IOT Based Speed Control System for Electric Vehicle

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ABSTRACT

This project presents an Arduino Uno-based smart monitoring and control system for electric vehicles (EVs), integrating key sensors and modules to enhance vehicle safety and performance. The system includes a voltage sensor to monitor battery levels, a GPS module for real-time location tracking, a temperature sensor to detect overheating, and a Bluetooth module for wireless communication with mobile devices. These inputs are processed by the Arduino Uno, which controls outputs such as an LCD for displaying data, a buzzer for alerts, and a motor driver (L298N) for controlling the vehicle motor. The system alerts users when abnormal conditions are detected, such as high temperature or low battery voltage, ensuring safety through timely warnings. The inclusion of GPS and Bluetooth connectivity allows for enhanced tracking and user interaction. This prototype demonstrates the potential for affordable, real-time EV monitoring, contributing to safer, smarter transportation systems with improved diagnostics and preventative maintenance capabilities.

Keywords: Arduino Uno, Bluetooth Module, LCD, L298N, GPS, Voltage Sensor, Temperature Sensor

I. Introduction:

Electric vehicles (EVs) are gaining popularity as a sustainable alternative to traditional fuel-based vehicles. To ensure their safe and efficient operation, smart monitoring and control systems are essential. This project focuses on developing an Arduino Uno-based embedded system that integrates multiple sensors and modules to monitor key parameters of an EV. The system uses a voltage sensor to track battery health, a temperature sensor to detect overheating, and a GPS module to provide real-time location data. A Bluetooth module enables wireless communication, allowing data to be accessed remotely. The Arduino Uno serves as the central controller, processing data and activating outputs such as an LCD display for real-time updates, a buzzer for alerts, and a motor driver (L298N) to manage motor function. This setup ensures the vehicle operates within safe conditions and alerts the user when anomalies occur. The system offers a cost-effective solution for enhancing EV safety, reliability, and user awareness.

Objectives

1.Collision Avoidance: Implement real-time obstacle detection using ultrasonic sensors and initiate automatic braking or speed reduction to prevent collisions.

2.Manual and Automatic Speed Control: Use a potentiometer for manual speed adjustment while enabling the system to override user input in case of emergencies.

3.Location Tracking: Utilize a GPS module to provide real-time location data, enhancing the vehicles navigational and tracking capabilities.

Problem Statement:

Electric vehicles are becoming increasingly popular due to their environmental benefits, but they often lack advanced safety and control features such as automated braking and intelligent speed management. Traditional systems do not provide real-time monitoring of critical parameters like voltage, temperature, or surrounding obstacles, which can lead to unsafe driving conditions and reduced efficiency. There is a need for an integrated system that can process sensor data and make real-time decisions to ensure safe vehicle operation. This project aims to develop a smart braking and speed control system using Arduino Uno to improve safety, performance, and monitoring capabilities in electric vehicles.

II. Literature Review:

Several research efforts have been made to enhance the safety and performance of electric vehicles using embedded systems and automation. Studies have shown that integrating microcontrollers like Arduino with various sensors improves vehicle responsiveness and control.

Research on automated braking systems emphasizes the importance of real-time obstacle detection using ultrasonic sensors to prevent collisions. Voltage and temperature monitoring have also been explored to ensure battery safety and system reliability. Projects involving GPS modules have demonstrated effective tracking and navigation assistance, especially in urban environments. Additionally, the use of potentiometers for manual speed regulation has proven to be effective in offering driver input flexibility.

III. System Architecture and Components

Block Diagram:

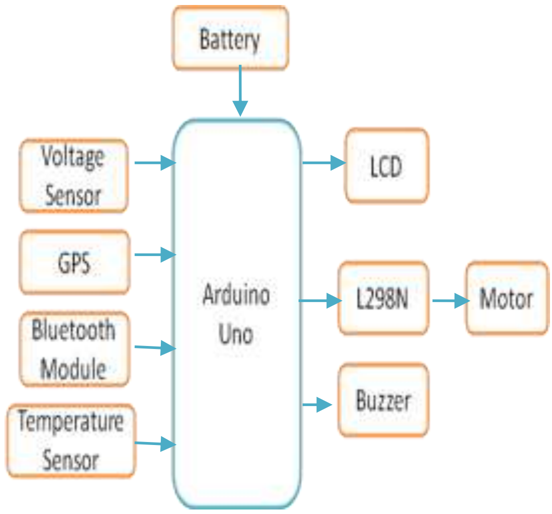

Fig 1. System Block Diagram

Hardware Components:

1. **Arduino Uno**: Arduino Uno is an open-source microcontroller board based on the ATmega328P chip. It features 14 digital input/output pins, 6 analog inputs, a USB connection, and a power jack. Known for its simplicity and ease of use, it is widely used in electronics projects and embedded systems. Programmable via the Arduino IDE, it allows users to create interactive devices by connecting sensors, modules, and actuators for various applications.

Fig 2. Arduino Uno

2. **GPS:**

The Global Positioning System (GPS) is a U.S.-owned satellite-based navigation system that provides accurate location, velocity, and time information globally. It comprises a constellation of satellites, ground control stations, and user devices. GPS operates through trilateration, where receivers calculate their position by analyzing signals from at least four satellites.

Fig 3. GPS Module

3. **L298N Motor Driver:**

L298N module is a high voltage, high current dual full-bridge motor driver module for controlling DC motor and stepper motor. It can control both the speed and rotation direction of two DC motors. This module consists of an L298 dual-channel H-Bridge motor driver IC. This module uses two techniques for the control speed and rotation direction of the DC motors.

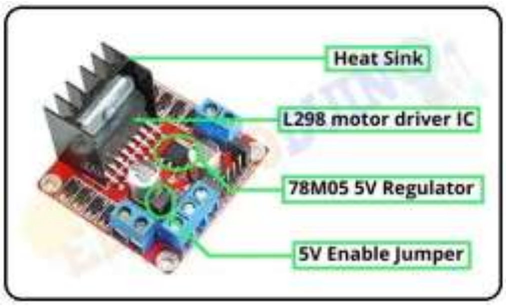

Fig 3: L298N Motor Driver

4. **I2C LCD Display:** LCD stands for liquid crystal display. Character and graphical LCD's are most common among hobbyist and DIY electronic circuit/project makers. Since their interface serial/parallel pins are defined so it's easy to interface them with many microcontrollers. Many products we see in our daily life have LCD's with them.

Fig 4. I2C LCD Display

5. **Temperature Sensor**: DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability

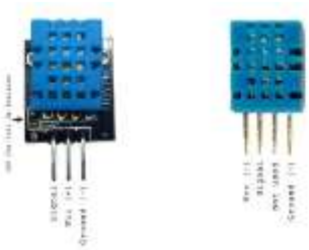

Fig.5.Temperature Sensor

Software and Programming

The system is programmed using:

☞ **Arduino IDE** – Used to write and upload code to Arduino Uno.

☞**Libraries** – Tiny GPS++, Liquid Crystal, New Ping for sensors and display.

☞**Setup Function** – Initializes sensors, LCD, motor driver, and serial communication.

☞**Loop Function** – Continuously reads sensor data and controls outputs.

☞**Sensor Readings** – Uses analog Read and digital Read for voltage, temperature, etc.

☞**Motor Control** – PWM signals via L298N for speed and direction.

☞**Display Output** – Shows sensor values on the LCD.

☞**Serial Monitor** – Used for debugging and viewing real-time data.

IV. Working Principle

☞ The system operates by using the Arduino Uno as the central controller, which receives inputs from various sensors.

☞ The voltage sensor monitors battery levels, the temperature sensor detects overheating, and the GPS module provides real-time location data.

☞A Bluetooth module enables wireless communication with external devices.

☞ Based on the sensor data, the Arduino processes the information and displays results on the LCD. If abnormal conditions are detected, the buzzer is activated as an alert.

☞ The L298N motor driver, controlled by the Arduino, manages the motor operation, ensuring safe and responsive movement according to the processed sensor inputs.

V. RESULTS

Fig 6. Physical Image of Circuit

Fig 7. Vehicle voltage and Temperature readings

Fig 8. Final Output.

VI. FUTURE ENHANCEMENTS

This project can be further developed by integrating advanced technologies such as IoT for remote monitoring and control of the vehicle using mobile applications. Machine learning algorithms can be employed to analyze sensor data and improve decision-making for braking and speed control. Additional safety features like facial recognition for driver authentication and fatigue detection can be added. The system can also be scaled to support autonomous driving functions using AI and camera-based vision systems. Moreover, solar charging systems and regenerative braking can be integrated to enhance energy efficiency, making the electric vehicle smarter, safer, and more sustainable for future transportation needs.

VII. CONCLUSION:

The Iot based Speed Control System presented herein offers a practical solution for enhancing the safety and efficiency of electric vehicles. By integrating various sensors with an Arduino-based control unit, the system effectively monitors and responds to dynamic driving conditions. Its modular and cost-effective design makes it particularly suitable for educational purposes and small-scale EV applications. Future developments could focus on integrating more advanced microcontrollers, incorporating machine learning algorithms for predictive analytics, and expanding the system's applicability to a broader range of vehicles.

VIII. REFERENCES:

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