WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

IOT Based Efficient Battery Monitoring System for E-Vehicles

[1]Prof. Shivkumar Londhe, [2]Payal Kurandale, [3]Kajal Kurandale

[1,2,3] Samarth College of Engineering and Manegment, Belhe

INTRODUCTION

In recent years, the environmental issues caused by traditional gasoline-powered vehicles have been addressed through the rise of electric vehicles (EVs), which are viewed as a viable alternative. As the world shifts toward sustainable mobility, there is an increasing need to enhance EV performance, efficiency, and safety. At the heart of electric mobility lies the battery, which powers the internal systems of these vehicles.

The Internet of Things (IoT) is a groundbreaking technology that is transforming various industries, including the automotive sector. A novel IoT-based battery monitoring system has been developed to provide real-time insights into the critical components powering electric vehicles. This system is expected to revolutionize the EV market by improving usability, reliability, and accessibility.

The IoT-based battery monitoring system is an innovative solution that integrates intelligent sensors, advanced data analytics, and cloud connectivity to monitor and manage EV batteries with remarkable precision. This article delves into the potential of this technology. With access to detailed information on battery health, charging behaviors, and usage patterns, EV owners, fleet managers, and manufacturers can make informed decisions to ensure optimal performance.

The IoT-based system fosters a proactive approach to battery management by offering continuous monitoring, data visualization, and remote diagnostics. This enables early detection of potential issues, prolonging battery life and reducing costly downtime. Furthermore, the seamless integration of IoT technology allows users to monitor battery status in real time through mobile apps or web platforms, delivering an exceptional user experience.

The technical aspects and key features of the IoT-based battery monitoring system, highlighting its ability to enhance safety by detecting abnormal battery behavior and preventing hazardous situations. Additionally, we will discuss how this advanced system supports efficient charging strategies, minimizes energy waste, and aids in the adoption of renewable energy sources within the EV ecosystem.

The industrial process expansion has increased complexity within electronic systems. In this evolving industrial landscape, detecting and isolating faults has become crucial. This proposed work simplifies the process of identifying faults in electric vehicles (EVs), particularly within the battery, which is a vulnerable component. Battery performance is affected by factors like depth of discharge (DoD), temperature, and charging duration. This project aims to provide real-time data on current and voltage levels using the Internet of Things (IoT) to facilitate fault analysis based on battery output.

Batteries convert chemical energy into electrical energy through electrochemical reactions, with lead-acid batteries being commonly used in UPS systems. Regular monitoring of key parameters such as terminal voltage, load current, discharge current, and ambient temperature is essential to determine the battery's health. In industries, UPS systems rely on uninterrupted power for smooth operation, and lead-acid batteries serve as a critical backup power source.

Battery Management Systems (BMS) play a vital role across applications like electric vehicles (EVs), hybrid electric vehicles (HEVs), uninterrupted power supplies (UPS), and telecommunications. The accuracy of these systems remains a point of discussion, as they generally exhibit up to a 10% margin of error when considering all relevant parameters. Batteries are the backbone of automation systems, widely used in various fields where reliable electrical power is required. Continuous monitoring of batteries is essential to ensure uninterrupted power delivery to the load.

OBJECTIVE:

The objective behind choosing a project focused on a battery management system (BMS) and a burning prevention system for electric vehicle (EV) batteries can be attributed to several key factors:

Safety: Ensuring the safety of EV batteries is critical due to the large amount of energy they store and their vulnerability to risks such as thermal runaway, overcharging, and short-circuiting, which could result in fires or explosions. This project is driven by the need to develop a robust BMS and burning prevention system to monitor, protect, and prevent these hazards, thus ensuring safe operation and minimizing accident risks.

Reliability: For EVs to operate efficiently and without interruptions, battery reliability is essential. A BMS is responsible for monitoring the battery's state of charge (SoC), state of health (SoH), and protecting it from adverse conditions like overvoltage, undervoltage, and overcurrent. The project motivation stems from the need to design a reliable BMS and burning prevention system that ensures optimal battery performance and longevity, improving overall EV reliability.

Battery performance optimization: Maximizing the efficiency and performance of EV batteries is crucial. The BMS plays a key role in managing charging rates, balancing cell voltages, and preventing overcharging or over-discharging. The motivation here is to create an advanced BMS and burning prevention system that enhances the battery's capacity, lifespan, and overall performance, thereby extending the range and efficiency of EVs.

Compliance with standards and regulations: EV batteries must meet strict safety standards and regulations set by organizations like IEEE and ISO. This project is motivated by the need to develop a BMS and burning prevention system that complies with these standards, ensuring the safe, reliable operation of EVs while meeting regulatory requirements for market acceptance.

Innovation and technological advancement: The rapidly evolving field of EV and battery technology is fueled by a drive for continuous innovation. This project is motivated by the opportunity to contribute to the development of cutting-edge BMS and burning prevention technologies, introducing new methods and algorithms that improve battery safety, reliability, and performance, while pushing the boundaries of future advancements.

Environmental sustainability: EVs are seen as a more sustainable alternative to traditional combustion-engine vehicles due to their zero emissions. The project is also motivated by the desire to support the development of eco-friendly transportation through a BMS and burning prevention system that ensures safe, efficient battery operations, reducing the environmental impact of EVs.

Overall, the decision to focus on a BMS and burning prevention system for EV batteries is driven by the need for safety, reliability, performance optimization, regulatory compliance, innovation, and sustainability, with the ultimate goal of advancing EV technology and ensuring the secure and efficient functioning of EV batteries.

Overview:

A battery management system (BMS) is an essential component in electric vehicles (EVs) that regulates and monitors the charging and discharging of battery cells. Its primary function is to ensure the safety, efficiency, and durability of the battery pack by preventing issues such as overcharging, over-discharging, and overheating.

The BMS continuously tracks and balances cell voltages, temperature, and state of charge (SoC) to guarantee that all cells operate within safe parameters. It also communicates with the vehicle's electronic control unit (ECU) to provide accurate information on battery capacity and driving range.

Additionally, the BMS performs several critical tasks aimed at optimizing performance and protecting the battery pack, including:

- Cell balancing: Ensures that all cells maintain the same voltage level, thereby maximizing the pack's capacity and prolonging battery life.
- Thermal management: Monitors cell temperatures and manages the cooling system to prevent overheating, which could lead to fires or explosions.
- Fault detection and diagnosis: Identifies abnormal conditions or faults in the battery pack, notifying the driver or taking preventive action to avoid damage.

To mitigate the risk of fire or overheating in an EV, it's vital to follow proper safety protocols in conjunction with the BMS. One of the most crucial safety measures is maintaining the battery pack's temperature efficiently, ideally between 20°C and 35°C. The cooling system should be designed and installed to support effective thermal management.

Moreover, preventing overcharging is critical. The BMS must accurately monitor the battery's state of charge, controlling the charging system to avoid overvoltage conditions. Ensuring that voltage levels stay within safe limits helps prevent excessive current from flowing into the battery, reducing the risk of the battery electrolyte igniting.

In summary, a battery management system (BMS) plays a key role in maintaining the safety, performance, and longevity of an EV's battery pack. Additionally, proper precautions must be taken to prevent overheating or overcharging, both of which could result in fire hazards.

LITERATURE SURVEY:

Atzori et al. (2017) presents an analysis of the Internet of Things (IoT), offering a detailed understanding of its definition, potential, and societal implications. The paper highlights how the IoT bridges the gap between the internet and the physical world, integrating various technologies into communication systems. It underscores the significance of IoT in today's world, where the internet plays a pivotal role in daily life. The study explores IoT's key applications in tracking and identifying smart objects, enabled by Wireless Sensing Networks (WSNs), which permeate numerous aspects of modern living. The research envisions a future where digital and physical worlds are seamlessly connected through robust communication technologies, while addressing the challenges, innovations, and applications related to IoT.

Wu et al. (2015) investigates the effects of overcharging and over-discharging on lithium-ion batteries (LIBs) in electric vehicles. Through dynamic simulation models, this study examines the potential hazards associated with these conditions and emphasizes the need for accurate fault diagnosis to prevent battery failure. The findings suggest that both overcharge and over-discharge faults can severely impact the performance of automotive LIBs, and the research highlights the importance of further attention from automobile manufacturers to enhance battery safety and reliability.

López-Benítez et al. (2017) introduces a new mathematical model to accurately predict data traffic for IoT applications. The study challenges conventional statistical models, such as Poisson or Exponential distributions, which may not provide the best fit for IoT data generation. Using real data from a smart home prototype, the authors demonstrate that a single statistical distribution may not be adequate. This paper contributes to a better understanding of data traffic behavior in IoT systems, offering practical applications for enhancing network performance.

A study by Mohamad et al. (2016) discusses the design and implementation of a real-time vehicle tracking system using Arduino and GPS technology. The system provides users with precise vehicle location data, including latitude and longitude, displayed on an LCD screen. By integrating the system with cloud-based tools like ThingSpeak and Freeboard, users can track vehicle movement and pinpoint the exact location on a map. This system offers a practical solution for tracking vehicles in real-time, particularly in scenarios such as delivery services or theft prevention.

Xia, Velandia et al. (2016) delve into the use of RFID technology for monitoring, traceability, and tracking in industrial settings, particularly crankshaft production. The study addresses the challenge of optimizing the inspection process by balancing inspection time with cost and reliability. Using a two-machine flow shop robotic cell, the research explores how adjusting inspection strategies can impact product quality, ultimately seeking an optimal balance between inspection time and quality control.

Tian et al. (2017) presents a nonlinear observer design for estimating the State-of-Charge (SOC) in lithium-ion batteries. SOC is crucial for monitoring and diagnosing battery health, and this paper explores two observer designs based on electrochemical models. The first observer utilizes a constant gain Luenberger structure, while the second improves upon it with a Jacobian-weighted gain. The effectiveness of both designs is demonstrated through simulations, showcasing the potential for more accurate SOC estimation in battery management systems.

METHODOLOGY

Cost-benefit analysis: Perform a detailed cost-benefit analysis to assess the financial viability and potential savings of implementing an IoT-enabled battery monitoring system. These goals should act as a clear roadmap for guiding the research, development, and deployment of an IoT-based EV battery monitoring solution. The purpose of this proposed work is to design and create a real-time IoT-based battery monitoring system for electric vehicles, capable of tracking key parameters like State of Charge (SoC) and State of Health (SoH). The system is intended to be highly reliable, precise, and cost-efficient.

To achieve this, the following specific objectives have been set:

1. Review and assess existing research on IoT-enabled EV battery monitoring systems: This will involve a thorough review of relevant scientific papers, conference proceedings, and other published works.
2. Identify the key challenges and limitations of current systems, and propose solutions to overcome them: This involves analyzing the strengths and weaknesses of existing systems and formulating new strategies to address these gaps.
3. Design and prototype an IoT-based battery monitoring system for EVs: This includes selecting appropriate sensors, microcontrollers, wireless communication modules, and other necessary components, as well as developing software algorithms for data collection, processing, and transmission.
4. Test and evaluate the prototype system under various operational conditions: This involves both lab testing and field trials using real electric vehicles.
5. Analyze the performance of the developed system using the collected data: Conduct statistical analysis on the gathered data to evaluate the system’s efficiency and reliability, and compare its performance with existing solutions.
6. Provide recommendations for further improvements in IoT-based battery monitoring systems for EVs: This will include identifying areas for future research and proposing strategies for improving the developed system's efficiency, reliability, and cost-effectiveness.

Overall, this project aims to contribute to the advancement of battery monitoring technologies to enhance the performance, reliability, and safety of electric vehicles. By utilizing IoT technology, this work intends to address current system limitations and provide a more accurate and dependable method for monitoring battery health and performance.

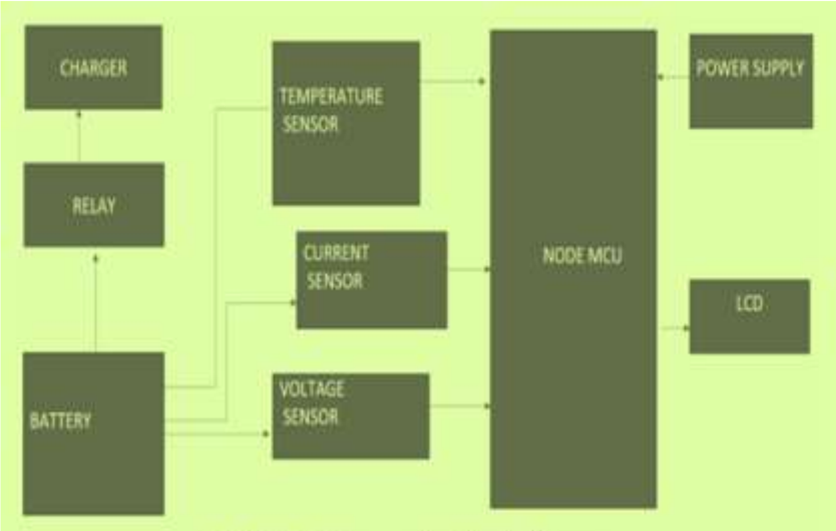

Fig 2.1: Existing system block diagram