IOT BASED AVOID FIRE ACCIDENT IN EV VEHICLE WITH MULTIPLE FAULT DETECTION USING AI

MRS. J.Jasmine Christina[1] Assistant professor/ECE,
Gowtham R[2],Mruthunjaya R[3],Nithin C[4],Rohith Kumar N[5] UG Scholors,
Department of Electronics and Communication Engineering,
Adhiyamaan College of Engineering (Autonomous), Hosur-635130, Tamil Nadu

ABSTRACT

The Internet of Things (IoT)-based Battery Monitoring System for Electric Vehicles (EVs) ensures the safety, efficiency, and longevity of EV batteries by providing real-time monitoring and automated safety mechanisms. This system integrates various sensors and IoT technologies to continuously monitor battery parameters and trigger safety protocols when abnormal conditions arise. The core components of the system include a voltage sensor, temperature sensor, flame sensor, NodeMCU, Arduino, LCD, relay module, and buzzer. The voltage sensor monitors battery voltage, ensuring the battery operates within safe limits and preventing overcharging or deep discharge that can damage the battery. Simultaneously, the temperature sensor tracks the battery's heat levels, detecting overheating that may lead to thermal runaway, a critical issue in EV batteries. A flame sensor is incorporated to detect potential fires caused by battery malfunctions, ensuring prompt intervention. If abnormal conditions such as high temperature or flame detection occur, the system activates safety protocols to mitigate risks. When the flame sensor detects a fire or the temperature exceeds a critical threshold, the system triggers the buzzer to alert the user and automatically disconnects the battery using a relay, preventing further escalation.

I INTRODUCTION

The adoption of electric vehicles (EVs) is rapidly transforming the transportation sector, offering an eco-friendly alternative to conventional internal combustion engine vehicles that rely on fossil fuels. As the global emphasis shifts toward sustainable energy solutions, EVs are becoming increasingly popular due to their ability to reduce greenhouse gas emissions, improve energy efficiency, and decrease dependence on non-renewable resources. However, the efficiency and safety of electric vehicles heavily depend on the performance and condition of their batteries, which serve as the primary energy source. Lithium-ion batteries, the most commonly used type in EVs, are highly sensitive to temperature fluctuations, voltage variations, and other environmental factors that can affect their functionality and longevity.

II LITERATURE REVIEW

2.1 TITLE: Electrical Method for Battery Chemical Composition Determination
AUTHOR: Ismail can, Dikmen, Teoman karada
YEAR: 2021
DESCRIPTION: Storage of electrical energy is one of the most important technical problems in terms of today's technology. The increasing number of high-capacity high-power applications, especially electric vehicles and grid scale energy storage, points to the fact that we will be faced with a large number of batteries that will need to be recycled and separated in the near future. Here, battery chemical composition

determination emerges as a technical problem. In this study, an alternative method to the currently used methods for categorizing batteries according to their chemistry is discussed. Brand new and aged batteries are used in experimental setup that is consist of a programmable electronic DC load and a software developed to run the algorithm on it. According to the algorithm, batteries are connected to two different loads one by one and voltage-current data are stored. Collected data are preprocessed by framing them and framed data are processed with a separation function.

2.2 TITLE: IoT Network Management within the Electric Vehicle Battery Management System

AUTHOR: Guillaume Le Gall, Nicolas Montavont, Georgios Z Papadopoulos

YEAR: 2021

DESCRIPTION: The Battery Management System of an Electric Vehicle is a system designed to ensure safe operation of the battery pack, and report its state to other systems. It is a distributed system, and the communication between its sub-modules is performed.

We first describe the realworld experiments we did to measure the link quality, at Medium Access Control layer, for wireless nodes placed inside an EV battery pack. Then, we propose two topology management and scheduling strategies using techniques named Linear Programming and Simple Descent, based on the results obtained in the experiments. Their goal is to achieve efficient data transfer while complying to the battery constraints.

III EXISTING SYSTEM

The existing systems for battery monitoring in electric vehicles (EVs) primarily rely on traditional battery management systems (BMS) that monitor and control the charging and discharging of batteries while ensuring their safety and efficiency. These systems focus on maintaining the battery's health, prolonging its lifespan, and preventing issues such as overcharging, over-discharging, overheating, and short circuits. Conventional battery monitoring systems include a set of sensors that measure voltage, temperature, and current levels, ensuring that the battery operates within the predefined limits. These systems also use protection circuits to prevent hazardous situations by automatically disconnecting the battery when an abnormal condition is detected. However, while these systems have proven to be effective in basic battery management, they often lack real-time monitoring capabilities and fail to provide remote access or predictive maintenance, leaving gaps in overall battery safety and performance. Traditional battery management systems primarily focus on maintaining the battery's state of charge (SOC) and state of health (SOH).

IV DISADVANTAGES

- Limited Real-Time Monitoring: Traditional systems lack IoT connectivity, preventing real-time monitoring, predictive maintenance, and timely identification of battery faults or anomalies.
- No Remote Access Capability: Absence of remote monitoring restricts users from accessing battery status, increasing the likelihood of unnoticed critical issues.
- Inadequate Fire Detection: Existing systems lack efficient flame detection mechanisms, leading to delayed response during battery fires, increasing potential safety hazards.
- Limited Historical Data Analysis: Conventional systems do not store historical data, preventing analysis, fault prediction, and proactive battery maintenance for extended lifespan.
- Passive Protection Mechanism: Systems rely on predefined thresholds, limiting adaptability and resulting in delayed responses or false alarms during abnormal conditions.
- Poor User Interface Feedback: Basic indicators fail to provide detailed insights, preventing users from making informed decisions for battery optimization and safety.

V PROPOSED METHODOLOGY

The proposed system for the IoT-based battery monitoring system in electric vehicles (EVs) is designed to enhance battery safety, efficiency, and reliability by incorporating advanced monitoring, real-time data transmission, and automated safety measures. This system integrates multiple hardware and software components, including a voltage sensor, temperature sensor, flame sensor, NodeMCU, Arduino, LCD display, relay module, and a buzzer, all working in harmony to ensure the continuous monitoring of battery health and immediate response to critical conditions.

VI BLOCK DIAGRAM

Battery: This is the heart of the electric vehicle. The battery stores electrical energy and provides power to drive the vehicle. The monitoring system's primary purpose is to ensure the health and safety of this crucial component.

Power Supply Unit (PSU): This unit provides the necessary power to run the monitoring system's electronics. It might convert the high-voltage battery power to the appropriate levels needed for the sensors, microcontroller, and other components.

Voltage Sensor: This sensor measures the voltage of the battery. It provides real-time data on the battery's charge level. This information helps in determining the state of charge (SoC) and state of health (SoH) of the battery.

Temperature Sensor: It monitors the temperature of the battery. High temperatures can be detrimental to battery life, so this sensor ensures that the battery operates within a safe temperature range.

Fire Sensor: Safety is paramount, especially in high-energy environments like electric vehicle batteries. The fire sensor is a crucial component that can detect abnormal heat or fire conditions, triggering immediate alerts.

IoT Module: This is the core communication component that enables the system to send data to and receive commands from a remote server or user interface. It's responsible for connecting the system to the internet.

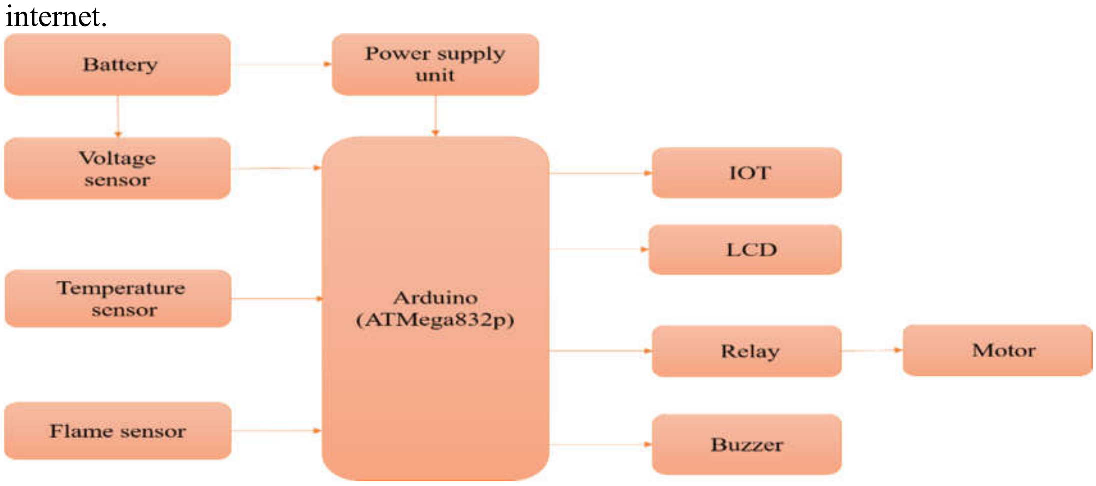

Fig 1: Basic Block Diagram.

VII APPLICATION

- Monitoring and managing battery systems in electric boats and ships to ensure safe and efficient maritime operations.
- The battery-powered medical devices, ensuring they operate reliably in critical healthcare settings.
- Monitoring battery health in electric bicycles and scooters used for urban transportation.

VIII RESULTS AND CONCLUSION

In this paper, we have proposed an IoT-based battery monitoring system for electric vehicles that leverages wireless communication and cloud computing to collect and analyze battery data in real-time. Our system offers granular and accurate insights into battery health and performance, real-time monitoring and analysis capabilities, cloud-based analysis, and enhanced safety. Through our experiments and evaluations, we have demonstrated the effectiveness and reliability of our system in detecting potential issues and providing actionable insights to users. We have also shown that our system can be easily integrated into existing electric vehicle infrastructure and can scale to accommodate large fleets of vehicles. The paper described the design and development of an IoT-based battery monitoring system for electric vehicle to ensure the battery performance degradation. We are developing the system for battery management in electric vehicle by controlling the crucial parameters such as voltage and temperature. It is very important that the BMS should be well maintained with battery reliability and safety. This present paper focusses on the study of Battery Management System and optimizes the power performances of electric vehicles. Moreover, the target of reducing the greenhouse gases can greatly be achieved by using battery management system.

IX FUTURE SCOPE

An IoT-based battery monitoring system in electric vehicles is an essential aspect of ensuring efficient operation and prolonging the battery life of electric vehicles. IoT-based battery monitoring systems can collect a significant amount of data related to battery usage and performance. By applying advanced data analytics, such as machine learning and artificial intelligence, to this data, the system can gain a deeper understanding of battery performance and predict potential issues before they occur. Integrating IoT-based battery monitoring systems with smart grids can enable better control and optimization of the energy flow between the vehicle and the grid.

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