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Bluetooth Module Car Using Arduino Uno

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Abstract

This paper presents the design and implementation of a Bluetooth-controlled car using Arduino Uno. The project leverages Bluetooth technology to enable wireless communication between a smartphone and the robotic car, allowing remote control via a dedicated mobile application. The system integrates an Arduino Uno microcontroller, an HC-05 Bluetooth module, an L293D motor driver, and DC motors to achieve precise movement control. The project demonstrates the feasibility of low-cost, user-friendly remote-controlled robotics, with applications in education, automation, and IOT. Experimental results confirm the system's reliability, with a control range of up to 10 meters and minimal latency. Future enhancements, such as obstacle avoidance and extended range, are also discussed.

Keywords: Arduino Uno, Bluetooth module, HC-05, L293D, remote-controlled car, robotics.

1. Introduction

The rapid advancement in wireless communication technologies has revolutionized remote-controlled systems, particularly in robotics. Bluetooth technology, due to its low power consumption and ease of integration, has become a popular choice for short-range wireless control [1]. This project explores the development of a Bluetooth-controlled car using Arduino Uno, offering a cost-effective and scalable solution for educational and industrial applications.

The primary objective of this work is to design a robotic car that can be controlled wirelessly via a smartphone. The system employs an Arduino Uno as the central processing unit, an HC-05 Bluetooth module for communication, and an L293D motor driver to regulate DC motors. The project highlights the integration of hardware and software components to achieve seamless control, providing a foundation for more advanced robotic systems.

2. Project Details.

2.1 System Overview

The Bluetooth-controlled car consists of the following key components:

- **Arduino Uno**: Acts as the brain of the system, processing commands from the smartphone.
- **HC-05 Bluetooth Module**: Facilitates wireless communication between the smartphone and Arduino.
- **L293D Motor Driver**: Amplifies control signals to drive the DC motors.
- **DC Motors**: Provide motion to the car's wheels.
- **Power Supply**: Two 9V batteries are used—one for the Arduino and another for the motor driver and motors.

2.2 Flow Chart

The system operation follows a structured flow:

1. Power supply initialization.
2. Bluetooth pairing between the smartphone and HC-05 module.
3. Command transmission from the smartphone app.
4. Arduino processes the commands and sends signals to the motor driver.
5. Motors execute the desired movement (forward, backward, left, or right).

3. Working Principle

3.1 Bluetooth Communication

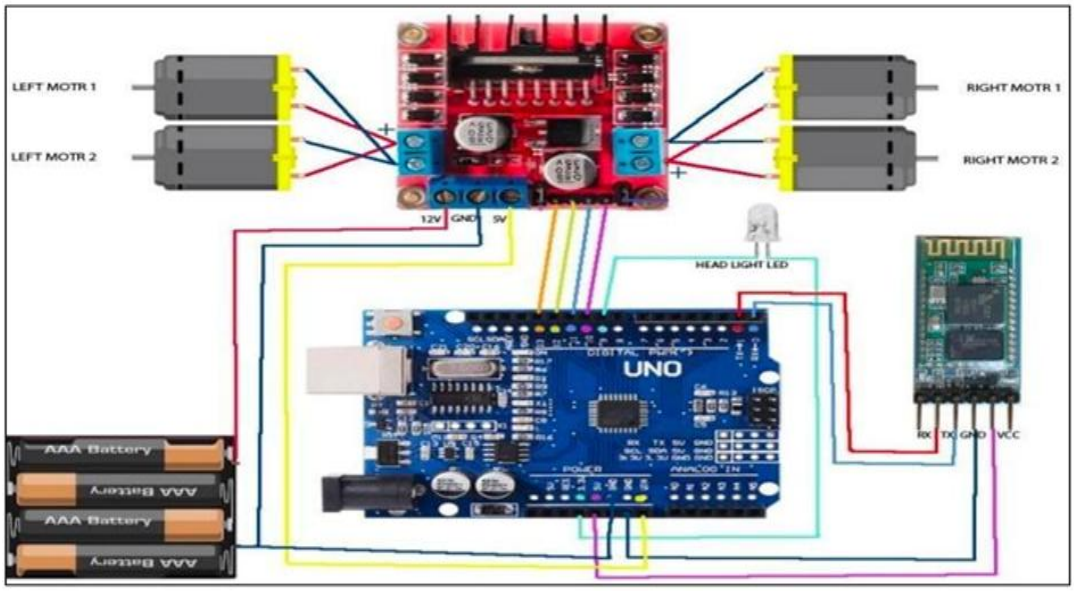
The HC-05 module receives commands from the smartphone app and transmits them as serial data to the Arduino. The Arduino decodes these commands (e.g., 'F' for forward, 'B' for backward) and generates corresponding PWM signals for the motor driver.

3.2 Motor Control

The L293D motor driver receives signals from the Arduino and drives the DC motors accordingly:

- **Forward/Backward**: Both motors rotate in the same direction.
- **Left/Right**: Differential motor speeds enable turning.

3.3 Circuit Diagram The given Circuit shows:



- Arduino pins connected to the L293D input pins.
- Motor outputs linked to the DC motors.
- Bluetooth module interfaced with Arduino's serial pins (RX/TX).

4. Hardware and Software Components

4.1 Arduino Uno

- Microcontroller: ATmega328P.
- Digital I/O Pins: 14 (6 PWM-capable).
- Analog Inputs: 6.
- Operating Voltage: 5V.

4.2 L293D Motor Driver

- Dual H-bridge design for bidirectional motor control.
- Voltage Range: 5V–35V.

- Maximum Current: 600mA per channel.

4.3 HC-05 Bluetooth Module

- Operating Voltage: 3.3V–5V.
- Range: ~10 meters.
- Frequency: 2.4GHz.

4.4 Software

- **Arduino IDE**: Used for programming the microcontroller.
- **Bluetooth RC Car App**: Provides an intuitive interface for control

4.5 Code Implementation

The Arduino sketch (provided in the PDF) uses serial communication to interpret Bluetooth commands and control the motors. Key functions include:

- `digitalWrite()` to set motor directions.
- `Serial.read()` to receive Bluetooth data.

5. Results and Discussion

5.1 Performance Evaluation

- **Response Time**: Commands executed with minimal latency.
- **Range**: Effective control within 10 meters.
- **User Interface**: The app's simple design ensured ease of use.

5.2 Challenges

- **Power Management**: Optimized by using separate batteries for the Arduino and motors.
- **Bluetooth Stability**: Addressed through code optimizations.

5.3 Educational and Practical Applications

- **Education**: Demonstrates embedded systems and wireless communication.
- **Industrial**: Potential for automated material transport.

6. Future Scope

1. **Obstacle Avoidance**: Integration of ultrasonic sensors.
2. **Extended Range**: Use of Wi-Fi or RF modules.
3. **Voice Control**: Implementation of Google Assistant.
4. **Camera Integration**: For real-time video feedback.

7. Conclusion

The Bluetooth-controlled car project successfully demonstrates the integration of Arduino and Bluetooth technology for remote control applications. The system is cost-effective, scalable, and suitable for educational purposes. Future enhancements can further expand its capabilities, making it applicable in advanced robotics and IOT domains.

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