**Bluetooth-Controlled Car**

**Introduction**

This project showcases the creation of a Bluetooth-controlled car using the HC-06 Bluetooth module, Arduino UNO, and a smartphone app. The Bluetooth car responds to user commands sent wirelessly through a mobile app, enabling it to move forward, backward, left, right, or stop. This hands-on project emphasizes the integration of hardware and software to build an interactive and functional robotic system.

**Objective**

The objectives of this project are:

1. Understand the principles of Bluetooth communication and its application in robotics.
2. Design and build a Bluetooth-controlled car.
3. Learn to control the car using a smartphone app.
4. Develop skills in coding, wiring, and troubleshooting.
5. Explore future possibilities for enhancing robotic projects with additional functionalities.

**Components Required**

**Component List:**

* **HC-06 Bluetooth Module**: Facilitates wireless communication.
* **Arduino UNO**: Acts as the brain of the car, processing commands and controlling motors.
* **Motor Driver (L298N)**: Drives the motors and enables movement.
* **Chassis with Wheels**: Serves as the car’s frame and support for components.
* **Jumper Wires**: Ensures secure and accurate connections.
* **Smartphone with App**: Sends commands to control the car.
* **Battery Pack**: Supplies power to the system.

**Design Overview**

**How It Works**:

* The user sends commands (F for forward, B for backward) from the mobile app.
* The HC-06 Bluetooth module receives these commands and transmits them to the Arduino UNO.
* Based on the received commands, the Arduino processes the data and sends control signals to the motor driver, which drives the car.

**System Flowchart**:

* **Input**: Commands from the smartphone app.
* **Processing**: Arduino processes the commands.
* **Output**: Commands control the car’s motors via the motor driver.

**Wiring Diagram**: The wiring connects the HC-06 module, motor driver, and Arduino, enabling communication and motor control.

**Understanding the HC-06 Bluetooth Module**

The HC-06 Bluetooth module is a serial communication device designed for ease of integration with Arduino and similar platforms. Its compact design and straightforward interface make it suitable for projects requiring wireless data transmission. Key features include:

* Bluetooth V2.0+EDR compatibility for enhanced speed and reliability.
* Adaptive Frequency Hopping (AFH) to minimize interference.
* A default baud rate of 9600 bps, ensuring compatibility with most systems.
* Simple four-pin connection: **VCC**, **GND**, **TXD**, and **RXD**.

A close-up of a circuit board

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**Wiring and Setup**

Assembly Process:

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1. **Prepare the Components**:
   * Ensure all components are functional and readily available.
2. **Assemble the Chassis**:
   * Attach motors, wheels, and other components to the chassis securely.
3. **Connect the Bluetooth Module**:
   * **VCC** → Arduino **5V**
   * **GND** → Arduino **GND**
   * **TXD** → Arduino **RX**
   * **RXD** → Arduino **TX**
4. **Wire the Motor Driver**:
   * Connect the motor driver’s inputs to the Arduino and outputs to the motors.
5. **Test All Connections**:
   * Double-check connections to ensure accuracy and prevent errors.

**Connections image**

A diagram of a circuit board

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**Arduino Code**

The Arduino code for the Bluetooth-controlled car enables wireless communication with a smartphone via the HC-06 module, translating received commands into motor actions for forward, backward, left, right, stop, and pause movements. The setup function initializes the serial communication and configures motor control pins, while the loop function constantly checks for incoming Bluetooth commands. These commands are processed by the **executeCommand()** function, which maps each input to specific motor control functions, such as advance() for moving forward or **turnL()** for turning left. The code also incorporates speed control using PWM signals, allowing for adjustments through the **Set\_Speed()** function. The stop functionality ensures safe operation by halting all motors when triggered. This modular design allows for easy customization, enabling additional features like obstacle avoidance, dynamic speed control, or even LED integration for headlights, making it a versatile foundation for further robotics projects.

**Steps to Upload Code**:

1. Disconnect the HC-06 module from the Arduino board.
2. Upload the code using the Arduino IDE.
3. Reconnect the Bluetooth module after successful upload.

**GitHub Repository**:  
<https://github.com/Enmanuel1700/Bluetooth-Controlled-Car.git>

**Mobile App Usage**

Downloading the mobile app allows users to control the robot car's movements and modes.

**Steps to Use the App**:

1. Pair your smartphone with the HC-06 module:
   * Enable Bluetooth on your phone.
   * Search for available devices and select **HC-06**.
   * Enter the passcode: **1234**.
2. Open the app and connect to the HC-06 module.
3. Use the app interface to send commands to the robot car.

**Note**: The LED on the HC-06 module will blink when not connected and remain steady when paired successfully.

**Troubleshooting**

1. **Connection Issues**:
   * Ensure correct wiring and stable power supply.
   * Re-pair the Bluetooth module if necessary.
2. **Upload Errors**:
   * Disconnect the HC-06 module during the code upload process.
3. **Data Transmission Errors**:
   * Verify that the baud rate matches the module's default setting.
   * Check for loose connections or incorrect wiring.

**Learning Outcomes**

By completing this lesson, users gain valuable knowledge and skills, including:

* Understanding the integration of Bluetooth modules with Arduino.
* Practical experience in wiring, coding, and troubleshooting Bluetooth systems.
* Using mobile apps for wireless control of robotics systems.
* Debugging and resolving common errors in serial communication setups.

**Extensions and Advanced Applications**

This lesson opens the door to advanced robotics projects, such as:

* Developing a custom mobile app for enhanced control.
* Adding real-time data logging to monitor sensor readings.
* Combining the Bluetooth module with sensors like ultrasonic or IR for complex behaviors like obstacle avoidance or line tracking.

**Conclusion**

This project highlights the power of Bluetooth communication in robotics, combining practical skills and creative thinking. By successfully building and controlling a robot car, users develop foundational knowledge for more complex IoT and robotics projects. Customizing the robot car with additional features opens new doors for innovation and learning.

**The image of the robot are below.**

A small robot with wheels and wires

Description automatically generatedA small toy car with wheels and wires

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