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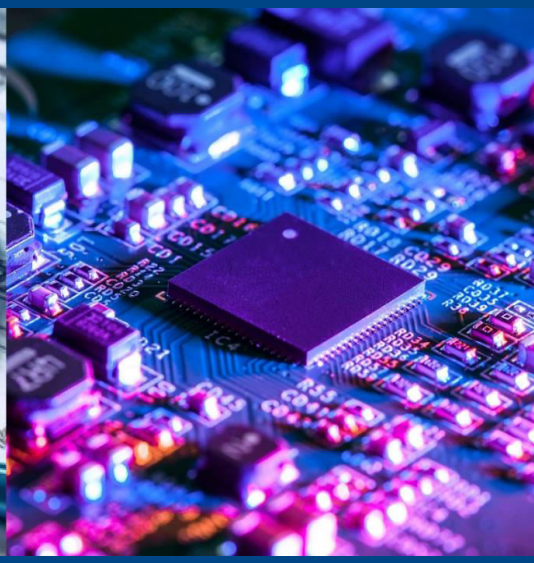

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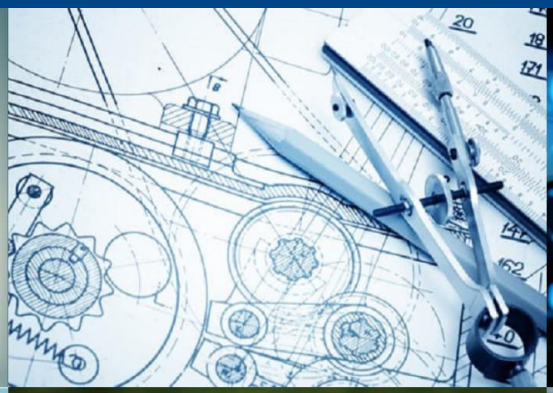

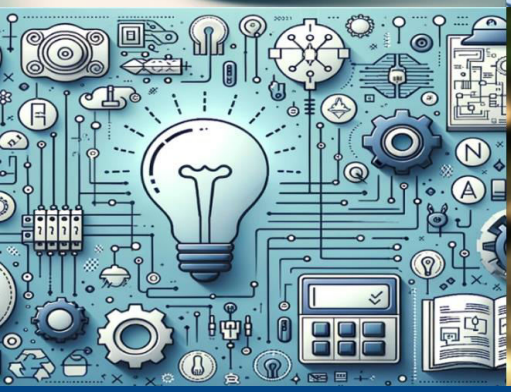

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International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

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# Battery Management System of Electrical Vehicle

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**ABSTRACT:** This paper presents the design and implementation of a Battery Management System (BMS) tailored for electric vehicles, utilizing Arduino and STM32 microcontrollers integrated with GPS and SIM800L GSM modules. The system monitors battery voltage and temperature to prevent damage from overcharging, overheating, or deep discharge. Upon detecting abnormal conditions, it sends real-time SMS alerts with the precise GPS location of the vehicle, enabling immediate preventive actions. The prototype demonstrates a cost-effective, scalable, and reliable solution to improve battery safety and maintenance in electric vehicles.

## I. INTRODUCTION

The rise of electric vehicles (EVs) demands reliable battery management to ensure safety, efficiency, and longevity of battery packs. Battery packs, commonly composed of multiple cells, require constant monitoring of voltage and temperature to avoid failures like thermal runaway or capacity loss. This project designs a BMS using Arduino for voltage and temperature sensing, and an STM32 microcontroller for GPS tracking and GSM-based alerting. The integration of these technologies offers a comprehensive approach to real-time battery health monitoring and location-based notification.

## II. PROBLEM STATEMENT

Electric vehicle batteries are prone to damage from overvoltage, under voltage, and overheating conditions. Without an effective monitoring system, these faults may go undetected, leading to vehicle failure, accidents, or battery degradation. There is a need for a low-cost, reliable, and remotely accessible system that can monitor battery parameters and notify users immediately upon detecting unsafe conditions.

## III. OBJECTIVES

- To design a BMS capable of monitoring voltage (1V to 24V) and temperature using Arduino.
- To implement GPS tracking and send real-time SMS alerts using STM32 and SIM800L GSM module.
- To provide remote monitoring capabilities by transmitting battery health status along with location.
- To ensure timely fault detection and notification for preventive maintenance.
- To develop a scalable system adaptable to various battery configurations.

## IV. SCOPE

The system focuses on 6-cell battery packs (totalling 24V max). It monitors voltage and temperature parameters only, sending SMS alerts to predefined mobile numbers with GPS coordinates when anomalies are detected. The project is suited for electric vehicles and similar battery-powered systems needing remote health monitoring.

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## V. LITERATURE SURVEY

**Existing Systems:** Traditional BMS designs often include complex circuitry and expensive components focusing on detailed battery health parameters like State of Charge (SOC), State of Health (SOH), and balancing cells. Many existing systems rely on wired communication or lack remote alerting capabilities.

**Proposed System:** The proposed system emphasizes cost-efficiency and remote alerting using GSM and GPS technologies. The Arduino performs sensor data acquisition, while STM32 handles GPS location and SMS communication, allowing alerts even when users are away from the vehicle.

**Enhancements:**Compared to basic BMS solutions, the integration of location-based alerts offers enhanced safety. Furthermore, the modular design supports easy expansion for future improvements like IoT integration or machine learning-based predictive maintenance.

## VI. METHODOLOGY

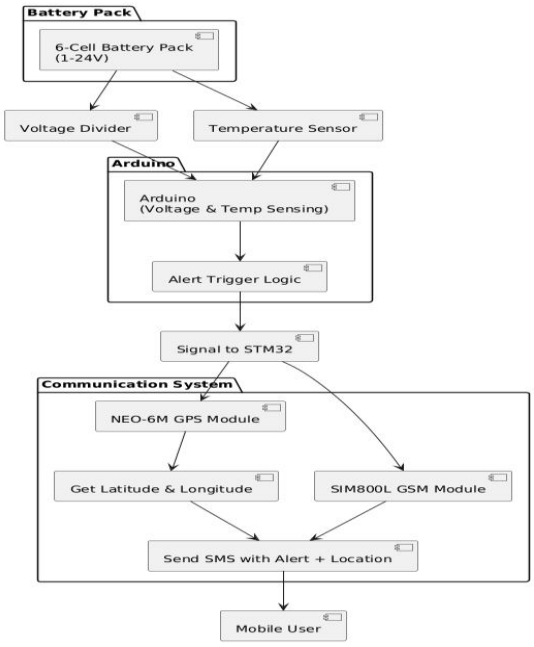
### Hardware Design

- Arduino Uno measures voltage and temperature.
- Voltage sensed using a voltage divider, scaled for 24V max input.
- Temperature measured via LM35 sensor.
- Data sent via UART to STM32F103C8T6 microcontroller.
- STM32 reads GPS data from NEO-6M module via UART.
- SIM800L module connected to STM32 to send SMS alerts.
- Power supplied and regulated to ensure stable operation.

### Software Design

- Arduino runs sensor reading code, sends processed data to STM32.
- STM32 processes sensor data, compares against thresholds.
- Upon fault detection, STM32 reads GPS coordinates.
- STM32 sends SMS via SIM800L with battery status and location.

### 6.1 Block Diagram



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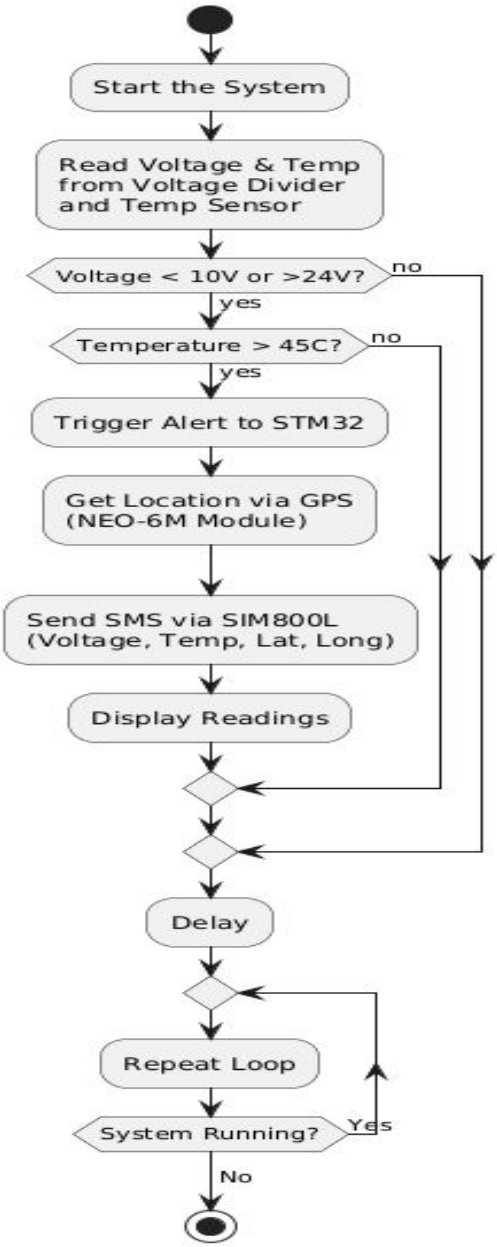
## VII. HARDWARE COMPONENTS

- Arduino Uno R3
- STM32F103C8T6 (“Blue Pill”)
- SIM800L GSM Module
- NEO-6M GPS Module
- LM35 Temperature Sensor
- Voltage Divider Resistors
- 6-Cell Battery Pack (1V to 24V range)
- Power Supply Modules

**Flowchart**



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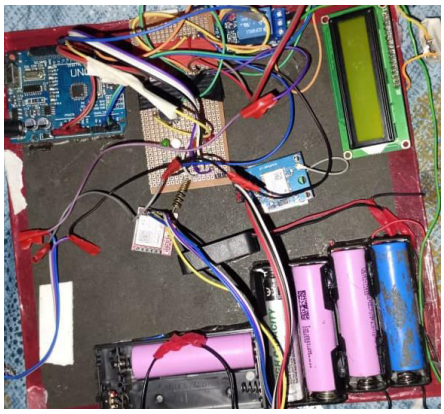
## VIII. SOFTWARE REQUIREMENTS

- Arduino IDE for Arduino programming
- STM32CubeIDE for STM32 firmware development
- AT command set for SIM800L control
- Serial communication protocols (UART)
- GPS NMEA sentence parsing

## X. TESTING & RESULTS

Testing verified the system's ability to detect voltage and temperature anomalies and send SMS alerts with GPS location. Tests included varying battery voltages, simulating temperature changes, and verifying GPS accuracy. The system successfully sent timely alerts, confirming reliability and accuracy.



## X. ADVANTAGES & DISADVANTAGES

**Advantages:**

- Real-time remote monitoring with location awareness.
- Low cost and easy scalability.
- Enhanced vehicle safety.
- Modular design.

**Disadvantages:**

- Limited to voltage and temperature sensing.
- GPS dependency on satellite signal quality.
- GSM dependency on cellular network coverage.

## XI. CONCLUSION

The project demonstrates a functional and practical battery management system for electric vehicles, leveraging Arduino and STM32 microcontrollers with GPS and GSM modules. It successfully monitors key battery parameters and alerts users remotely, improving safety and maintenance effectiveness.

## XII. FUTURE SCOPE

- Incorporate current sensing and SOC/SOH estimation.
- Add IoT connectivity for cloud monitoring and analytics.
- Implement predictive maintenance using machine learning.
- Develop dashboard interfaces for local display and control.
- Enhance GPS reliability via A-GPS or other positioning methods.

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