POORNAPRAJNA COLLEGE (AUTONOMOUS)

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(Affiliated to Mangalore University)

Department of Physics

A project report on

BLUETOOTH CONTROLLED CAR USING ARDUINO UNO

Submitted in partial fulfilment for the award of Degree in

Bachelor of Science

Submitted by

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Register No: **U05PL21S0022**

Under the Guidance of

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Udupi – 576 101

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CERTIFICATE OF COMPLETION

This is to certify that the project titled "**BLUETOOTH CONTROLLED CAR USING ARDUINO UNO**" is a bonafide work carried out by **Mr. SAMARTH S SHETTY** for the partial fulfilment for the award of degree in Bachelor of Science, at Poornaprajna College (Autonomous), Udupi, during 2023-24.

Dr. Ramu L
Principal

Ms. Prathibha C Acharya
H.O.D.

DECLERATION

I hereby declare that the project titled, "BLUETOOTH CONTROLLED CAR USING ARDUINO UNO" has been conducted by me under the valuable guidance of **Dr. B. Lakshmeesha Rao**, Assistant Professor, Department of Physics, Poornaprajna College (Autonomous), Udupi. The report is being submitted for the partial fulfilment of Bachelor of Science Degree, of Poornaprajna College (Autonomous), Udupi. I also declare that this project topic of my study has not been previously studied or formed the basis for the reward of any Degree/Associateship/Fellowship or similar title in this College or in other University.

Place: Signature

Date: (Samarth S Shetty)

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GUIDE CERTIFICATE

This is to certify that the project work, entitled "BLUETOOTH CONTROLLED CAR USING ARDUINO UNO" is a bonafide work carried out by Mr. Samarth S Shetty (UUCMS No: U05PL21S0022), of Final year B.Sc., under my guidance and submitted to Department of Physics, Poornaprajna College (Autonomous), Udupi, during the year 2023-24, as partial fulfilment of requirement for the award of Bachelor of Science degree and it has not formed the basis for the award previously of any Degree, Diploma, Fellowship or any other similar titles.

Place:

Date: [Dr. B Lakshmeesha Rao]

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Introduction

The Bluetooth-controlled car project aims to modernize a traditional RC car by integrating Bluetooth technology, allowing it to be controlled via a smartphone. This transformation involves using an Arduino Uno microcontroller, Bluetooth module and a motor driver to facilitate the wireless communication and control of the car's movements. By utilizing Bluetooth, the project demonstrates how modern wireless communication can be applied to enhance the functionality and user experience of everyday devices.

Arduino is an open-source platform that is a combination of hardware and software. Arduino is easily accessible – even for those who do not know much about electronics. Arduino boards are simple a type of microcontroller. They can read inputs from the sensors and turn those inputs into output. The Arduino programming language is a modified version of C/C++ [1]

Bluetooth technology has become ubiquitous in wireless communication, offering a reliable and efficient means of connecting devices over short distances. It is widely used in various applications, including wireless headphones, keyboards, mice, and home automation systems. The key advantages of Bluetooth technology include low power consumption, ease of use, and widespread compatibility with numerous devices.

The current project is an attempt to build Bluetooth controlled car system with Arduino Uno card attached to the car (Toy Car) along with Bluetooth Module and Motor Driver. **Bluetooth module** is a set of integrated chips which can be used as wireless network transmission, basically wireless communication device. **Motor driver** is a device that act

as an interface between motor and microcontroller, allowing the microcontroller to control the motor's speed and direction. Since microcontrollers usually cannot supply the required current to drive a motor directly, a motor driver provides the necessary power amplification and control signals to operate the motor.

Through this project, we aim to bridge the gap between theoretical concepts and practical applications, showcasing the potential of Bluetooth technology in everyday devices.

Scope of the Study

The scope of the project has been listed below.

- Education: It's a valuable tool for teaching how mechanical instrument works using wireless connection and learn the programming of creating the app for running the car.
- Entertainment: Mobile control cars are popular as toys for children. They provide hours of fun and excitement, especially when racing or performing stunts. Instead of remote we can use mobile to control and which don't need to maintained separately since we use it daily basis.
- Exploration: Mobile control cars can be used explore the conditions in the disaster areas and give the related to their conditions
- Research: They can be used in research projects for data collection, experimentation, and testing in fields such as robotics, artificial intelligence, and autonomous vehicles.
- Prototyping: Mobile control cars serve as prototypes for larger-scale autonomous vehicles, drones, or robotic platforms, allowing engineers to test algorithms and functionalities in a smaller, more manageable form factor.
- Security: They can be equipped with cameras and sensors for surveillance purposes, monitoring areas remotely and providing real-time video feeds to operators. It can be used in military basis to spy the opponent camp and collect the information using camera.
- Delivery: They can be inserted with GPS and be used deliver the object from one place to another. Can be used transfer any packaging to the required place using map.

Overall, the Bluetooth controlled car technology has a wide range of uses, from educational tools and recreational toys to practical applications in research, exploration, and security.

Objectives

- **Remote Control Convenience:** Enable users to control the car remotely using a smartphone or tablet using Bluetooth technology, offering greater flexibility and convenience in operation.
- **Enhanced Interactivity:** Provide an interactive and engaging experience by incorporating features such as real-time telemetry data, customizable control options, and multiplayer capabilities using Bluetooth connectivity.
- **Educational Tool:** Serve as an educational tool for learning about electronics, programming, and robotics, allowing users to explore concepts such as wireless communication, sensor integration, and automation.
- **Customization and Personalization:** Allow users to customize and personalize their Bluetooth-controlled cars by adding additional sensors, lights, or accessories, and by programming unique functionalities using software development kits (SDKs) or open-source platforms.

Methodology

Building a Bluetooth-controlled car is a fun filled educational project. Here is a basic methodology to get started:

Equipment needed

1. RC Car
2. Arduino Uno R3
3. Bluetooth Module HC-05
4. Motor driver l298N
5. Jumper wire
6. Power supply

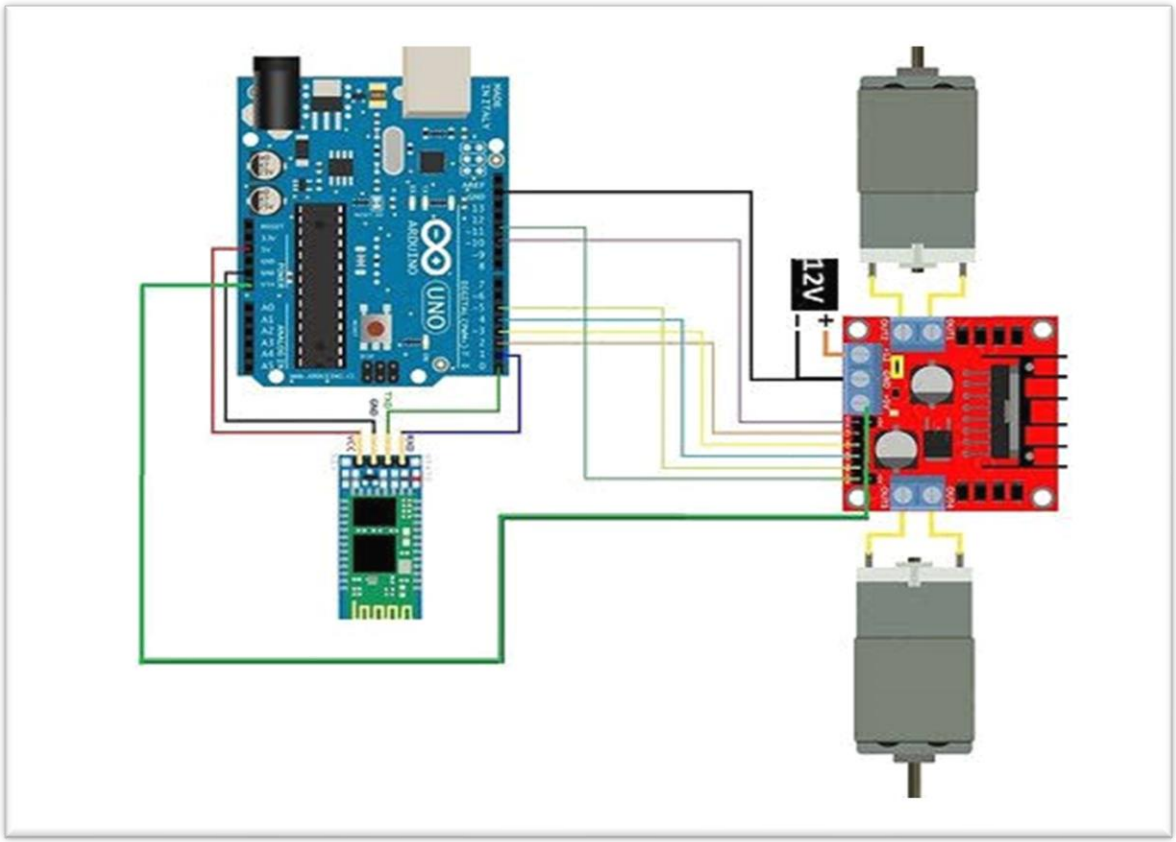


Figure 1. Schematic diagram of Bluetooth controlled car project

Design and Assemble

Arduino digital pins are connected to motor driver input in1, in2, in3, in4 (Figure 1). Motors are connected to output 1,2,3,4 and Bluetooth RX, TX, VCC, GND are connected to Arduino Uno TX, RX, +5V, GND respectively. Power supply is connected to +12v motor driver. Motor driver GND to power supply and Arduino Uno GND as shown in the above Figure 1. (Note: Power supply should not be more than 12v and less than 5.5v also digital pin connection can be changed with respect to code uploaded).

Arduino IDE is downloaded from official website of Arduino, after installing in the PC USB cable is connected to board and PC.

Programming

Open ARDUINO IDE application then type the code following necessary conditions. Verify/Compile and check the error (Figure 2). If error occurred rectify it.

Figure 2. Verifying and compiling the program

After compiling go to tools select board and choose Arduino board used also make sure port is selected. Then upload the code.

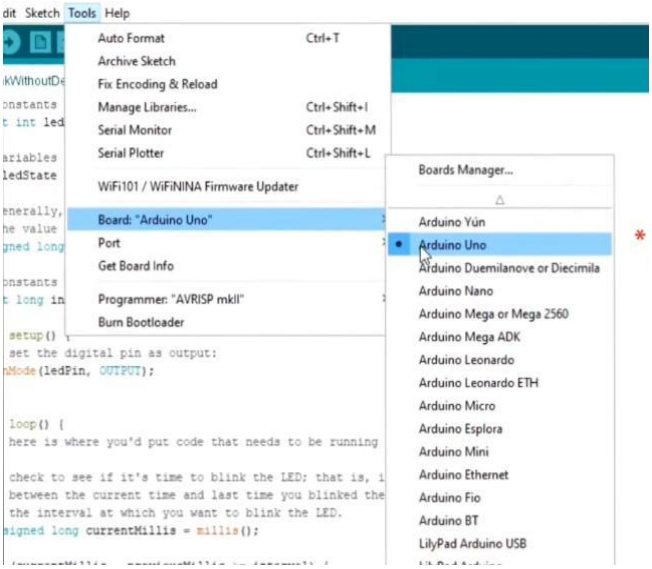


Figure 3. Selecting Arduino Uno board

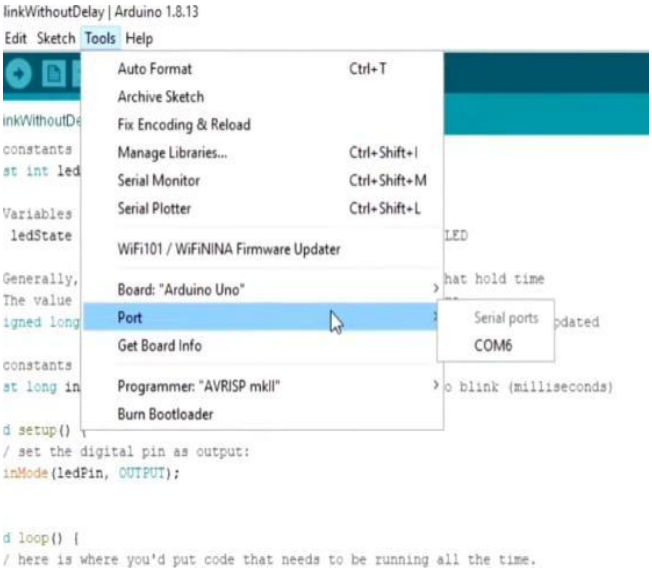


Figure 4. Selecting the port

The example code

Here is the example Code

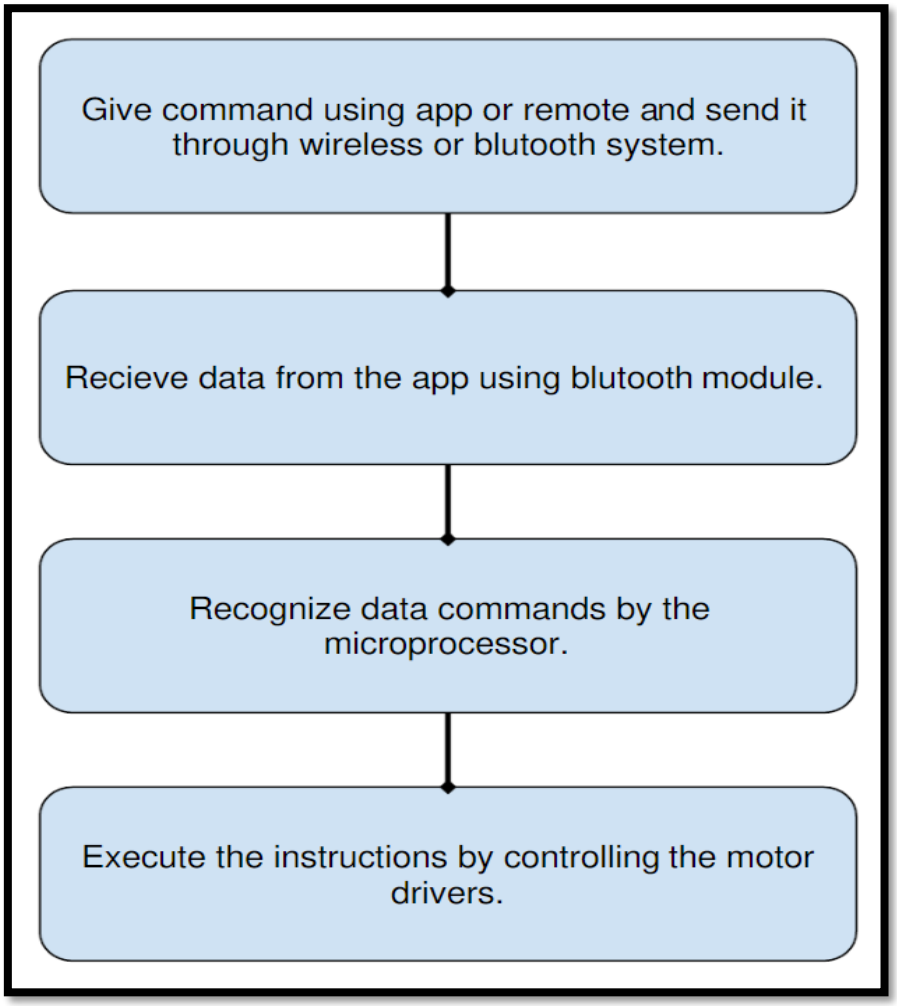
```
#include <SoftwareSerial.h>
// Motor control pins
```

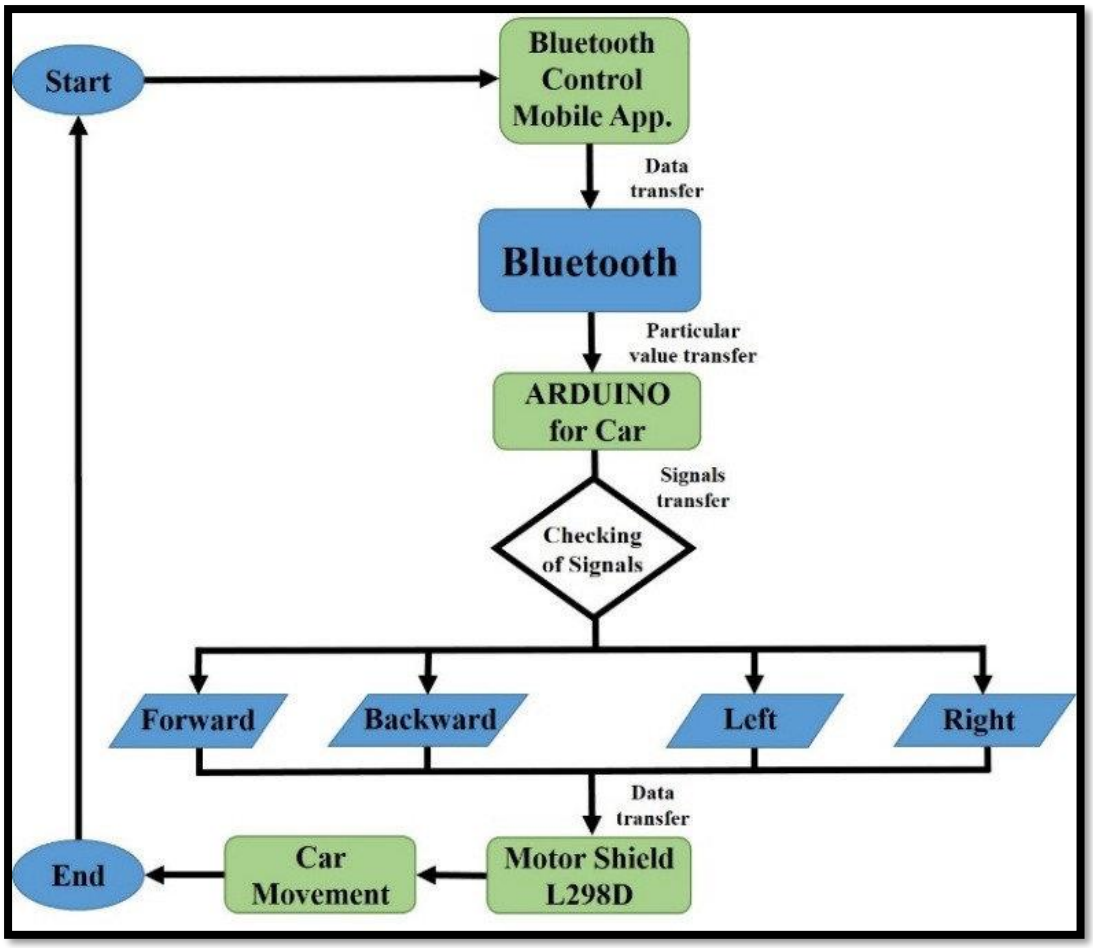
```
const int motor1Pin1 = 2;
const int motor1Pin2 = 3;
const int motor2Pin1 = 4;
const int motor2Pin2 = 5;
const int enable1Pin = 9;
const int enable2Pin = 10;                    // Bluetooth module pins
SoftwareSerial Bluetooth(10, 11);                    // RX, TX
void setup()                    // Set all the motor control pins to outputs
 {
  pinMode(motor1Pin1, OUTPUT);
  pinMode(motor1Pin2, OUTPUT);
  pinMode(motor2Pin1, OUTPUT);
  pinMode(motor2Pin2, OUTPUT);
  pinMode(enable1Pin, OUTPUT);
  pinMode(enable2Pin, OUTPUT);          // Set initial motor speed
  analogWrite(enable1Pin, 255);             // 100% speed
  analogWrite(enable2Pin, 255);            // 100% speed
  Serial.begin(9600);                      // Initialize serial communications
  Bluetooth.begin(9600);
}

void loop() {
  if (Bluetooth.available()) {
    char command = Bluetooth.read();
    controlCar(command);
  }
```

```
}
void controlCar(char command) {
  switch (command) {
    case 'F': // Move forward
      digitalWrite(motor1Pin1, HIGH);
      digitalWrite(motor1Pin2, LOW);
      digitalWrite(motor2Pin1, HIGH);
      digitalWrite(motor2Pin2, LOW);
      break;
    case 'B': // Move backward
      digitalWrite(motor1Pin1, LOW);
      digitalWrite(motor1Pin2, HIGH);
      digitalWrite(motor2Pin1, LOW);
      digitalWrite(motor2Pin2, HIGH);
      break;
    case 'L': // Turn left
      digitalWrite(motor1Pin1, LOW);
      digitalWrite(motor1Pin2, HIGH);
      digitalWrite(motor2Pin1, HIGH);
      digitalWrite(motor2Pin2, LOW);
      break;
    case 'R': // Turn right
      digitalWrite(motor1Pin1, HIGH);
      digitalWrite(motor1Pin2, LOW);
      digitalWrite(motor2Pin1, LOW);
      digitalWrite(motor2Pin2, HIGH);
```

```
      break;
    case 'S': // Stop
      digitalWrite(motor1Pin1, LOW);
      digitalWrite(motor1Pin2, LOW);
      digitalWrite(motor2Pin1, LOW);
      digitalWrite(motor2Pin2, LOW);
      break;  }
}
```

Flow of Chart of Implemention





Working

Step 1: Open Bluetooth RC controller apk

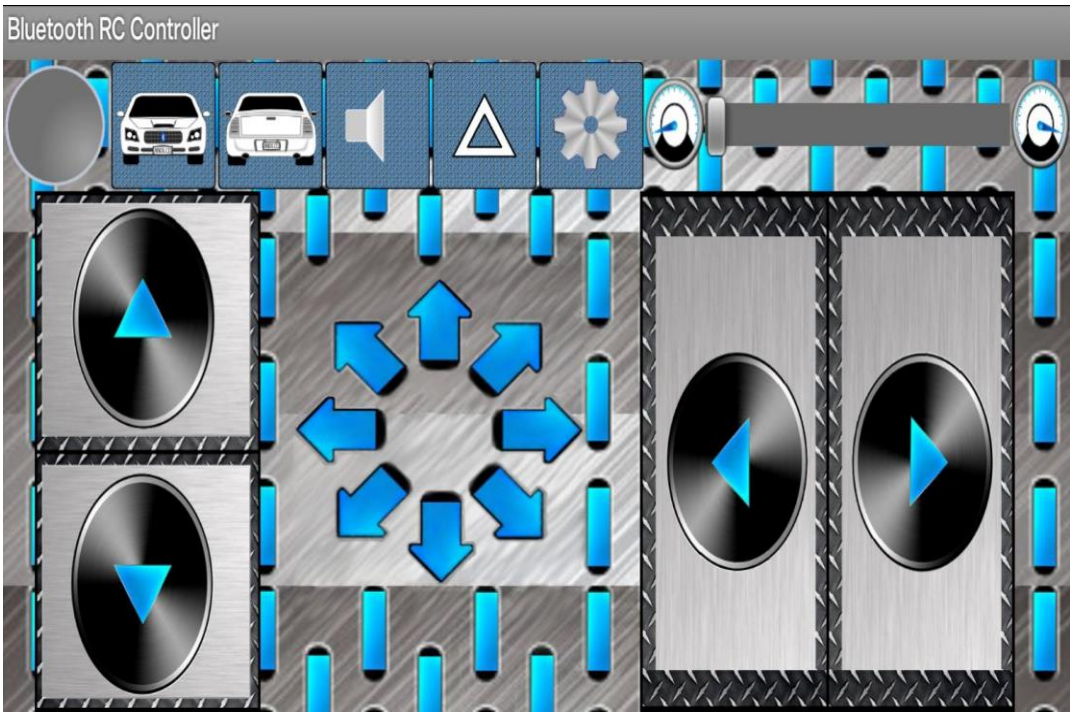


Figure 5. Bluetooth RC controller interface

Step 2: Open settings select connect to car.

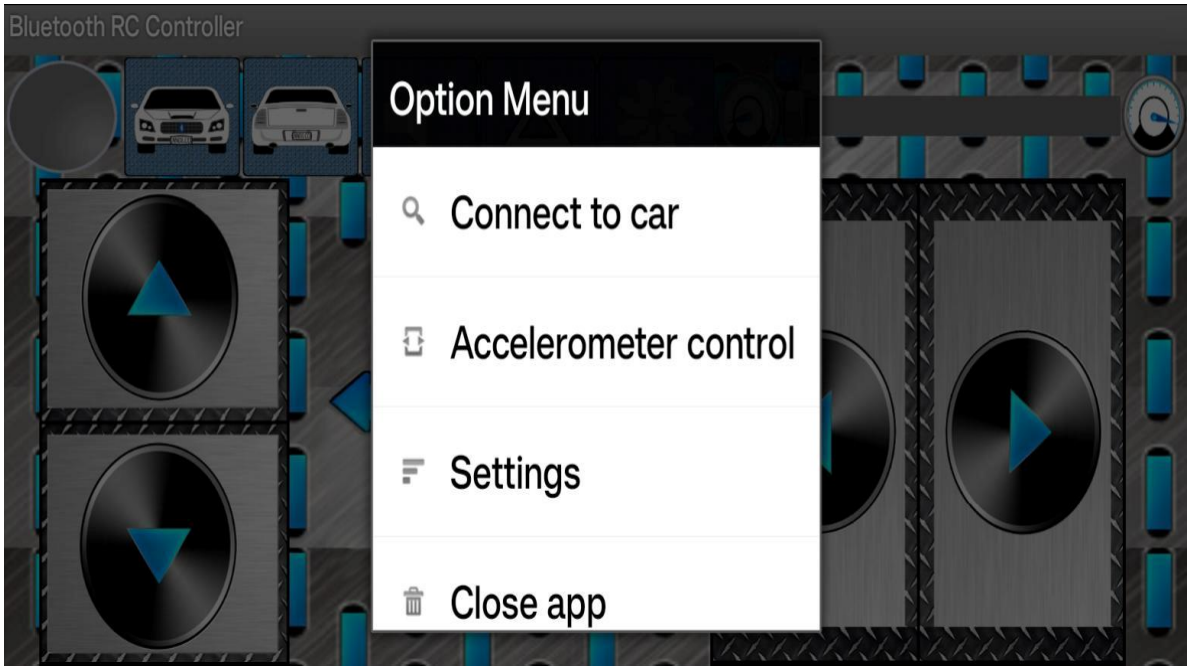


Figure 6. Bluetooth RC interface Menu Option

Step 3: scan for device and select HC-05 module

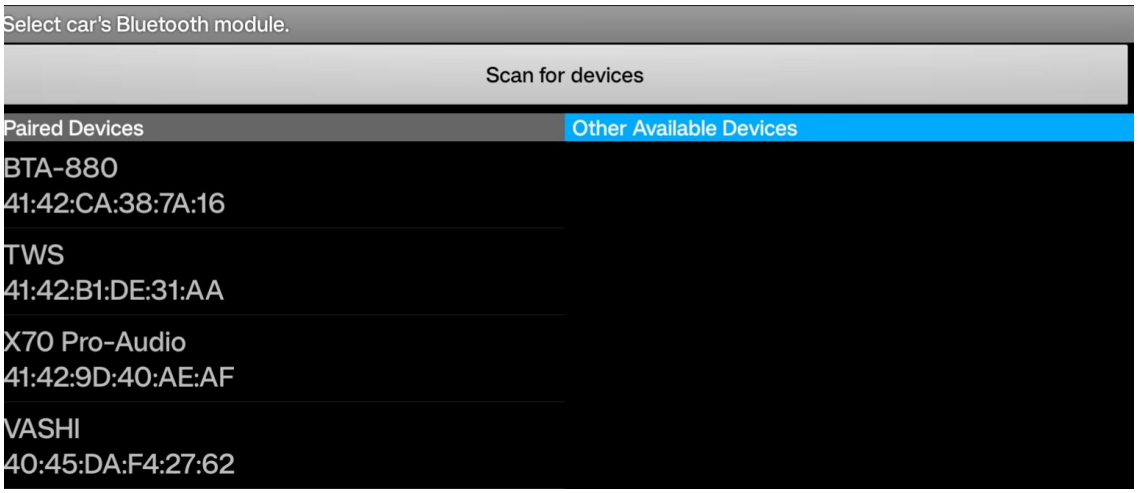


Figure 7. Selecting HC-05 module

Step 4: Use navigation buttons to move the car

Analysis and Interpretation

Hardware Components

ARDUINO UNO R3

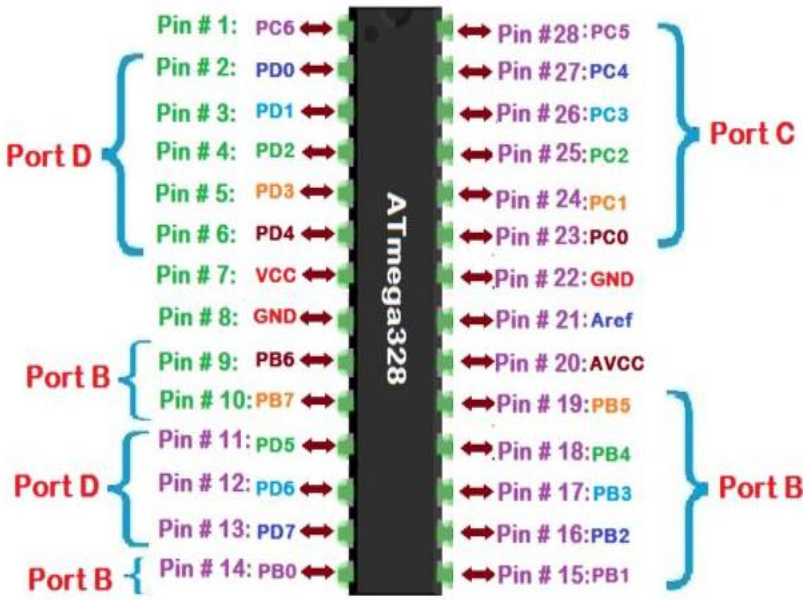


Figure 7. Atmega328 microcontroller

It acts as the brain of the car, processing input signals from the Bluetooth module and controlling the motor driver accordingly. IC ATmega328 microcontroller is used & one of the most popular IC. This IC has 28 pin configuration. IC programming memory size is 32KB. Operating voltage is 1.8v-5.5V, it has two internal oscillators, one clocked at 8MHz and one at 128kHz. By default, the fuses of the ATmega328p are configured that the internal 8MHz oscillator can be used.

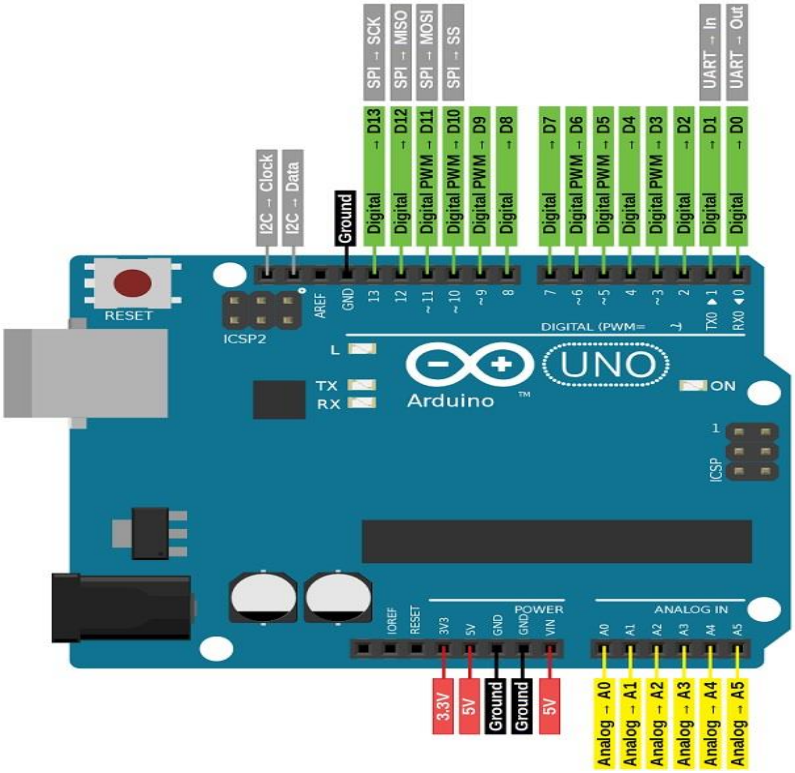


Figure 8. Arduino UNO board

There are total of 14 digital pins, in that pin 0 and 1 are used for serial Communications for programming and debugging the Arduino (Figure 8). Digital pin 3,5,6,9,10,11 are PWM (pulse width modulation), it is identified as symbol '~'. This pin of the board is used to convert the digital signal into an analog by varying the width of the Pulse. Pin 10,11,12,13 are used for SPI communication. Pin A0, A1, A2, A3, A4, A5 are analog pins which are used as analog input.

Bluetooth module

Bluetooth serial modules allow all serial enabled devices to communicate with each other using Bluetooth (Figure 9).

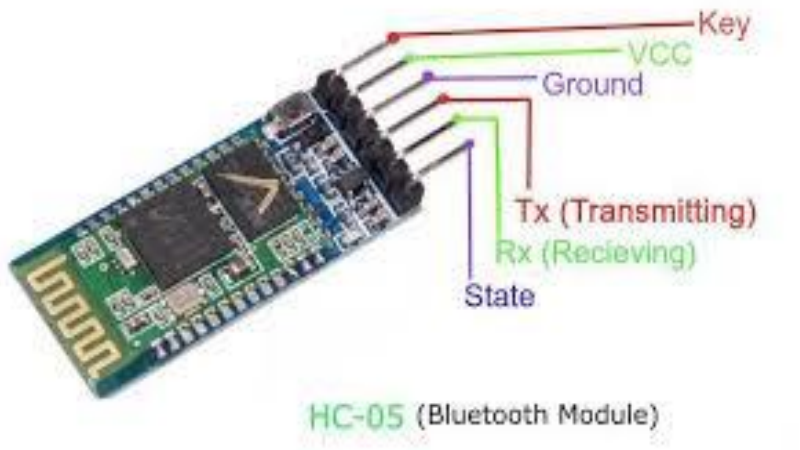


Figure 9. Bluetooth Module (HC-05)

It has 6 pins,

1. **Key/EN:** It is used to bring Bluetooth module in AT commands mode. If Key/EN pin is set to high, then this module will work in command mode. Otherwise by default it is in data mode. The default baud rate of HC-05 in command mode is 38400bps and 9600 in data mode.

HC-05 module has two modes,

i. **Data mode:** Exchange of data between devices.

ii. **Command mode:** It uses AT commands which are used to change setting of HC-05. To send these commands to module serial (USART) port is used.

a) **VCC**: Connect 5 V or 3.3 V to this Pin.

b) **GND:** Ground Pin of module.

c) **TXD:** Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)

d) **RXD:** Receive data serially (received data will be transmitted wirelessly by Bluetooth module).

e) **State:** It tells whether module is connected or not.

HC-05 module Information

- HC-05 has **red LED** which indicates **connection status**, whether the Bluetooth is connected or not. Before connecting to HC-05 module this red LED blinks continuously in a periodic manner. When it gets connected to any other Bluetooth device, its blinking slows down to two seconds.
- This module **works on 3.3V**. We can connect 5V supply voltage as well since the module has on board 5 to 3.3 V regulator.
- As HC-05 Bluetooth module has **3.3V level for RX/TX** and microcontroller can detect 3.3 V level, so, no need to shift transmit level of HC-05 module. But we need to shift the transmit voltage level from microcontroller to RX of HC-05 module.
- The data transfer rate of HC-05 module can vary up to **1Mbps** is in the **range of 10 meters**.[2]

Motor Driver

Figure 10. L298N is a dual H-Bridge motor driver

The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time (Figure 10).

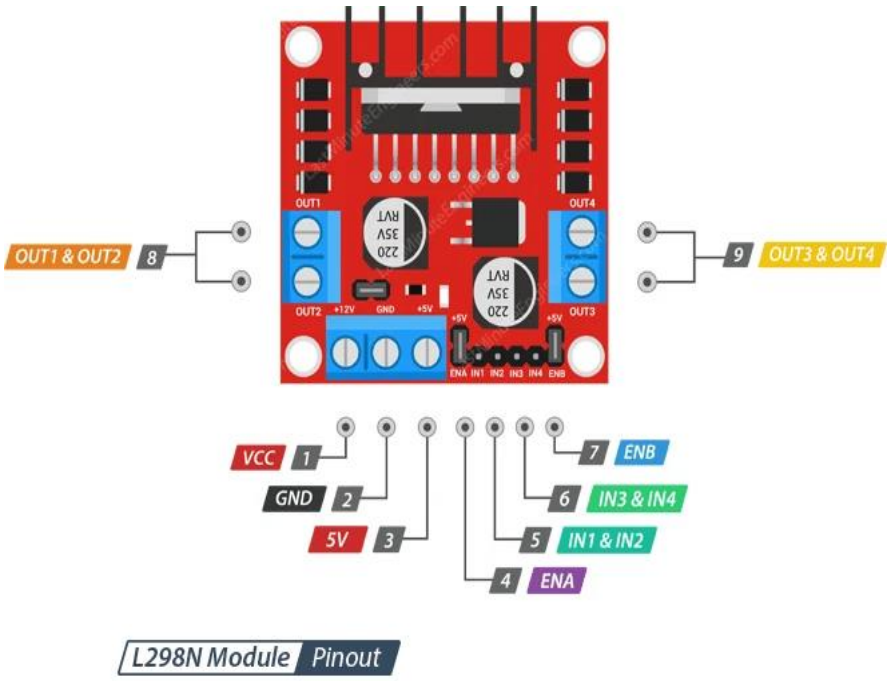


Figure 10. Pin Configuration of L298N Motor Driver

L298N motor driver has 4 input pins, ENA, ENB pins, VCC(+12v), GND, 5V (out) (Figure 11). Input 1,2,3,4 works when it receives signal from microcontroller. Input **IN1, IN2, IN3, and IN4** pins control the **switches** of the H-Bridge circuit inside L298N IC.

Working of L298N Motor Driver

Case 1

When S1, S2, S3, and S4 all switches are open then no current goes to the Motor terminals. So, in this condition, the motor is stopped (not working), which is illustrated in Figure 11.

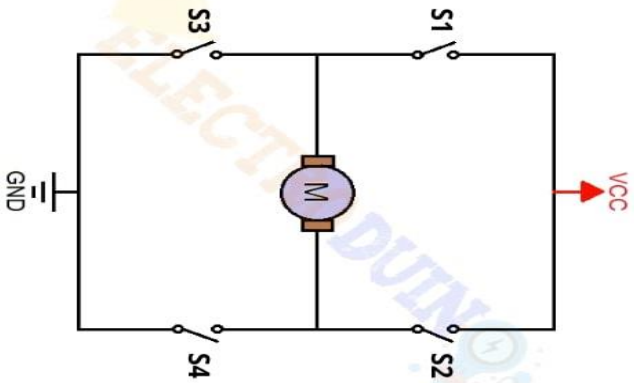


Figure 11. L298N Motor Driver Module Working of H-Bridge Case 1

Case 2

When the switch S1 and S4 are closed, then the motor left terminal is getting a positive (+) voltage and the motor right terminal is getting a negative (-) voltage. So, in this condition motor start rotating in a particular direction (clockwise), which is illustrated in Figure 12.

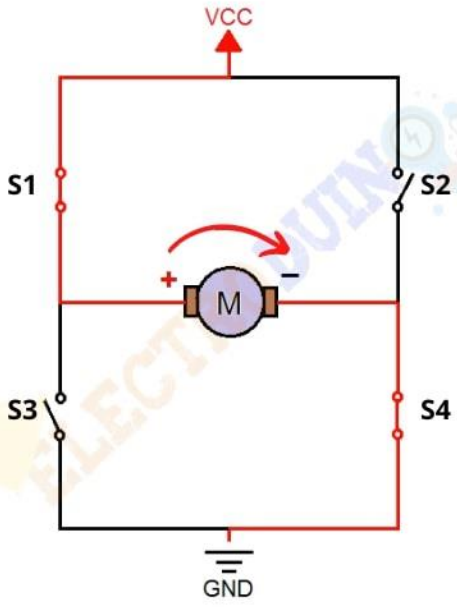


Figure 12. L298N Motor Driver Module Working of H-Bridge Case

Case 3

When S2 and S3 switches are closed, then the right motor terminal is getting a positive (+) voltage and the left motor terminal is getting a negative (-) voltage. So, in this condition motor start rotating in a particular direction (anticlockwise), which is illustrated in Figure 13.

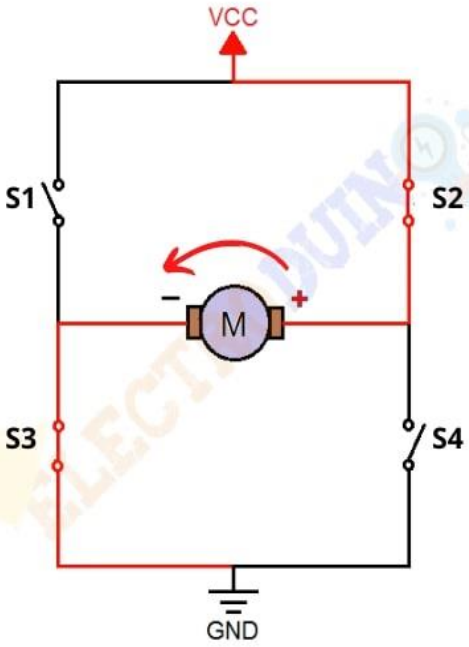


Figure 13. L298N Motor Driver Module Working of H-Bridge Case 3[3].

DC Motor

Figure 14. DC motor for RC car

It is a device which convert electric energy into mechanical energy. It works on principle of Lorentz Law, which states that "the current carrying conductor placed in a magnetic and electric field experience a force". The speed and direction of rotation can be controlled by applying suitable voltage and current to this device (Figure 14).

Power Supply

It is the device which provide power to the Microcontroller, Motor driver and Bluetooth module (Figure 15).

Figure 15. DC 6V power supply

Jumper Wire

Wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering.

Types

a) Male to Male jumper
b) Male to Female jumper
c) Female to Female jumper

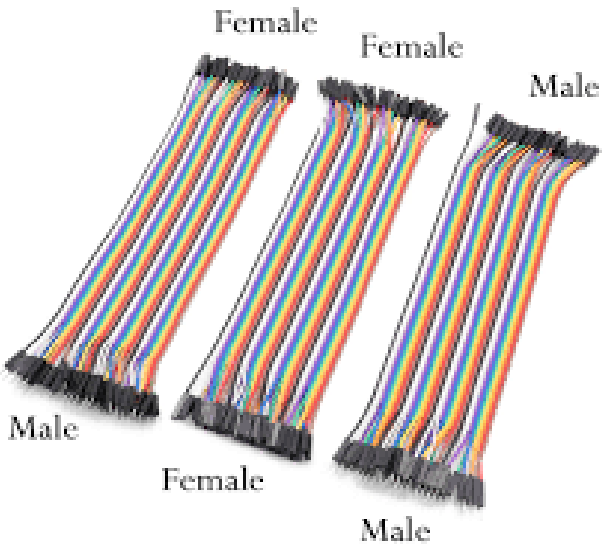


Figure 16. Different types if Jumper wires

Software Components

Arduino IDE

Integrated development environment (IDE) is software for building applications that combines common developer tools into a single graphical user interface. Its official website is https://www.arduino.cc/en/software ,using this we can download application which is necessary to upload the code to Arduino.

Bluetooth RC controller

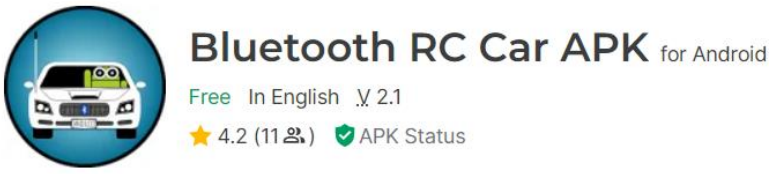


Figure 17. Screen shot of Bluetooth RC car Application

The application is used for controlling is **BLUETOOTH RC CAR APK** (Figure 17). It is available in Android Playstore.

Arduino Code

The code is written in a simple programming language similar to C and C++.The initial step to start with Arduino is the IDE download and installation.

- The Arduino code listens for incoming serial data from the Bluetooth module.
- Depending on the command received (e.g., 'F' for forward, 'B' for backward, 'L' for left, 'R' for right), the Arduino sends signals to the motor driver.
- The motor driver then controls the DC motors to move the car in the desired direction.

The programmed Arduino Uno board with Bluetooth module is installed in a RC car. The Motor driver L298N was attached to the output of Uno board and motors are connected to the drivers. When operated through Mobile phone through Bluetooth RC Car application, the RC car moved as per the command. The speed and the course of the movement can be controlled using Bluetooth RC car mobile application.

Conclusion

By understanding the components, communication protocols, control logic, and implementation steps, the Bluetooth controlled car is built effectively build and analysed. Mobile control of a car is technically feasible with the right hardware and software integration. Overall, users find the mobile control interface intuitive and enjoyable. The car demonstrates satisfactory speed, accuracy, and reliability in responding to mobile commands. Proper security measures are implemented to prevent unauthorized access to the car's control system. The mobile control system is optimized for energy efficiency to extend battery life.

Challenges and Considerations of this project are Bluetooth range is typically up to 10 meters. Interference from other devices can affect performance. Ensure the battery pack provides adequate power for the entire system. Minimal latency is essential for real-time control, which depends on the quality of the Bluetooth module and the efficiency of the code.

It can be suggested that the continuous improvement the mobile control app for better user experience, such as adding more features or refining the layout, integrating additional features like obstacle avoidance, camera streaming, or autonomous navigation to make the car more versatile. The fine-tune the control algorithm to further improve the car's responsiveness and agility. The security protocols and encryption methods could be regularly updated to safeguard against potential cyber threats. The latest technologies involving robotics can be integrated for the desired robust RC vehicle.

Learning Outcomes

- Programming Skills: Participants can learn programming language such as Arduino to control the car's movements, sensors, and communication with the mobile device.
- Electronics: Understanding electronic components like motors, sensors, and microcontrollers, as well as how to wire and integrate them into a functional system.
- Mechanical Design: Designing and building the physical structure of the car, including chassis, wheels, and any moving parts.
- Problem-Solving: Troubleshooting and debugging issues that arise during the construction and operation of the car.
- Teamwork: Collaborating with others on the project, assigning tasks, and working together towards a common goal.
- Creativity: Encouraging participants to come up with unique features or modifications to personalize their mobile-controlled car.
- Understanding of Control Systems: Learning about control algorithms and methods to improve the car's performance and responsiveness to commands.
- Project Management: Planning and organizing the project timeline, resources, and milestones to ensure timely completion.
- Overall, projects like these can provide a hands-on learning experience that combines elements of engineering, programming, and problem-solving.

References

1. Arduino Programming: A Step-By-Step Guide for Beginners from Create&Learn.
2. Bluetooth Module HC-05 Pinout, AT Commands & Arduino Programming from Electronicwings
3. Arduino Serial |Serial.begin() Serial Communication from Javapoint

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