Project-report: Bluetooth-controlled vehicle

What this project does:

This project designs a Bluetooth-controlled vehicle with two wheels, based on mbed and Raspberry Pi. When the user presses UP, DOWN, LEFT, or RIGHT on the controller, the vehicle moves accordingly. Safety functions are integrated by incorporating a sonar radar on the vehicle. When obstacles are too close, the vehicle is forced to stop, and a red caution light turns on. The moving speed, direction, and obstacle distance are displayed on the LCD.

What each component in the project does:

Mbed: Receives movement information from Raspberry Pi; Gets obstacle distance from the sonar sensor; Controls two motors; Controls the caution light; Controls the LCD display; Powers the LCD, motor, sonar sensor, and light; Processes valid movements and handles obstacle avoidance

Raspberry Pi: Receives movement commands from the 8-bit controller via Bluetooth; Sends movement commands to the mbed via USB; Powers the motor driver

8-bit Controller: Collects user commands based on 8 button; Sends commands to the Raspberry Pi

Sonar Sensor: Measures obstacle distance; Sends distance information to the mbed

uLCD: Displays obstacle distance, movement speed, and direction

Caution Light: Warns the user of obstacles that are too close

Motor: Drives the vehicle

Problem encountered in the project:

1. Insufficient PWM pins on mbed: Initially, we planned to use 4 motors and 4 servos to enable 4WD and RWS. However, we discovered that the mbed does not have enough PWM pins to support this configuration. To resolve this, we switched to a simpler design using only 2 motors.

2. Lack of balance: We initially 3D-printed the chassis and attached it to the motors and wheels. However, the vehicle could not balance properly and often fell apart when moving. To address this, we replaced the custom chassis with the one provided in the kit, which offered better stability.

How your project is similar and different from other real world embedded systems:

Similarities: Like autonomous vehicles, this project incorporates obstacle detection and avoidance using sensors. It uses a modular approach to design, with individual components handling specific tasks, similar to real-world embedded systems. The Bluetooth communication between the controller and the vehicle mirrors remote-controlled systems in real-world applications.

Differences: The scale of this project is much smaller compared to industrial autonomous systems. It lacks advanced features such as machine learning for navigation or GPS for location tracking.
The project focuses on fundamental control and safety rather than complex automation or multi-environment adaptability.

How to improve project:

Add additional for more accurate obstacle detection and better navigation; Design a more efficient power supply system to enhance runtime and reliability; Implement Wi-Fi or long-range Bluetooth for extended remote control capabilities; Redesign or reinforce the chassis for better balance and durability; Include additional information such as battery status and operational modes on the LCD.