. The number of robotic units in 2020 was 12 million worldwide and the number is increasing rapidly. A robot is machine that is usually designed to reduce the amount of human work [2]. According to a survey the number should be increase up to 12% in 2022. Many industries are planning to adopt robotic automation to optimize their business. In 2015 the value of robotics market was just $95 million. But in the end of 2019 its value increased rapidly to $1 Billion. This increment will go up to 28.6% till 2030. Robotic technologies available in the market at present in order to help with car parking [3]. Many companies like Amazon, eBay, Best Buy etc. Already started to implement modern robotic technology to their businesses. So it is clear that there is no way of decreasing robot usage. Moreover, this technology is being a part of a human's daily life. So working in robotics, inventing new type of robots is a good approach. Almost every day new types of robot being invented, people are making robots according to their needs. Usage of robots is pretty common in mobile industries, hospitals, car industries, e-commerce etc as the accuracy, flexibility, speed of a robot is way better than a human. Besides it also reduces labor cost which is very important for a industry. A line following robot which is commonly used to carry children to shopping malls, entertainment places is a new commercial product in this field [1]. Robots like line following bots uses an array of IR reflective sensors to find out the degree to which a circular arc deviates from a straight line [4]. Ultrasonic sensor based robot is additionally ready to acknowledge victims before it, the sensing element system is extremely low-cost as a result of it solely uses one distance sensing element [5]. The problem is to differentiate objects placed in close vicinity of each other and to calculate the width of the objects or the width of a gap between objects placed next to each other [6]. HC-05 Bluetooth module is an easy to use Bluetooth Serial Port Protocol module, designed for transparent wireless serial connection setup [7].

2.2 Scope of the problem

Our approach system is like a prototype but we are trying to represent it in a very realistic way. Moreover, we have to face some problems, some of them are ignorable and some of them are not.

1. We need an external device like smart phone or a remote controller to control the robot.
2. The range between the robot and remote controller is limited. And should not work in long range.
3. The line following mode does not work properly in a sharp angle like 90 degree or close to 90 degrees.
4. Internet connection is must needed for voice controlling.
5. It is hard for the infrared sensors to detect black line when there is a reflect of white light into the lines.

2.3 Challenges

Our main challenge is that we have to deal with both hardware and software as we are working on Arduino and offering controlling system via smartphone, we have to implement android app also. As our approach is to implement such a system where user should send command to the robot over the air using android app, the sensors should receive the data according to the user input. In addition of a new feature, we have to redesign the whole project like change of coding, change of android app, physical design change and so on. Besides, as it is a wireless controlling system there is a matter of range. The signal between the robot and the controlling device becomes weak if there is an obstacle between them. There is a way to increase the range and that is ESP8266 WI-FI module which give Arduino access to a WI-FI network. So using ESP8266 WI-FI module, the range limit can be increased but here we must need internet connection.

CHAPTER 3

Requirement Specification

3.1 Introduction

In this chapter, we will discuss about our approach systems, hardware devices, software's, data process parts and so on.

3.2 Requirements

- **Hardware Requirements**

1. Arduino UNO
2. HC05 Bluetooth module
3. Infrared sensor x4
4. DC Gear motor x4
5. Gear Motor Wheel x4
6. L293D motor driver
7. Ultrasonic Sensor
8. Servo Motor
9. Jumper Wire
10. Battery
11. Fire detecting sensor
12. Water Pump
13. Relay module
14. Buzzer

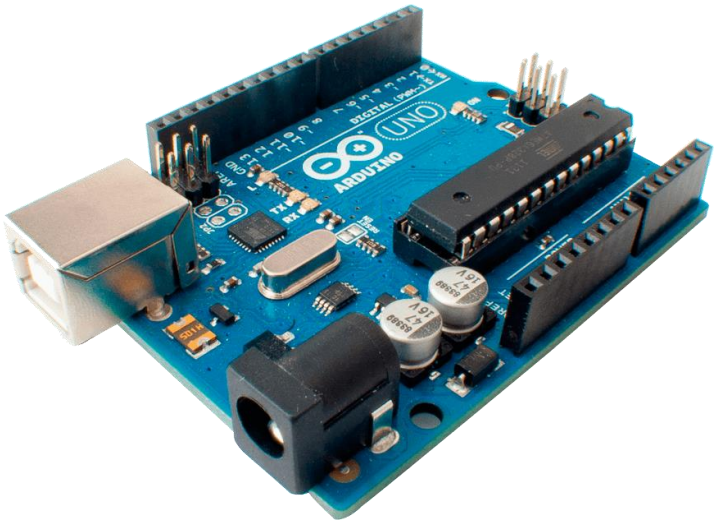
- **Software Requirements**

15. Arduino IDE
16. MIT App Inventor

1. Arduino

Arduino is a powerful integrated development board which offers digital input and analog input features which allows to take input from sensors, process it, converts into output according to the signal received from the sensors. Best part about Arduino is user can

customize it by coding on the Arduino IDE and uploading the codes to the board. So many useful beginner or basic level project, advanced level project can be done by using Arduino and other necessary components. Literally it provides full freedom to the user how someone wants to use it. Gathering necessary equipment, completing circuit board according to circuit diagram, coding and uploading and a project is good to go.



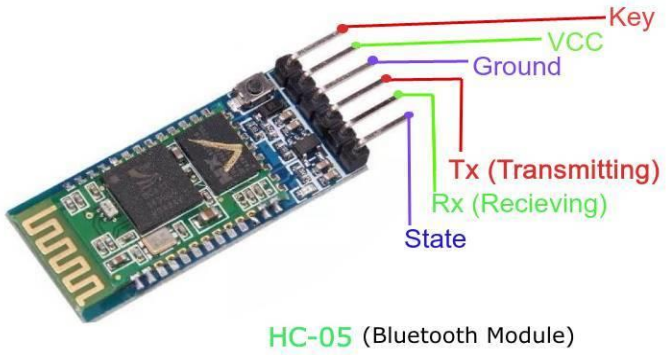
3.1 Fig:Arduino UNO

Table 3.1: Specification of Arduino UNO

Microcontroller	Atmega328p
Operating Voltage	3.3V
Input Voltage	7-12V
Digital I/O Pins	14
Analog Input Pins	6
EPROM	1 KB
SRAM	2 KB
Flash Memory	32 KB
Clock Speed	16 MHz

2. HC05 Bluetooth Module

Bluetooth module is a hardware that allows to pair or connect two devices with each other. In this case it is used on Arduino to connect it with android app. As it is a wireless technology, the data transmission between them need no wired connection. HC05 Bluetooth module consists of 6 pins and they are key, VCC, GND, TX, RX, State. The VCC and Ground pin is used to power up the module. TX and RX key is for sending and receiving data and the key pin is for switching between data modes (low and high).



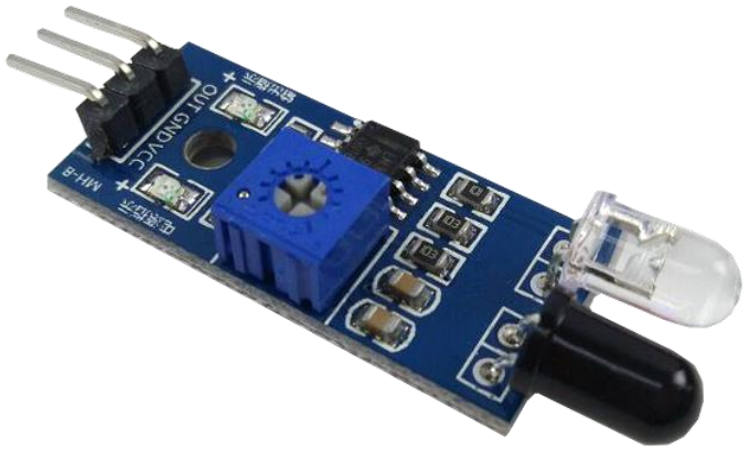
3.2 Fig: HC05 Bluetooth Module

Table 3.2: HC05 Bluetooth Module Specification

Bluetooth Protocol	V2.0+EDR
Frequency	2.4 Ghz
Modulation	GFSK
Sensitivity	<-84dBn at 0.1% BER
Power Supply	+3.3 VDC 50 mA
Dimension	26.9mm * 13mm * 2.2mm

3. Infrared Sensor

Infrared sensor is an electric module consists of two led in front of it and three pins. The white led is IR emitter and the black led is IR receiver. The three pins are VCC pin, GND pin OUT pin. In case of detecting an object or line in front of it the IR signal reflects from the objects and the black led receives that signal.



5.1 Fig: Infrared Sensor

Table 3.3: Infrared Sensor Specification

Operating Voltage	5V dc
I/O pins	3.3V-5V
Range	(+-) 20cm(adjustable)
Supply Current	20mA

4. DC Gear motor

Gear motors generally has low rpm but high torque. As it has high torque it is applicable in such projects where high torque is main priority over rpm. It consist of multiple gears inside the gear box. The gears are used to reduce rpm. So gear box is a great solution to increase the torque of small motors.

3.4 Fig: Dc Gear Motor

Table 3.4: Dc Gear Motor Specification

Operating Voltage	3V-6V
Max Torque	800g.cm
No Load Rpm	90+-10
No Load Current	190mA
Reduction ratio	1:48
Stall Current	~1A

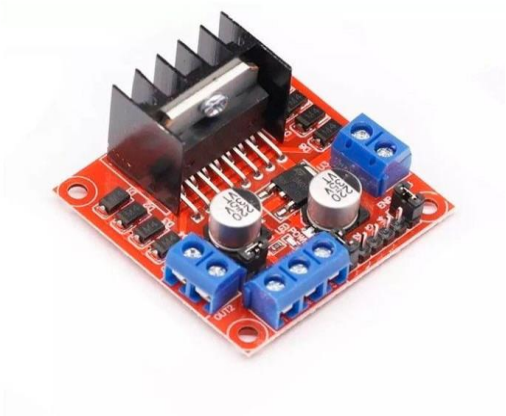
5.Gear Motor Wheel

This gear motor wheel consists of two parts one of them is the barrel and the second part is tire. The barrel is made of plastic and the tire is made of rubber. This two parts can be separated. The use of this wheel in a project provides clean and smooth movement and grip and also gives a nice look to it. The durability of this wheel is strong enough to use them in small projects like Cars, Robots, Toys and other similar type of project.

3.5 Fig: Gear Motor Wheel

6. **L298N Motor Driver**

To control direction of dc motors and also controlling speed L298N motor driver is widely used. It consists of 4 output pin (out1, out2, out3, out4), 4 input pin (in1, in2, in3, in4), to pwm signal pin (ENA, ENB), 12V pin, 5V pin, GND pin. Besides it also consists of led indicator L298 IC, 78M05 regulator. With the help of this module maximum 4 dc motor can be controlled.

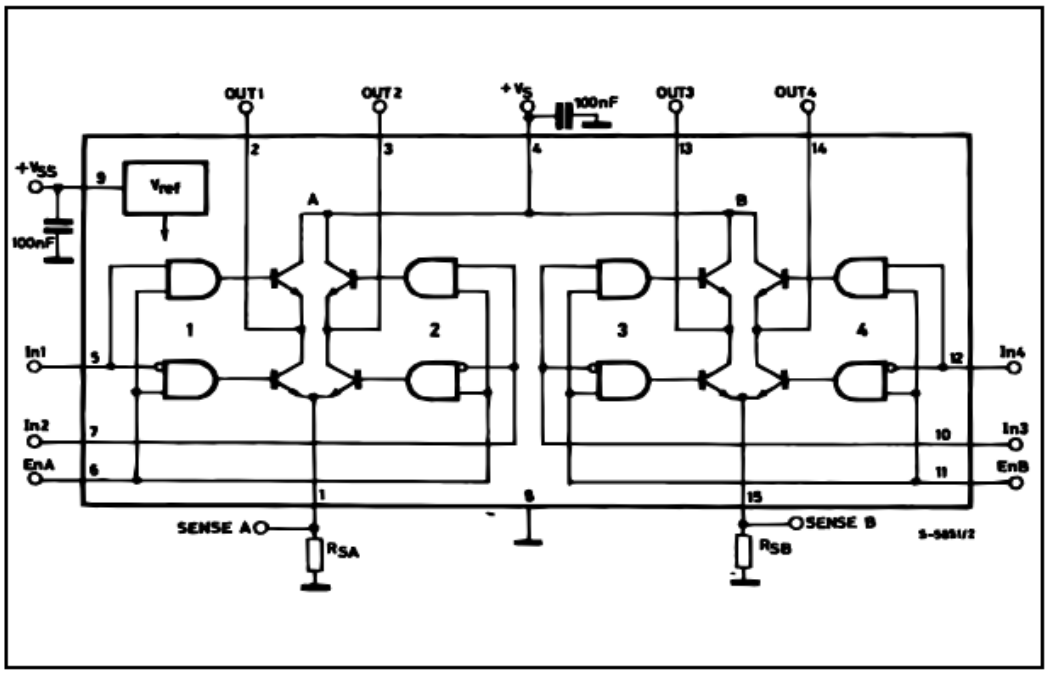


3.6 Fig: L298N Motor Driver

Table 3.5: L298N Motor Driver Stats

Max Operating Voltage	46V
Output Current	2A
Motor channels	2
Min Logic Voltage	4.5v
Max Logic Voltage	7V
Max power	25W

BLOCK DIAGRAM



3.7 Fig: L298N Motor Driver Block Diagram

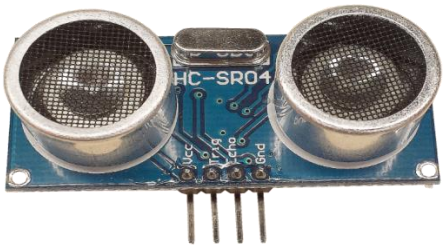
ELECTRICAL CHARACTERISTICS (V_S = 42V; V_{SS} = 5V, T_j = 25°C; unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_S	Supply Voltage (pin 4)	Operative Condition	V_{IH} +2.5		46	V
V_{SS}	Logic Supply Voltage (pin 9)		4.5	5	7	V
I_S	Quiescent Supply Current (pin 4)	V_{en} = H; I_L = 0 V_i = L V_i = H		13 50	22 70	mA mA
		V_{en} = L V_i = X			4	mA
I_{SS}	Quiescent Current from V_{SS} (pin 9)	V_{en} = H; I_L = 0 V_i = L V_i = H		24 7	36 12	mA mA
		V_{en} = L V_i = X			6	mA
V_{IL}	Input Low Voltage (pins 5, 7, 10, 12)		–0.3		1.5	V
V_{IH}	Input High Voltage (pins 5, 7, 10, 12)		2.3		VSS	V
I_{IL}	Low Voltage Input Current (pins 5, 7, 10, 12)	V_i = L			–10	µA
I_{IH}	High Voltage Input Current (pins 5, 7, 10, 12)	Vi = H ≤ V_{SS} –0.6V		30	100	µA
V_{en} = L	Enable Low Voltage (pins 6, 11)		–0.3		1.5	V
V_{en} = H	Enable High Voltage (pins 6, 11)		2.3		V_{SS}	V
I_{en} = L	Low Voltage Enable Current (pins 6, 11)	V_{en} = L			–10	µA
I_{en} = H	High Voltage Enable Current (pins 6, 11)	V_{en} = H ≤ V_{SS} –0.6V		30	100	µA
$V_{CEsat\ (H)}$	Source Saturation Voltage	I_L = 1A I_L = 2A	0.95	1.35 2	1.7 2.7	V V
$V_{CEsat\ (L)}$	Sink Saturation Voltage	I_L = 1A (5) I_L = 2A (5)	0.85	1.2 1.7	1.6 2.3	V V
V_{CEsat}	Total Drop	I_L = 1A (5) I_L = 2A (5)	1.80		3.2 4.9	V V
V_{sens}	Sensing Voltage (pins 1, 15)		–1 (1)		2	V

3.8 Fig: L298N Motor Driver Electrical characteristics

7. Ultrasonic Sensor

Measuring distance of an object is done by using ultrasonic sensor. It is equipped with crystal oscillator transmitter and receiver. It is also consisting of 4 pins and they are VCC, TRIG, ECHO, GND. Ultrasonic sensor sends sound waves. For a human being it is not possible to hear those sound waves because the waves are higher than human hearing frequency range. The receiver receives sound waves sent by the transmitter. Main drawback of this sensor is that sometimes it is not capable to detect small objects, soft objects like cotton.



3.9 Fig: Ultrasonic Sensor

Table 3.6: HC-SR04 Ultrasonic Sensor features

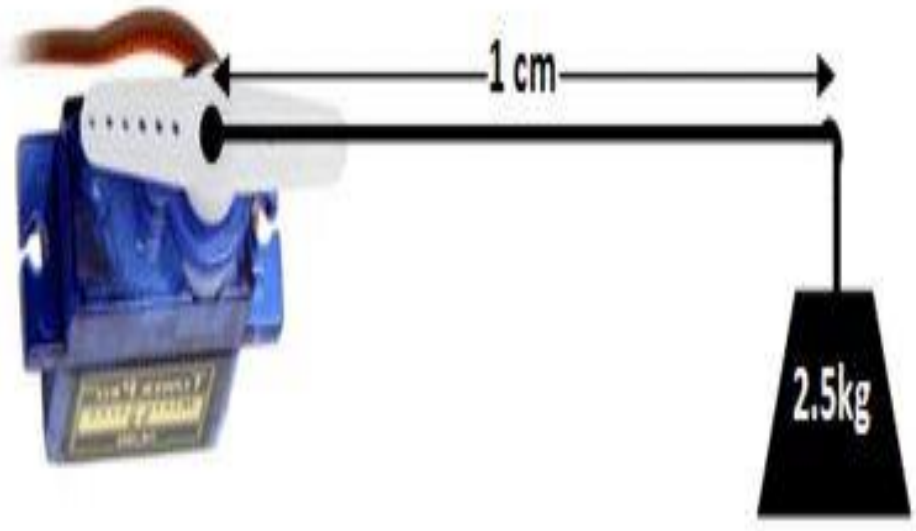
Operating Voltage	+5V
TMD	2cm-450cm
PMD	2cm-80cm
Accuracy	3mm
Angle covered	<15degree
Operating Current	<15mA
Operating Frequency	40GHz

8. **Servo Motor**

A tiny dc motor consisting of a potentiometer, control circuit board and a gear box is known as servo motor. To make a limited turn like 90-degree or a total of 180-degree servo motor is widely used. Servos are not mainly speed oriented. They receive position signal pulse sent by using a controller and behaves that way.

Normally all dc motor has two terminals but SG90 micro servo has three terminals. They are power, ground and signal. The extra terminal of this servo motor acts as a signal carrier. Basically the signal terminal sends signal to the servo motor to take turn according to the signal.

3.10 Fig: Servo Motor



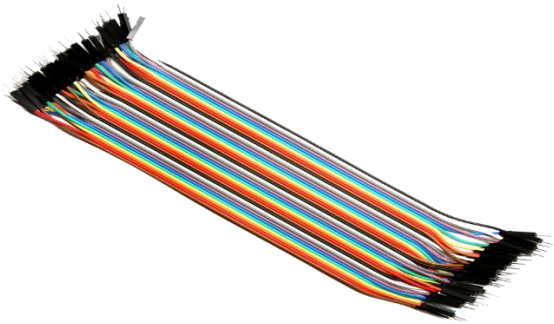
3.11 Fig: Servo Motor Torque at 1 cm Distance Is 2.5kg

Table 3.7: SG90 Servo Motor features

Operating Voltage	4.8V~6V
Torque	2.0kg/cm(4.8V)
Speed	0.09s/60°(4.8V)
Rotation Angle	180-degree
Gear	Plastic
Weight	10.5g
Dimension	22.8mm*12.2mm*28.5mm

9. **Jumper Wire**

Jumper wire is a group of colorful cables equipped with 1 pin each end. This type of wire mostly used in small projects or prototype projects to make temporary connections such as making a project on a bread board. There are three types of jumper wire (male to male, male to female, female to female)



3.12 Fig: Male to Male Jumper Wire

3.13 Fig: Male to Female Jumper Wire

3.14 Fig: Female to Female Jumper Wire

10. Battery

Battery is the main power source in this project. It provides power to the Arduino, Bluetooth module and all other equipment of this project. The best way to power up the Arduino is to give it power directly from a battery so that any external voltage regulator is not necessary. The last thing is to make the project portable battery is must needed.

3.15 Fig: Battery

5. Fire detecting sensor

A flame detector is a sensor designed to detect and respond to the presence of a flame or fire. Responses to a detected flame depend on the installation but can include sounding an alarm, deactivating a fuel line and activating a fire suppression system. The IR Flame sensor used in this project is shown below, these sensors are also called Fire sensor module or flame detector sensor sometimes.

3.16 Fig: Fire detecting sensor

13. Water Pump

A water pump is a device capable of generating a flow of liquid using kinetic energy. Therefore, it has some basic elements:

- Starter: where the liquid is absorbed.

Motor + Propeller: the one in charge of generating the kinetic energy that extracts the water from the inlet and sends it through the outlet.

Check-out: it is the inlet where the liquid propelled by the power of the water pump will come out.

3.17 Fig: Water Pump

14. Relay module

The relay module is an electrically operated switch that can be turned on or off deciding to let current flow through or not. They are designed to be controlled with low voltages like 3.3V like the ESP32, ESP8266, etc. or 5V like our Arduino.

3.18 Fig: Relay Module

15. Buzzer

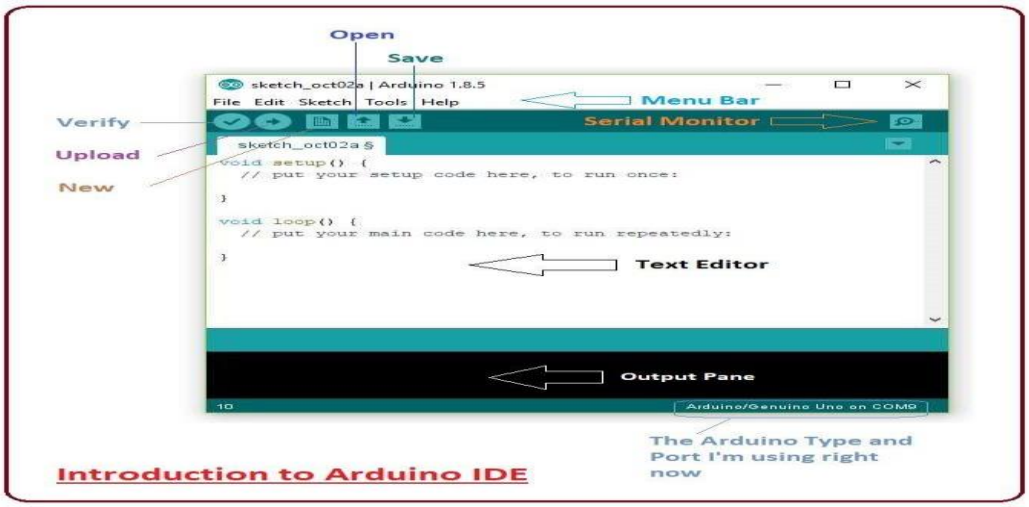
An Arduino buzzer is also called a piezo buzzer. It is basically a tiny speaker that we can connect directly to an Arduino. The buzzer produces sound based on reverse of the piezoelectric effect.

The buzzer produces the same noisy sound irrespective of the voltage variation applied to it. It consists of piezo crystals between two conductors. When a potential is applied across these crystals, they push on one conductor and pull on the other. This, push and pull action, results in a sound wave. Most buzzers produce sound in the range of 2 to 4 kHz.

3.19 Fig: Buzzer

- **Software Requirements**

15. Arduino IDE



3.20 Fig: Arduino IDE Interface

It is not possible to work on Arduino without coding. The Arduino, sensors and all other equipment will behave the way we do coding. The coding part is done on an IDE named Arduino IDE. It is an open source, cross platform application that allows to write codes

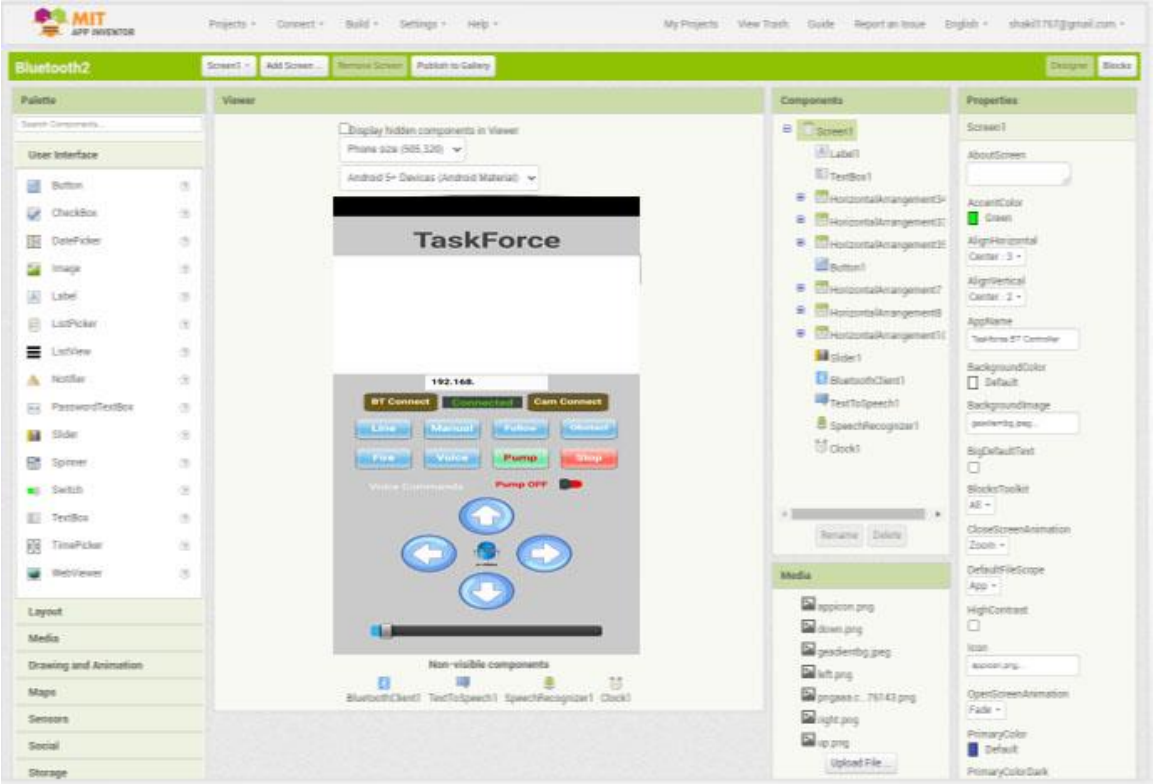
and upload the code to the microcontroller. Similarly editing or updating a code and again uploading it is done by this IDE. With the help of some facilitator cores we can work on other retailer boards like NodeMCU, Pocket Beagle, Seeeduino Nano etc.

Table 3.8: Introduction to Arduino IDE

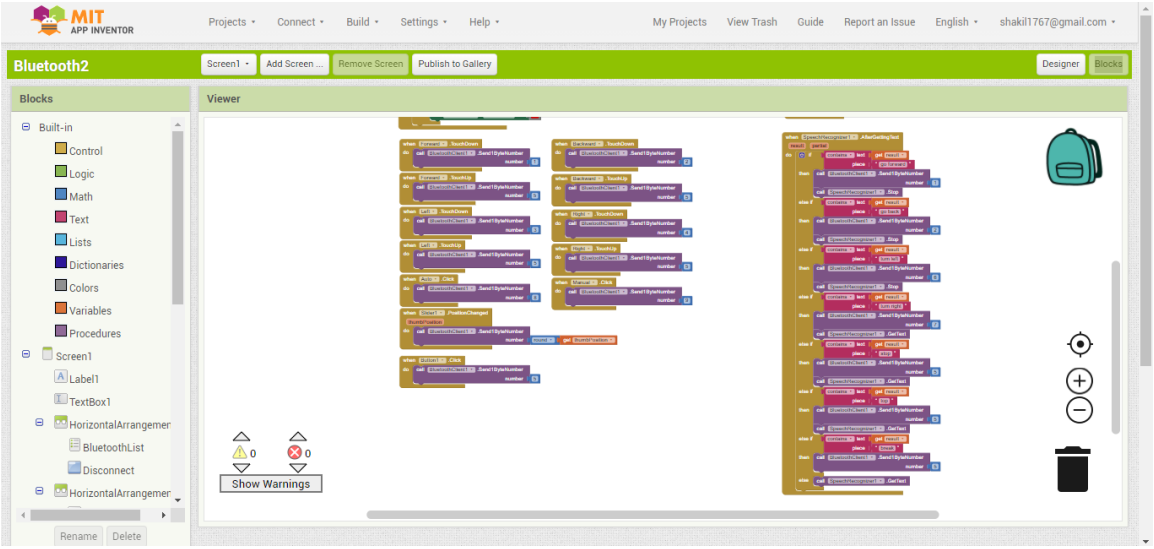
Platform	Open Source
Language	C,C++
Operating System	MAC, Windows, Linux
Arduino modules	Arduino UNO, Arduino Mega, Arduino Nano etc.
IDE environment	Editor and Compiler
Cost	Free

16. MIT App Inventor

Massachusetts Institute of Technology(MIT) is a cloud based online web application. To build an android app is not an easy task. We need to do a lot of coding to create an android app. MIT app inventor makes these task easier because coding is not mainly necessary here. It is an optical programming environment that allows user to create an android app very easily without coding. To design the UI user can drag and drop elements to the app interface according to their need. Almost every type of element is available on this platform. For the backend it provides thousands of predefined blocks categorized by control, logic, math, text, lists, dictionary, color, variable and procedure. Each category contains a lot of logic. User just need to select the appropriate category of and drag and drop necessary logic. Lastly user can import the project as an android apk format.



3.21 Fig: MIT App Inventor Design Interface



3.22Fig: MIT App Inventor block interface

Methodology

Our project provides multiple function with wireless control system. The infrared sensors are used to implement line following method. In the line following mode the receiver LED receive data from the transmitted LED. Then the data is sent to the Arduino and finally Arduino sends the data to the motor drivers. When both sensor detects white surface it keeps moving forward and when both sensor detects black line it stops. In case of object detection when the ultrasonic sensor detects an object in front of it at a certain distance it sends sound wave to the receiver and according to the object detection the robot keeps moving. In manual and voice controlling mode user has a choice in which direction he/she wants to drive the robot. Everything is done by using our android app like connecting to device, changing modes, voice controlling, manual controlling, obstacle avoiding etc. We used battery as the power source of this project and they are rechargeable. In case of the battery runs out of power we can easily recharge them. The full project works without internet but in case of voice controlling mode we need internet connection.

CHAPTER 4

Design Implementation

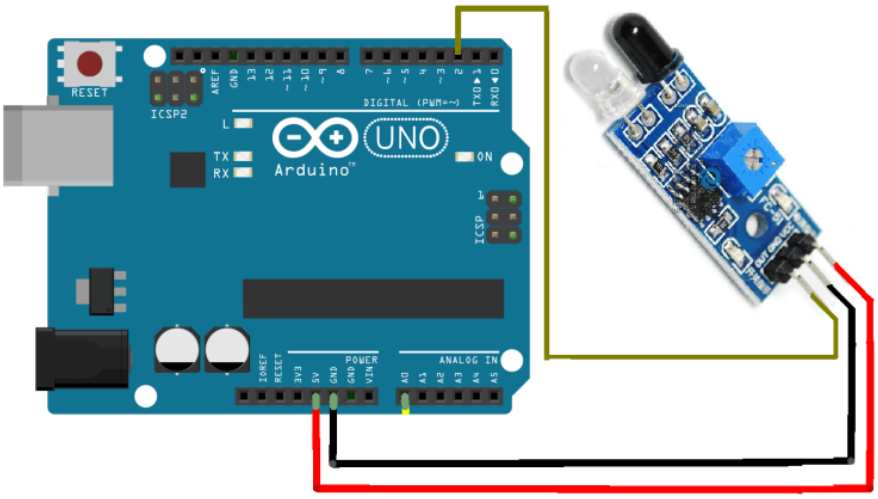
4.1 Introduction

This chapter is about the circuit diagram explanation, working process, coding explanation Arduino logic. We will briefly discuss about the connection of components, programming them according to our need, implementation of design and the logic behind the Arduino working process.

4.2Circuit design:

- Infrared Sensor Connection Diagram

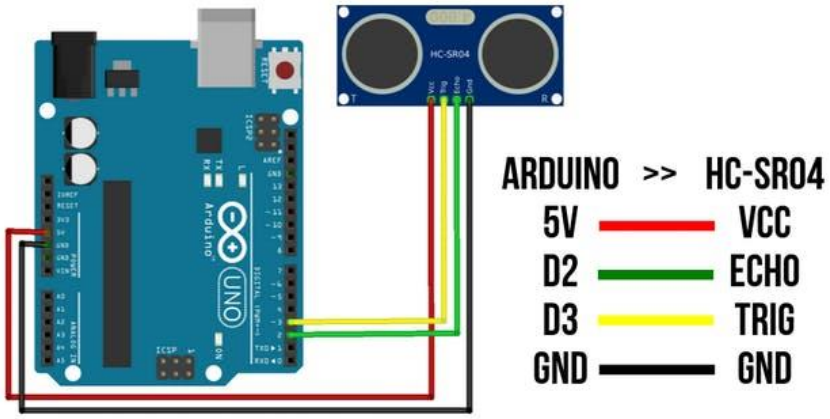
The VCC pin of infrared sensor is connected with Arduino 5V pin, GND pin is connected with Arduino GND pin and the OUT pin is connected with Arduino digital pin 2.



4.1Fig: Connection of Infrared Sensor with Arduino

- Ultrasonic Sensor Connection Diagram

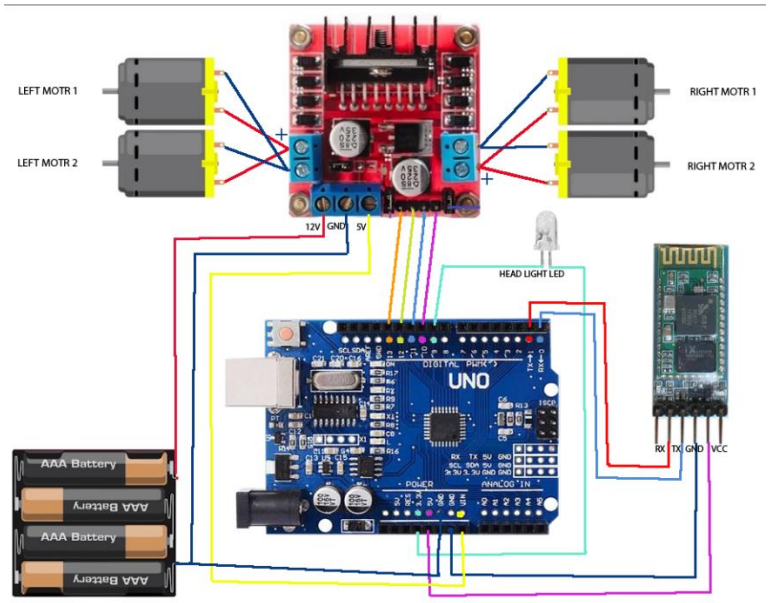
The VCC pin of Ultrasonic sensor is connected with Arduino 5V pin, GND pin is connected with Arduino GND pin, the ECHO pin is connected with Arduino digital pin 2, TRIG pin is connected to Arduino digital pin 3.



4.2Fig: Connection of Ultrasonic Sensor with Arduino

- Dc Motor Driver and Bluetooth Module Connection Diagram

VCC pin of Bluetooth module is connected with Arduino 5V pin, GND pin is connected with Arduino GND pin, TX pin and RX pin is connected with Arduino 2 and 3 pin respectively. Next comes the connection of motor driver. There are two motors in each side. Positive terminals of right side motors is connected with OUT 2 pin, negative terminals of right side motor is connected with OUT1 pin. Similarly Positive terminals of left side motors is connected with OUT 3 pin, negative terminals of left side motor is connected with OUT 4 pin. Positive terminal of the battery is connected with motor driver 12V pin and negative terminal of the battery is connected with GND pin. Arduino Vin pin is connected with motor driver 5V pin.

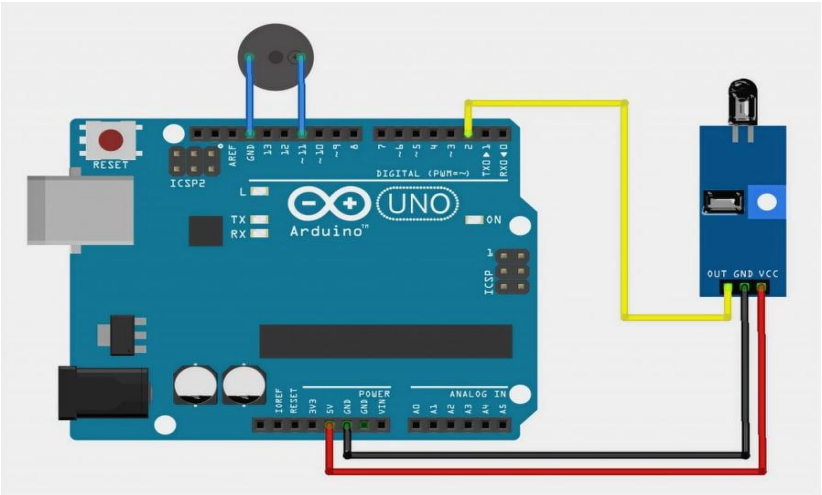


4.3Fig: Connection of Motor Driver and HC05 Bluetooth Module with Arduino

- Flame detection sensor and buzzer with Arduino

  The flame sensor detects the presence of fire or flame. It uses the infrared flame flash technique to detect fire.

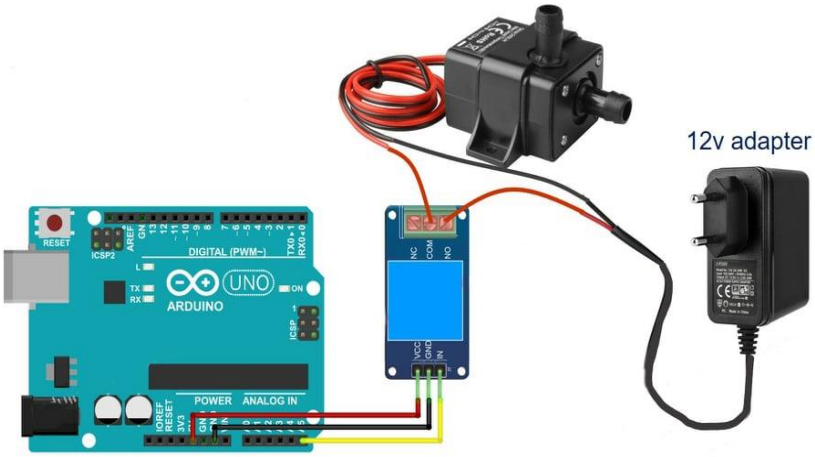
  To receive the signal sent from the flame sensor, signal pins of Arduino is used, we can use any signal pin of Arduino. The signal pin of flame sensor and positive pin of buzzer is connected with Arduino ground pins. The GND and VCC pin of flame sensor is connected to Arduino GND pin and 5v pin.



4.4Fig : Connection of flame detection sensor and buzzer with Arduino

- Relay module and Water pump with Arduino

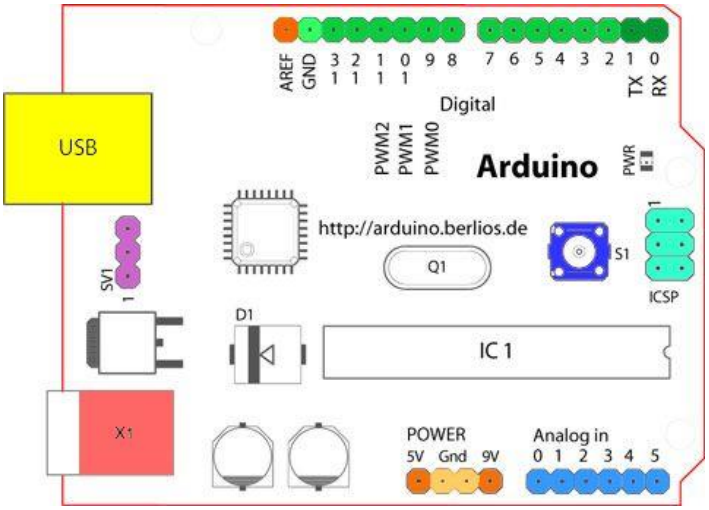
  The water pump needs extra power to work. So relay module is used to send signal to it via Arduino and external power source is used for the water pump. Relay module consists of 3 pins (GND,VCC,INPUT). GND and VCC pin is connected to Arduino GND and 5v pin and INPUT pin is connected to Arduino signal pins.



4.5Fig : Connection of relay module and water pump with Arduino

4.3 Introduction to Arduino UNO:

A powerful integrated development board known as Arduino is a popular, well known microcontroller all over the world. It is included with various types of electrics parts, analog and digital input pins.



4.6Fig: Outline of an Arduino Board

In Fig 4.4 normally used pins and components of an Arduino is marked with different colors. The orange pins indicates analog reference pins (5V,GND, 9V). The digital ground pins mark with light green(ICSP). Digital pins from 2-13 marked in green and digital pins 0-1 (TX/RX) marked in dark green. These two pins are transmit (TX) and receive(RX) TTL serial data. It is not possible to use these two pins as digital input and output. The dark blue color indicates reset button. Analog input pins (A0-A5) marked with sky blue. The pink color indicates external power supply input port. For uploading sketches to the Arduino board the USB port is used which is marked with yellow. Here is the classification of different pins of an Arduino:

I. Digital Pins
- RX, TX
- External interrupts: 2,3
- PWM: 3,5,6,9,10,11
- BT reset: 7
- SPI: 10-13
- LED: 13

II. Analog Pins
- I2C: 4,5

III. Power Pins
- Vin

- 5V
- 3V
- GND

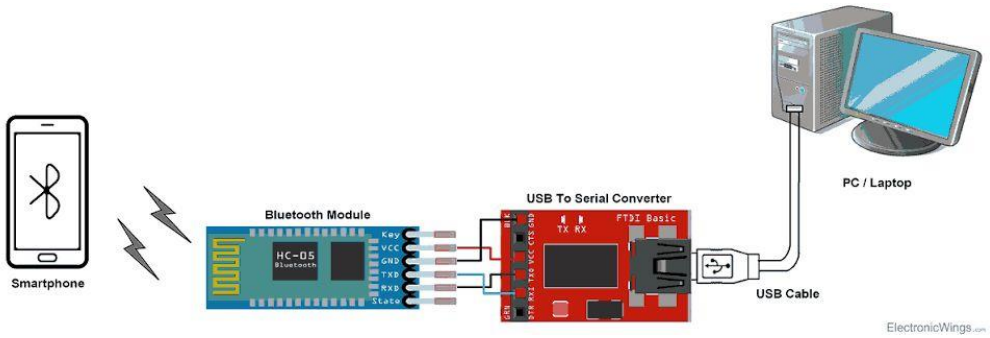
IV. Other Pins

- AREF
- Reset

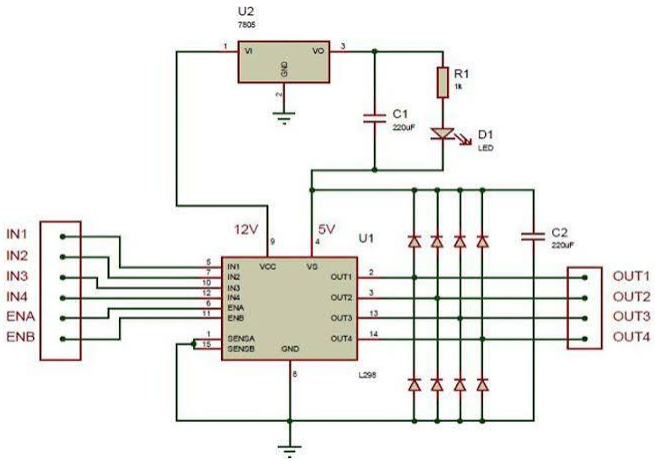
5.1 Explanation of Process:

We used 4 gear motors in this projects which helps the robot to move from one place to another. In each side there are 2 motors and they are connected in parallel with each other. And all the motors are connected to the output pins of DC motor driver. The ENA,ENB and input pins of motor driver is connected with Arduino digital input pins. Next comes the infrared sensor consisting of 3 pins which acts as a line detector in this projects. GND and VCC pins of each IR sensor is connected in parallel with each other and they are connected with Bluetooth modules VCC and GND pins respectively. And the output pins of the IR sensors is connected to Arduino analog pins. The sensors send data according to the color in front of it to the Arduino board and then the Arduino sends command to the motor drivers how to acts. The RX and TX pin of Bluetooth module is connected with Arduino digital input pins. The Bluetooth module receive data and transmit it to the Arduino via TX pin of the module.

4.7Fig: Infrared Sensor working principle



4.8Fig: HC05 Bluetooth Module Working Principle



4.9Fig: L298N Motor Driver Schematic

4.5 Summary:

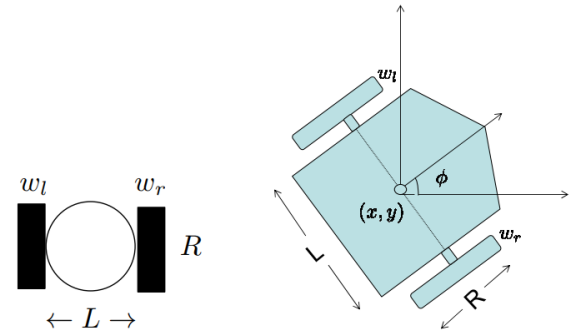
In this chapter 4, we briefly described about the circuit diagram. We split our circuit diagram into different section so that we can describe it easily. The first part was the infrared sensor diagram. Secondly we described ultrasonic sensor connection diagram. Then we describe about the Connection of flame detection sensor & buzzer with Arduino. Next we describe about the Connection of relay module and water pump with Arduino. The last part was the connection diagram of L298N Dc motor driver and HC05 Bluetooth module. Then we described details of each individual element like their specifications, features, how they work and so on (in chapter 3). In this chapter then we described the process of how each element work or text part in each action, their working principle, connection method. We went through all the important function, their implementation and how they work in which condition.

CHAPTER 5

Kinematics of the Robot

5.1 Kinematics

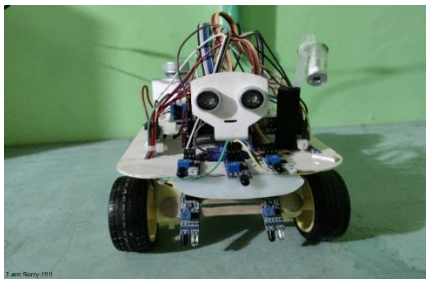
The structure of our project is a flat chassis where all the dc motors is placed below the chassis and all other equipment is placed on top of the chassis. The wheels are side mounted with the motor shaped in the left side and right side of chassis. It does not include any steering or breaking system. We can see this type of arrangement in wheel-chair, stretcher etc. If both side motors turn in clock wise, the robot moves forward and if the both side motors turn anti clock wise the robot moves backward.



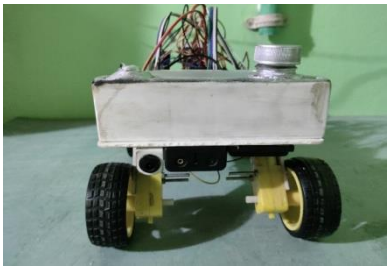
(a) Two Wheeled Robot (b) Simplified Model

5.1Fig: Mobile Robot Two Wheeled And Simplified Model

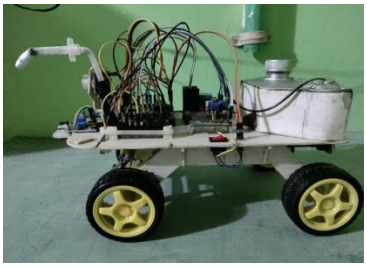
5.2 Mechanical Design



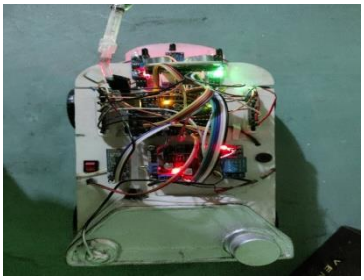
5.2Fig: Front View



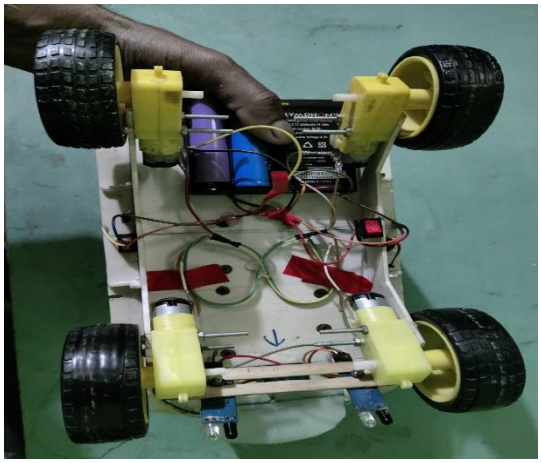
5.3Fig: Back View



5.4Fig: Left Side View



5.5Fig: Top View

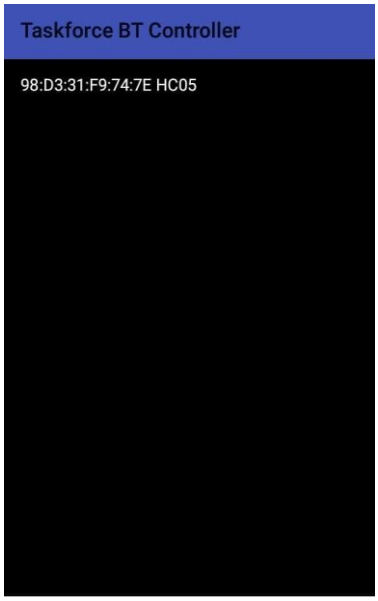


5.6Fig: Bottom View

5.7Fig: Right Side View

5.2 Application Interface

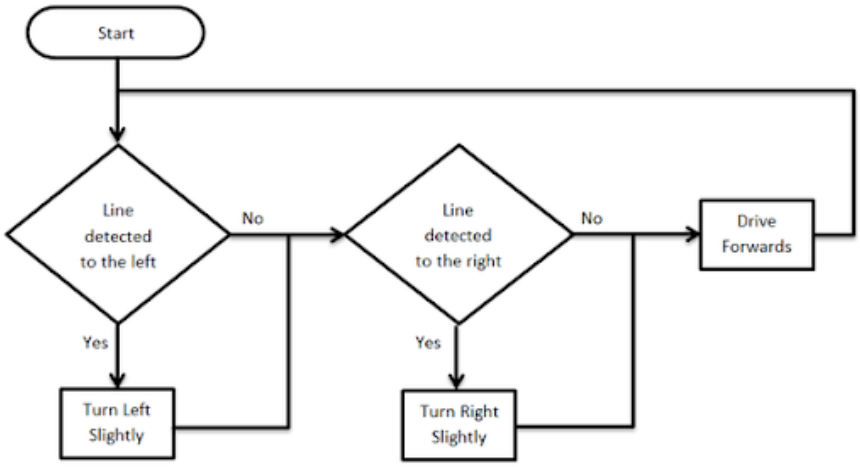
5.8Fig: App UI (Connected)



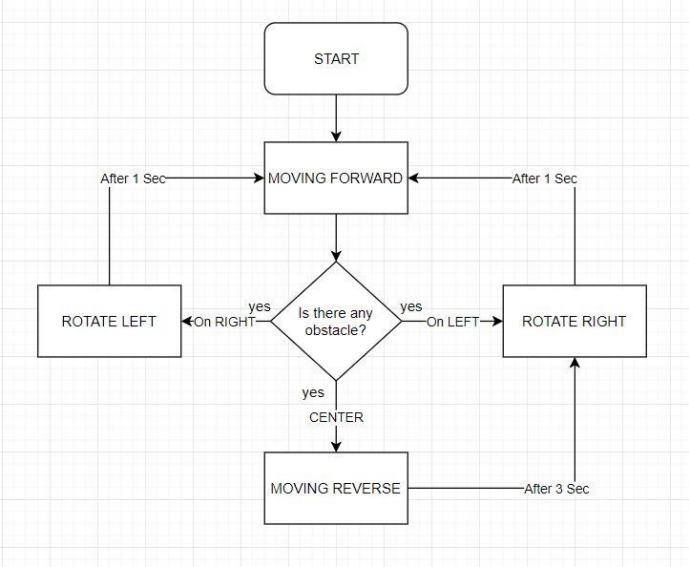
5.9Fig: Paired Device List

5.10Fig: App UI(Disconnected)

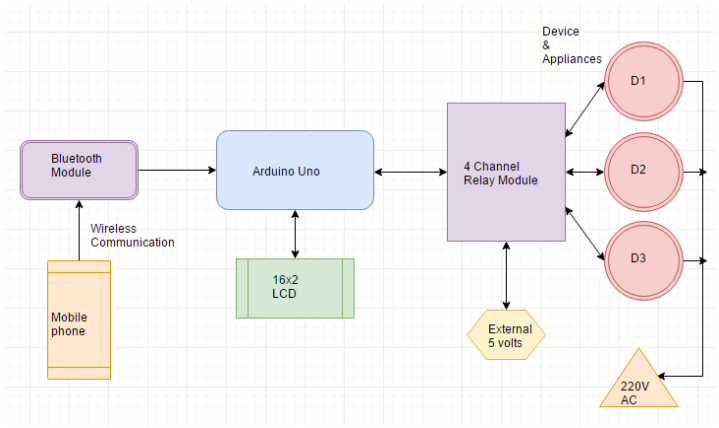
5.4 Block Diagram



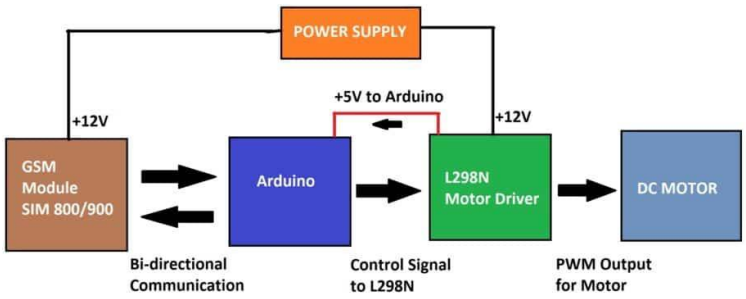
5.11Fig: Line following mode Block Diagram



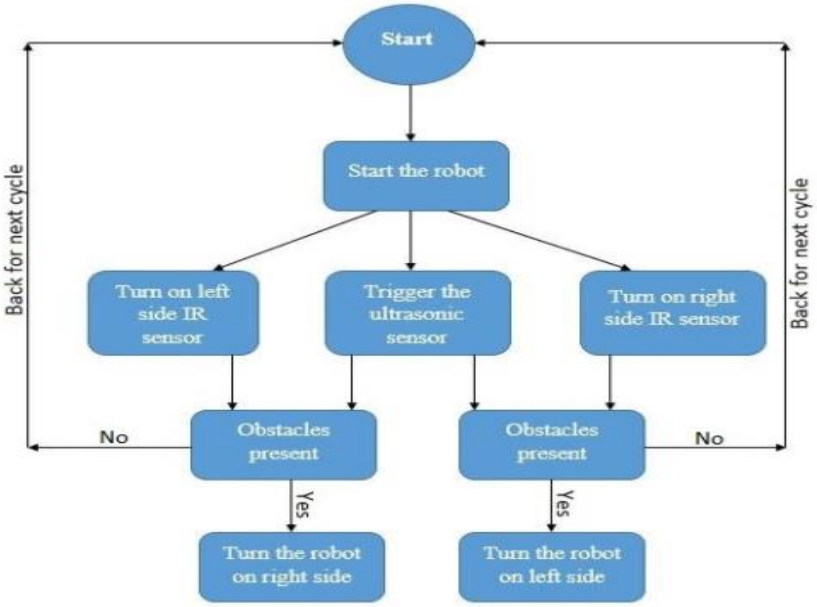
5.12Fig: Obstacle Avoiding Mode Block Diagram



5.13Fig: HC05 Bluetooth Connectivity Block Diagram



5.14Fig: L298N Driver Block Diagram



5.15Fig: Line following and Obstacle Detecting Block Diagram

5.5 Cost Estimation

Table 5.1: Total Cost Estimation

Equipment	**Quantity**	**Rate**	**Amount (BDT)**
Arduino UNO	1	600	600
L298N Motor Driver	1	150	150
HC05 Bluetooth Module	1	350	350
Infrared Sensor	4	90	360
Ultrasonic Sensor	1	110	110
Dc Gear Motor	4	80	320
Gear Motor Wheel	4	70	280
SG90 Servo Motor	1	230	230
Jumper Wire	2 set	90	180
Battery	2	150	300
On Off Switch	1	10	10
Buzzer	1	30	30
Fire detecting sensor	1	90	90
Water pump	1	160	160
Relay module	1	100	100
		Total	3270 BDT

CHAPTER 6

Conclusion

Conclusion:

Our Smart Robotic car has the ability to detect a line and follow along, detect object in its path and changed direction according to the detection, recognize voice command and the ability to be controlled manually. Our project report represent the full working process, mechanical design, circuit diagram, coding part and other necessary information needed for this project. The dimension of this project is 10*6.8*2.6 inch. First of all we thought about a robot that we should be able to control by our self and it should be equipped with multiple sensors to perform various tasks. Then we came up with this **Bluetooth Controlled Smart Robotic Car** idea. This robotic car represent the usage of IR sensor, Ultrasonic sensor based on line following and obstacle detection. It will always detect black line and white surface because of the IR sensor and we will also keep detecting objects in front of it because of the ultrasonic sensor. We created an android app to control the robot as most people now a day has a smart phone on their hand. So we thought it would be a great idea to make this robot controllable by using android app. The interface of this app is pretty simple and easy to understand. In addition we can apply more ideas to bring many more features in this project.

Future Work:

In the journey of this project we faced so many difficulties and also learnt something new.

This paper reveals the design of architecture and implementation of functional module in autonomous robotic car. Functional module are composed by intelligent obstacle avoiding using CNN and TEB, SLAM, lane detection and tracking, data fusion, data recording, command parsing, velocity control, and hardware design. This paper attaches much importance on proposing the architecture of autonomous car-like robot, features the fusion of all sorts of steering messages from different sensors, and fulfills all required

functions successfully, instead of focusing on theoretical mathematical formula or the optimization of specific algorithms.

In future works, priority will be given to enhancing the robustness and accuracy of functional modules by adding reinforcement learning. Here are some citable features we have a plan to implement later:

- Collision mitigation systems
- Parking sensors
- GPS- controlled tracking system
- Lane departure control
- Dynamic Headlights.

CHAPTER 7

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