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Bluetooth-Controlled Robot Car Design

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Abstract

Bluetooth-controlled robot cars are an excellent example of integrating communication technology with embedded systems for real-world applications. This paper explores the conceptual design, architecture, and working principles behind a robot car that is controlled via a Bluetooth-enabled smartphone. Components such as microcontrollers, motor drivers, and Bluetooth modules are examined in detail. Implementation methodology, challenges faced, and test results are also presented. This design is an ideal entry-level project for engineering students and robotics enthusiasts aiming to understand wireless robotic control.

Keywords: *Bluetooth, Robot Car, Microcontroller, HC-05, Embedded Systems, Wireless Communication*

INTRODUCTION

Bluetooth-controlled robot cars are an essential milestone in the field of embedded systems and robotics. They offer a practical and low-cost platform to study the integration of communication protocols and autonomous behavior. A mobile robot car controlled via Bluetooth can navigate through environments upon receiving commands from a user's smartphone. This paper aims to delve into the architecture, hardware components, software design, implementation details, and challenges in building such systems.

SYSTEM ARCHITECTURE

The overall system is composed of several key hardware components integrated together. The microcontroller acts as the brain of the robot car, while the Bluetooth module facilitates

wireless communication. The motor driver circuit enables bidirectional control of DC motors. The car chassis holds all components in place.

Key Components

Table 1

Component	Specification	Description
Microcontroller	Arduino Uno	Central unit that processes instructions.
Bluetooth Module	HC-05	Enables wireless communication between mobile phone and robot.
Motor Driver	L298N	Controls the rotation direction and speed of the motors.
Motors	12V DC	Drives the robot wheels.
Power Supply	12V Battery	Provides energy to all components.

HARDWARE INTEGRATION

All components are interconnected with careful consideration of current and voltage ratings. The HC-05 module communicates with the Arduino Uno via serial UART protocol. The L298N motor driver is powered through the 12V battery and receives control signals from the Arduino. The motors are connected to the L298N outputs to drive the wheels. Attention is paid to ensuring sufficient power distribution and avoiding short circuits.

SOFTWARE DESIGN

The software comprises Arduino IDE code to interpret Bluetooth signals and control the robot accordingly. The smartphone sends directional commands via a Bluetooth terminal app. These commands are received by the HC-05 and processed by the Arduino Uno, which then sends voltage signals to the motor driver.

Control Commands

Table 2

Command	Action
F	Move Forward
B	Move Backward
L	Turn Left
R	Turn Right
S	Stop

IMPLEMENTATION & TESTING

Once the hardware was assembled and software uploaded to the Arduino board, the system was powered on for testing. The Bluetooth module paired successfully with the smartphone. Various directional commands were tested with the robot responding effectively in all cases. Obstacle avoidance and terrain testing were conducted to understand limitations.

CHALLENGES FACED

Several challenges arose during implementation. Initial pairing issues were resolved by resetting the HC-05 baud rate. Electrical noise caused motor jitter which was mitigated with capacitors. Maintaining balance and avoiding wheel slip required chassis adjustments and tire replacements. Signal delay from the mobile device introduced minor latency, impacting precise turns.

APPLICATIONS AND FUTURE SCOPE

Bluetooth-controlled robot cars can be used for academic demonstrations, surveillance in controlled areas, and remote-controlled delivery in restricted spaces. Future scope includes upgrading to Wi-Fi or GSM for extended range, integrating obstacle detection sensors, and AI-based decision-making to enable autonomy.

CONCLUSION

The development of a Bluetooth-controlled robot car provides a practical, low-cost platform to understand embedded systems, robotics, and wireless communication. Through this project, key insights were gained in both hardware integration and software control using the Arduino

platform. This type of robot car not only aids in prototyping real-world robotics solutions but also contributes to educational tools for STEM learning.

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