Bluetooth-Controlled Autonomous Smart Car Robot

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GitHub: https://github.com/PollybearG/Bluetooth-Controlled-Autonomous-Smart-Car-Robot

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Solo project to demonstrate embedded systems skills using Arduino Nano, Bluetooth, and sensors for wireless control and obstacle avoidance.

Abstract

Background

Electronic technology is integral to daily life, from appliances like TVs to devices like smartphones, relying on low-voltage components and sensors. Distance sensors enhance cars and robotic vacuums, temperature sensors aid cookware, and controllers have evolved from wired to wireless (IR, Bluetooth, Wi-Fi). This project, inspired by robotic vacuums, integrates obstacle avoidance and wireless control using an Arduino Nano.

Project Overview

This project builds a smartphone-controlled robot car using an Arduino Nano (ATmega328P, 30 pins, 5V/3.3V output) with SPI/I2C support. It features two HC-SR04 ultrasonic sensors for ~90% obstacle detection, a HC-05 Bluetooth module for ~10m wireless control, a BH1750 light sensor (I2C, 3.3V) with LEDs, and an L298N motor driver for movement. Components are soldered on a custom PCB, with a wooden chassis to avoid signal interference. The Android app provides intuitive control.

Project Design

Hardware

- Microcontroller: Arduino Nano, selected for compactness and I2C/SPI support.
- Sensors: Two HC-SR04 sensors (angled for wider detection), BH1750 light sensor (with level shifter for 3.3V).
- Module: HC-05 Bluetooth for phone control, L298N motor driver for dual-motor operation.
Schematic Circuit is available in GitHub repository(Images/Schematic Circuit.jpg)

Software

Programmed in C using Arduino IDE, implementing Bluetooth communication and sensor logic. Full code available in GitHub repository (Code/Smart_Car_Robotic_Project.ino).

Implementation

- Designed PCB in NI Multisim, optimized for signal integrity.
- Integrated subsystems (sensors, motors, Bluetooth) for autonomous movement and phone control.

Hardware and PCB board photos available in GitHub repository(Images/Smart_Car_Robot_Hardware.jpeg)(Images/Smart_Car_Robot_PCB_Board.jpeg)

Results

- Achieved ~90% obstacle detection accuracy with HC-SR04 sensors.
- Bluetooth range reached ~10m with stable connection.
- Light sensor triggered LEDs reliably in low-light conditions.

Challenges and Solutions
- Resolved HC-SR04 false positives by adjusting sensor timing.
- Fixed PCB shorts by rerouting traces and verifying continuity.
- Optimized L298N power supply to prevent motor stalls.

Conclusion

This project demonstrates embedded systems skills in C programming, hardware integration, and wireless communication. It successfully implemented a functional smart car with obstacle avoidance and remote control, applicable to IoT and robotics.

Improvement

- Integrate Wi-Fi with ESP-IDF for extended range.
- Add Kalman filtering for sensor accuracy.
- Upgrade to ESP32 for advanced features.

References

- Arduino Nano: arduino.cc
- HC-SR04: sparkfun.com
- BH1750: rohm.com
- L298N: lastminuteengineers.com
- HC-05: howtomechatronics.com

(Note: Report reconstructed and optimized based on original NAIT project to highlight technical skills and outcomes.)