ULTRASONIC BASED VEHICLE SPEED CONTROLLING SYSTEM

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Abstract:

This paper presents the design and development of an ultrasonic-based vehicle speed controlling system that utilizes Node MCU, ultrasonic sensor, L298 module, 12V battery, LCD 16x2 display, and a DC motor to regulate vehicle speed and prevent accidents. The ultrasonic sensor detects the distance between the vehicle and obstacles, transmitting the data to the Node MCU for processing. Based on the sensor data, the system adjusts the vehicle speed by controlling the DC motor via the L298 module. The system also features an LCD 16x2 display that provides real-time feedback on vehicle speed and distance from obstacles. The 12V battery powers the system, ensuring continuous operation. The proposed system has the potential to significantly enhance road safety by preventing accidents caused by excessive speed. The system's ability to adapt to changing road conditions and obstacles makes it an effective solution for various vehicle applications, including autonomous vehicles, public transportation, and personal vehicles

Key Words: Node MCU, L298 Motor Driver, Ultrasonic Sensor, LCD

1. **Introduction:** In our project, we are designing a vehicle speed control system integrated with an obstacle detection mechanism, all controlled wirelessly using RF (Radio Frequency) technology. This system aims to ensure vehicle safety by automating speed control and preventing accidents caused by sudden obstacles on the road. An ultrasonic sensor is used to detect obstacles in front of the vehicle. By emitting sound waves and measuring the time it takes for the waves to return, the sensor can determine the distance between the vehicle and any objects ahead. This data is crucial for automatic braking or slowing down the vehicle when an obstacle is detected. The ESP8266 Node MCU serves as the central control unit of the system. It is a Wi-Fi-enabled microcontroller that enables wireless communication with other devices, such as a remote transmitter or a mobile app. The Node MCU processes the information from the ultrasonic sensor and controls the speed of the DC motor accordingly. The L298 Motor Driver Module is used to control the DC motor that drives the vehicle. This module is capable of driving the motor forward or backward and controlling its speed by adjusting the power sent to the motor. It plays a vital role in automating the vehicle's speed in response to the data received from the ESP8266 Node MCU. The LCD 16x2 Display provides real-time feedback on the vehicle's current status, including speed, obstacle detection status, and other important information. This makes it easy for the user to monitor the system’s performance and ensure that the vehicle operates within safe limits. The DC motor is the actuator responsible for controlling the movement of the vehicle. It is connected to the motor driver module and the control system, which adjusts its speed based on input from the ultrasonic sensor and the communication from the ESP8266 Node MCU

2. **Literature Survey:** A large amount of road accidents take place every year only because of reckless driving of the drivers and because of this, people get injured and killed. For those who get seriously injured and become physically impaired people, the tale is more hideous. It must come to an end here. Restless driving needs to be monitored. So, we were thinking about implementing unique safe zones across the country in which vehicles are automatically forced to hold their speed at some safe level and are unable to speed up their vehicle while they are in that area. These zones are created by concentrating on public areas such as schools, hospitals, busy roads, U-Turns, etc.
3. **PROBLEM STATEMENT:** In any state or country that deals with high traffic during the year, there are certain highways. In order to operate comfortable cars, there must be a certain speed limit on those highways. Roads in front of schools, colleges, universities, official government offices, U-turns, etc. are also at high risk of road accidents in busy areas. So, our community wanted to make these vital areas a special safe zone for both adults and children. This safe zone would ensure that the vehicles have a certain speed limit so that, if they are within that range.

4. Methodology: Making the roads safer for every person in the world. For regulating vehicle drivers' careless and reckless driving.

- Vehicle speed control in particular selected areas where the speed limit of the vehicle is to be decided by the governing authority.
- To create a vehicle that can defend itself with acceleration or high speed from collisions as it closes to another object or automobile.

5. Hardware Components:

a. **ESP8266 Node MCU (Microcontroller + Wi-Fi Module):**
    a. Acts as the central processing unit.
    b. Reads data from all connected sensors.
    c. Displays data on the 16x2 LCD.
    d. Sends sensor data to an IoT platform (e.g., Blynk, Things-peak) over Wi-Fi.

b. **16x2 LCD Display (with I2C):**
    a. Displays real-time readings such as temperature, humidity, and gas concentrations.
    b. Allows on-site monitoring without the need for a computer.

c. **LIPO Battery:** A LiPo (Lithium Polymer) battery is a rechargeable battery commonly used in drones, RC cars, robotics, and other portable electronics. It is a type of lithium-ion battery, but instead of using a liquid electrolyte, it uses a polymer electrolyte, making it lightweight and flexible in shape. LiPo batteries are powerful, lightweight, and efficient, making them the preferred choice for drones, robotics, and RC vehicles. However, proper handling, charging, and storage are essential for safety and longevity.

d. **Buzzer:**
    a. Used as an alert mechanism.
    b. Activated by the ESP8266 when gas levels exceed safe thresholds.

e. **L298 Motor Driver Module:**

a. In this setup, likely used as a power distributor or for controlling future actuators (like fans or servo motors based on weather data).
b. Takes 12V battery input and supplies power to other components safely.

f. **Power Supply (2x 18650 Batteries):**
   a. Supplies 12V power via the L298N.
   b. Power is distributed to the ESP8266, sensors, LCD, and buzzer.

g. **Power Switch:**
   a. Turns the entire system ON or OFF.

6. Software Used:

Arduino IDE:

The Arduino IDE (Integrated Development Environment) is a cross-platform software application designed for writing, compiling, and uploading code to Arduino microcontroller boards. It serves as the primary tool for developers, hobbyists, and students to create interactive electronics projects. With its intuitive interface and straightforward workflow, the Arduino IDE has become popular worldwide for prototyping and developing both simple and complex systems. The Arduino IDE stands out for its simplicity, flexibility, and extensive support network. It is ideal for beginners learning programming and electronics, as well as professionals developing advanced systems, making it a versatile tool in the world of embedded systems and IoT.

7. Hardware implementation:

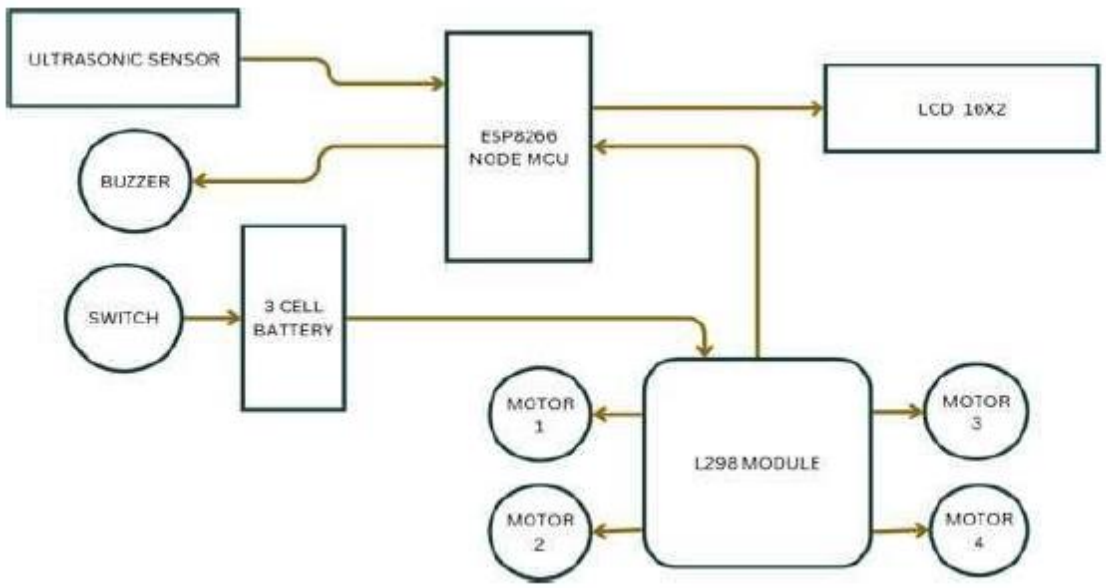

Figure 1: Block diagram

This system uses an ultrasonic sensor, a microcontroller (Node MCU ESP8266), an LCD display, and an L298N motor driver module to control the speed of a vehicle based on the distance of obstacles ahead

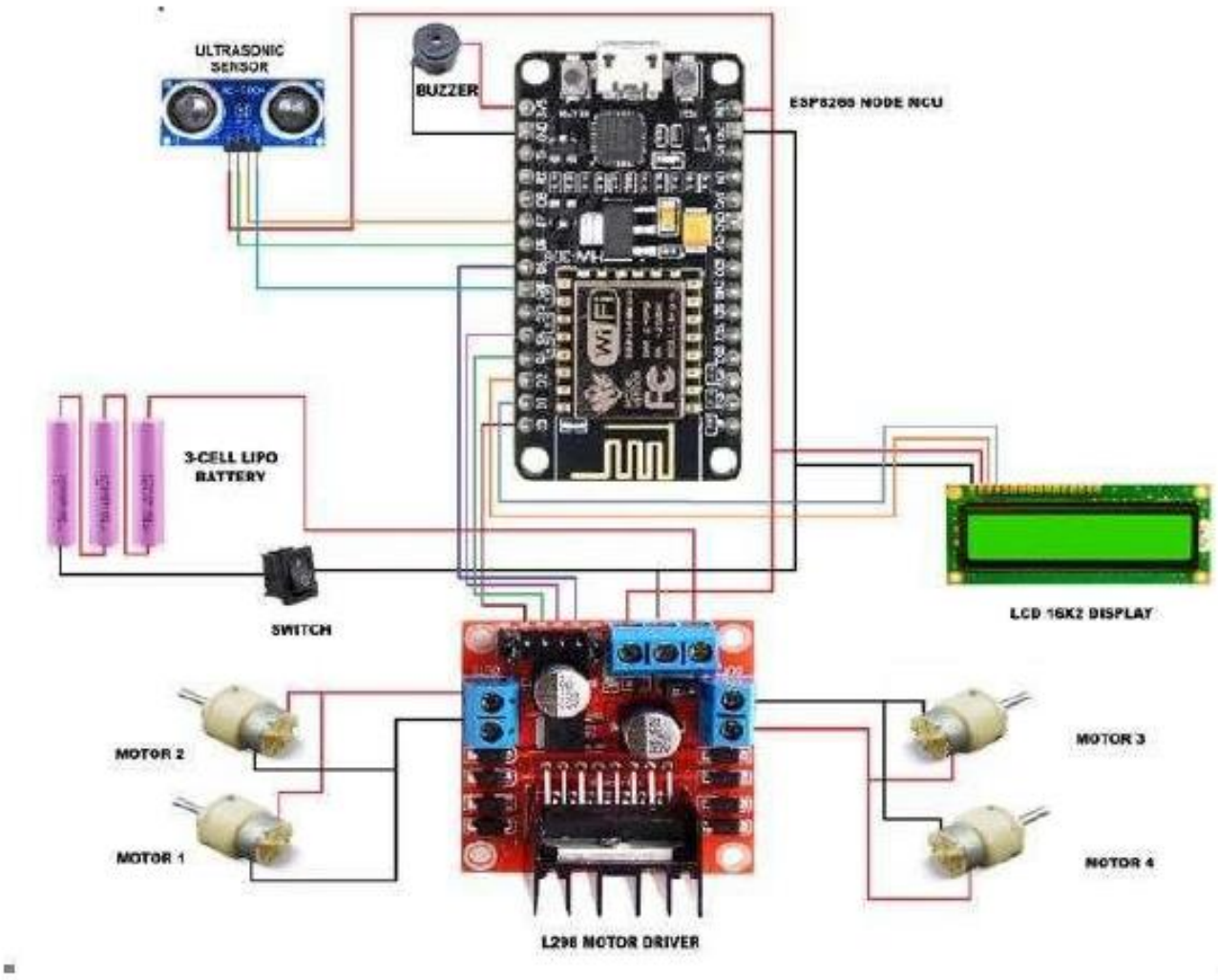

Figure 2: Circuit diagram

8. Results:

1. The measured distance will be displayed on the LCD 16x2 display.

2. The L298 motor driver controls the BO motors according to signals from the ESP8266 Node MCU.

3. If the vehicle gets too close to an obstacle, the buzzer turns ON to alert.

4. The system can be monitored remotely via a web dashboard or mobile app.

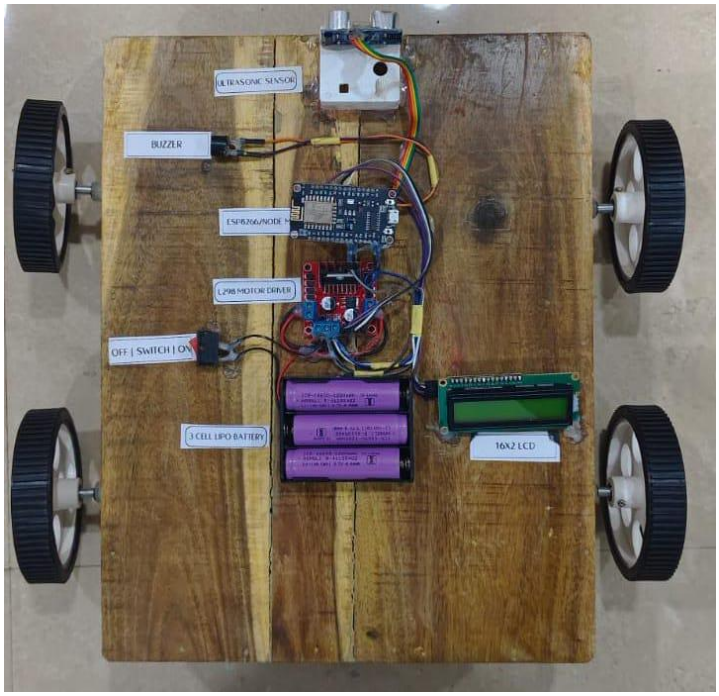

Figure: 3 final output

9. Conclusion:

By integrating advanced sensors, predictive algorithms, wireless communication, and IoT capabilities, this system can be transformed into a highly autonomous and intelligent vehicle control system. These improvements will increase safety, efficiency, and adaptability, making the system suitable for real-world applications like autonomous cars, smart robots, and industrial automation. The ultrasonic- based vehicle speed controlling system is an efficient and reliable solution for preventing collisions by automatically adjusting vehicle speed based on obstacle proximity. Using the HC-SR04 ultrasonic sensor, Node MCU ESP8266 microcontroller, and L298N motor driver, the system continuously monitors the distance of obstacles ahead and regulates the speed of DC motors accordingly. When an obstacle is detected within a predefined range, the system reduces the vehicle's speed and activates a buzzer to alert the user, ensuring safety. Additionally, the 16x2 LCD display provides real-time feedback on the distance and speed, enhancing user awareness. This system demonstrates the practical application of embedded systems in autonomous vehicles and robotics, offering benefits such as improved safety, energy efficiency, and real-time responsiveness. With further enhancements, it can be adapted for advanced driver-assistance systems (ADAS), smart parking, and obstacle-avoiding robots, contributing to the development of intelligent transportation systems.

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