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Electric Vehicle Battery Management System Using Microcontroller

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Abstract -Electric cars have gained popularity due to their zero-emission and energy efficiency. However, an electric vehicle's performance is determined by its battery management system. This study aims to provide an Arduino-based BMS for electric vehicles to monitor and regulate battery charging and discharging processes. The BMS monitors charge, temperature, and voltage for each cell in the battery pack. The system monitors battery life and performance using several sensors and indications. The suggested BMS improves battery pack performance and the lifespan, making electric vehicles more dependable and efficient.

***Key Words*:** Electric Vehicle, BMS, Microcontroller, Protection

1. INTRODUCTION

As electric vehicles (EVs) become more popular, there is a greater need for battery monitoring systems that can correctly and consistently monitor the battery's level of charge and health. Proper battery operation is crucial for an EV's performance, range, and safety. This project suggests monitoring an EV battery with a voltage sensor, current sensor, and Arduino microcontroller. The device has a temperature sensor that detects when the battery temperature reaches a safe level, triggering a cooling mechanism to avoid overheating. When the battery voltage is low or the temperature is high, they can take the necessary action to prevent battery damage.

This system is simple to install and use, with uncomplicated wire connections and an intuitive UI. Using an Arduino microcontroller allows for flexible programming and customization. Electric cars are gaining popularity owing to their environmental benefits and cheap running costs. However, there are limits to EV batteries, including limited range and battery life.

Implementing a battery monitoring system can enhance the performance and longevity of EV batteries by properly measuring their state of charge, health, and temperature.

The suggested system measures the battery's voltage and current to calculate its state of charge and capacity. The device contains a temperature sensor to detect when the battery temperature exceeds a safe level, which can cause battery degeneration and failure. The device monitors temperature and automatically activates cooling to prevent overheating and battery damage. In addition to monitoring and cooling, the system detects low battery power or excessive temperature. This function helps owners fix problems and prevent battery damage.
The Arduino microcontroller allows for flexible programming and modification, making it adaptable to many EV models and battery types.

The system is simple to install and use, with uncomplicated wire connections and an intuitive UI.

This project intends to improve the performance, range, and safety of electric vehicles by monitoring and maintaining their batteries. It also reduces the danger of battery damage and failure.

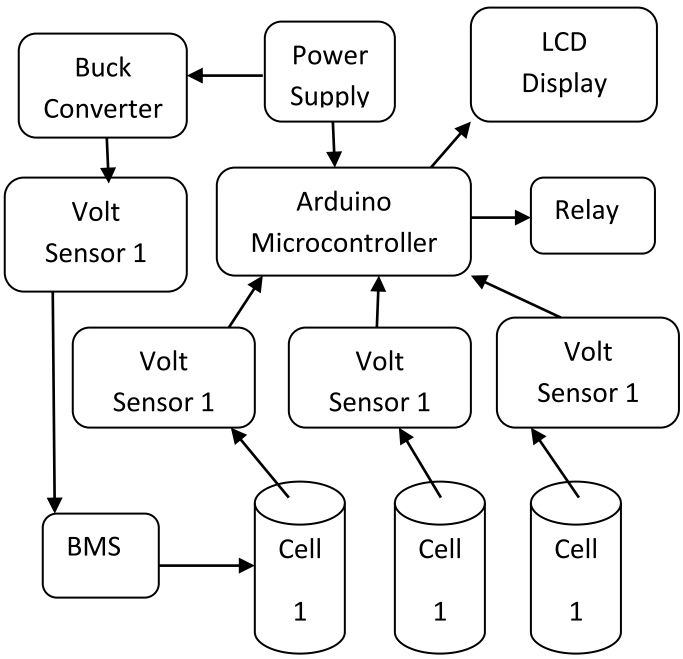

Fig -1: Block Diagram of Purposed System

2. LITERATURE REVIEW

Atzori et al. (2017) suggest Understanding the Internet of Things (IoT), which has been included in this review study. The term "Internet of Things" refers to the issues associated with connecting the internet and physical world. The internet has become an integral element of daily living and has significantly impacted individuals' lives. This innovation focusses on integrating many technologies with communication systems. IoT applications mostly involve identifying and tracking smart things. Wireless Sensing Networks (WSN) offer ubiquitous sensing networks, which impact several aspects of modern life.

C. Wu et al. (2015) suggest research on the effects of overcharging and discharging on lithium-ion batteries. This study aims to identify and investigate overcharge and over discharge faults in lithium-ion batteries. The dynamic simulation model was used to analyse overcharge and over discharge faults in automotive lithium-ion batteries (LIBs). The influence of fault diagnostics was also summarised. This study found that defect diagnostic analysis of LIB can yield positive outcomes. It has a particular applicability value for the diagnosis of LIB with various parameters. Overcharge and overdischarge issues in automotive LIB pose a risk to battery performance and should be addressed by manufacturers.

López-Benítez et al. (2017) offer a prototype for multidisciplinary research in the context of the Internet of Things. This paper introduces a new mathematical technique for precisely modelling data traffic in the Internet of Things (IoT). Conventional statistical data traffic models for IoT rely on the assumption that data follows a regular Poisson or Exponential distribution, without experimental confirmation. In some usage cases, a single statistical distribution may not be sufficient to optimise data packet production based on inter-arrival time. Data from a customised IoT prototype for smart home applications was collected over a 10-week period.

O. A. Mohamad, et al. (2016) suggest "Design and implementation of a real-time tracking system using Arduino and Intel Galileo," Electronics Computers and Artificial Intelligence (ECAI) 2016 8th International Conference. As technology advances, it's crucial for people to have the ability to monitor and regulate their physical and personal data. Although physical transportation systems have made it simpler for individuals to move, they have also become a liability in various ways. This project includes a real-time tracking gadget to address vehicle monitoring difficulties. This article presents a system built with Arduino Uno R3 and a Global System for Mobile (GSM) device.

Xia, Velandia et al. (2016) propose RFID-based crankshaft monitoring, traceability, and tracking for the industrial internet of things. Designing a closed-loop engineering system with condition monitoring using IoT and cloud computing. This work explores the stochastic scheduling of a two-machine shop robotic cell with adjustable inspection times. A multi-function robot inspects similar components in two ways: at the rear of the upstream machine or during transit between machines. The inspection procedure involves adjusting the inspection cost to modify the time required. Reducing inspection time may lead to more failures of components, regardless of when they are found.

Yong Tian et al. (2017) offer an optimum nonlinear observer for state-of-charge estimate of lithium-ion batteries in Industrial Electronics and Applications (ICIEA). SOC information is vital for controlling, diagnosing, and monitoring Li-ion cells and batteries. Electrochemical battery models, which measure Li-ion concentration in each electrode, can provide more accurate SOC information than traditional data-driven circuit models used in battery management systems. This research presents two nonlinear observer designs that estimate Li-ion battery State-of-Charge by reducing an electrochemical model. The first observer design employs a constant gain Luenberger structure, whereas the second improves it by weighting the gain against the output Jacobian.

3. PROPOSED SYSTEM

The goal of battery management and burning prevention in electric cars is to assure safe and dependable battery operation while reducing the danger of fire and other risks. Battery management systems (BMS) monitor and control the battery's charge, temperature, and other parameters to guarantee safe operation. The BMS detects potential defects in the battery system, allowing for prompt maintenance and repairs.
Electric cars include several safety mechanisms, like BMS, to avoid battery fires and other risks.
Thermal management systems regulate battery pack temperature, while electrical safety measures like fuses and circuit breakers prevent short circuits.

Battery management and burning prevention strive to improve the safety and reliability of electric cars, while also boosting their acceptance as a sustainable and ecologically benign mode of transportation.

Effective battery management and burning prevention may speed up the transition to a low-carbon transportation system by ensuring electric vehicle safety and dependability.

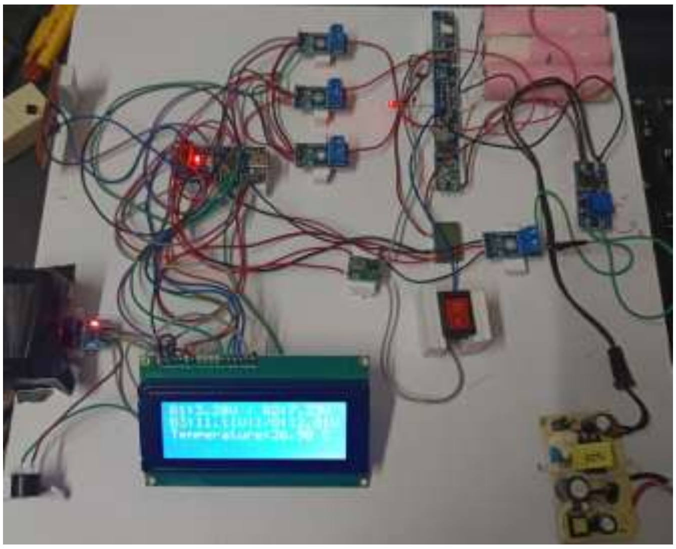

Fig -2: Hardware of Purposed System

The suggested system monitors the battery of an electric car using a voltage and current sensor. If the temperature rises, the cooling system activates The system monitors an electric vehicle's battery performance in real-time. The system measures the voltage and current of the battery using two sensors. The Arduino microcontroller analyses the data to determine the battery's charge and health. If the battery temperature surpasses a certain level, a cooling system is engaged to avoid damage.

The system includes a buzzer module that enables real-time contact with car owners.
The system delivers notifications to the registered number if battery metrics fall below a specific level or temperature exceeds a limit. This function alerts the car owner of the

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battery's state, allowing them to take necessary precautions.

Any possible difficulties. The suggested technology is cost-effective and simple to install in any electric car. The solution enhances the performance and dependability of electric vehicles by extending their battery life. The real-time communication capability allows car owners to take timely action to preserve battery health and performance.

4. RESULT AND DISCUSSION

The suggested system for monitoring the battery of an electrical car uses a voltage and relay module, an Arduino, and a cooling system. The results and debates are as follows.

Data Acquisition: Continuous data collection was achieved through the use of voltage and current sensors. The temperature sensor was used to measure temperature at regular intervals. The information was saved in the Arduino's memory.

Fig -3: Outputs of Purposed System

Data Analysis: Data analysis was conducted to evaluate the battery's charge, temperature, and overall health. The data analysis module employed algorithms to monitor battery performance and health, providing useful information.

Cooling System Control: The cooling system control module activates when the battery temperature exceeds a certain threshold, automatically turning on the cooling system. The cooling system kept the battery temperature within a safe working range.

Alert System: If the battery's charge or temperature reached a critical level, the buzzer module alerted the vehicle operator or fleet management.

Fig -4: Outputs of Purposed System

The proposed system successfully monitors battery performance, keeps it within a safe temperature range, and alerts the operator or fleet manager when it reaches critical levels. The system alerted the operator or fleet manager of battery performance issues, allowing for preventive steps to save downtime and maintenance costs.

The system's user interface provided real-time monitoring of the battery's charge, temperature, and condition for vehicle operators and fleet administrators. The technology effectively maintains battery performance and longevity while decreasing downtime and maintenance costs, making it a useful addition to any fleet of electric vehicles.

3. CONCLUSIONS

The depletion of fossil fuels will lead to the development of completely electric cars, which will have a significant influence on people's lives. Currently, electric car manufacturers will priorities battery management systems. Electric vehicles rely only on battery energy for operation. This paper proposes utilizing to monitor vehicle performance directly. The system detects low battery performance and alerts the user to take action.
The device continually monitors the battery's voltage, current, and temperature, providing real-time information on its health and charge status. The cooling system control module keeps the battery temperature within a safe range, while the alarm system notifies the vehicle operator or fleet manager of critical battery conditions.

The suggested system may considerably enhance electric car fleet management, battery performance, and maintenance, as demonstrated by its deployment and results. It can decrease the need for battery replacements, optimize charging, and avoid unexpected vehicle downtime.

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The heading should be treated as a 3rd level heading and should not be assigned a number.

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