International Journal of Engineering Applied Sciences and Technology, 2024
Vol. 9, Issue 08, ISSN No. 2455-2143, Pages 57-60
Published Online December 2024 in IJEAST (http://www.ijeast.com)

E BIKE BATTERY HEALTH PARAMETER CHECKER WITH REAL TIME DATA ON WEB

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Abstract: **With the increasing adoption of electric bicycles (e-bikes), ensuring battery health and performance is critical for safety, efficiency, and longevity. This paper explores the development of real-time battery health monitoring systems integrated with web-based platforms. Recent advancements leverage IoT-enabled sensors, cloud computing, and data analytics to provide continuous monitoring and predictive maintenance. Key parameters such as voltage, current, temperature, state of charge (SoC), and state of health (SoH) are tracked in real-time and visualized on user-accessible web dashboards. Studies highlight innovative approaches like Smart E-Bike Monitoring Systems (SEMS), acoustic-based charge detection (SingMonitor), and cloud-based battery management architectures. These technologies enable proactive maintenance, enhance user experience, and contribute to sustainable e-mobility solutions. This paper reviews existing research, discusses challenges such as data security and system scalability, and proposes future directions for intelligent e-bike battery health monitoring.**

Keyword- **SEMS, SOH, Lithium ions batteries.**

I. INTRODUCTION

The growing demand for electric bicycles (e-bikes) as a sustainable mode of transportation has increased the need for efficient battery management systems. The performance and longevity of e-bike batteries are directly influenced by factors such as charging cycles, temperature variations, and discharge patterns. Without proper monitoring, battery degradation can lead to reduced efficiency, unexpected failures, and safety hazards.

Traditional battery monitoring methods rely on periodic manual inspections, which are often inefficient and fail to provide real-time insights into battery health. To address these limitations, modern e-bike battery management systems integrate real-time data collection with web-based platforms, leveraging the Internet of Things (IoT) and cloud computing technologies. These systems continuously track key battery health parameters, including voltage, current, temperature, state of charge (SoC), and state of health (SoH), ensuring proactive maintenance and optimized performance.

Recent research has introduced innovative approaches to real-time battery monitoring, such as Smart E-Bike Monitoring Systems (SEMS), acoustic-based charge detection (SingMonitor), and IoT-enabled battery management architectures. These advancements enhance user experience, improve safety, and contribute to the long-term sustainability of electric mobility solutions. However, challenges such as data security, system scalability, and integration with existing e-bike infrastructure need to be addressed for widespread adoption.

This paper explores the latest advancements in real-time e-bike battery health monitoring, discussing the benefits, challenges, and future directions of implementing web-based battery diagnostics for enhanced efficiency and user convenience.

II. RELATED WORK

Several studies have explored the implementation of real-time monitoring systems for e-bike battery health, integrating IoT, cloud computing, and web-based interfaces to enhance performance and safety. These works focus on different aspects, such as data acquisition, predictive maintenance, and remote diagnostics.

Kiefer and Behrendt introduced the **Smart E-Bike Monitoring System (SEMS)**, a modular and scalable platform designed for real-time e-bike data acquisition. The system collects information on battery health, location, and rider behavior, transmitting it to a web-based platform for visualization and analysis. This research emphasizes the importance of real-time monitoring in improving battery lifespan and overall e-bike efficiency.

Jian et al. proposed **SingMonitor**, a novel approach that remotely monitors e-bike charging status using sound signals. The system leverages unique current-induced acoustic signatures that travel through the power grid and affect mobile device power supplies. By analyzing these sound variations, the system accurately determines the e-bike’s charging state, providing a cost-effective and non-intrusive monitoring method.

Another significant development is the **IoT-Based Battery Monitoring and Management System** by Chen et al. This framework adopts a "cloud-network-edge-end" IoT architecture, enabling continuous tracking of battery parameters such as voltage, temperature, and charge cycles. The collected data is processed on cloud servers and displayed on a web interface, allowing users and fleet operators to monitor battery performance remotely. The system also provides predictive analytics for battery maintenance, reducing unexpected failures.

Further research has explored the use of **machine learning algorithms** for battery health prediction. Studies indicate that AI-driven models can analyze historical battery data to forecast degradation patterns, enhancing preventive maintenance strategies. However, challenges remain in integrating these models into real-time web applications due to computational complexity and data privacy concerns.

While these studies demonstrate significant advancements in e-bike battery monitoring, further work is needed to address scalability, security, and integration with existing e-bike systems. This paper builds on prior research by proposing a comprehensive real-time battery health monitoring system with enhanced web accessibility and predictive analytics.

III. METHODOLOGY

This study proposes a real-time e-bike battery health monitoring system that integrates IoT-based sensors, cloud computing, and a web-based user interface to ensure efficient battery management. The system architecture consists of four main components: **data acquisition, data transmission, cloud-based processing, and web visualization**.

3.1. Data Acquisition

To monitor battery health parameters, a set of IoT-enabled sensors is integrated into the e-bike's battery management system (BMS). These sensors continuously measure key metrics, including:

- **Voltage (V)** – To assess the charge level and detect abnormalities.
- **Current (A)** – To monitor charging and discharging rates.
- **Temperature (°C)** – To prevent overheating and thermal runaway.
- **State of Charge (SoC) & State of Health (SoH)** – To evaluate battery efficiency and predict degradation trends.

IV. EXPERIMENTSANDANALYSIS

The system's analysis and experiments are reported in this part. The experiment's procedures and findings regarding the voltage sensor and GSM module's properties will be explained first. This will ensure that the circuits are in good working order. Experiments and findings to confirm battery deterioration will next be described.

As seen in Figure 1, a millimetre was used in this experiment to measure the values of five (5) batteries. Then, as illustrated in Figure 2, these values were contrasted with those of the identical batteries that were linked to the voltage sensor circuit. Showing the variations and accuracy percentage between the two figures is the goal. The voltage levels of the chosen batteries were changed. Both new and old batteries were included. These variations will be evident in the measurement findings.

Fig.1 Battery voltage measurement using millimetre

4.1GPSModule Experiment

The correctness of the GPS coordinate was ascertained in this subsection by verifying the SIM808 GSM/GPRS/GPS module's characteristics. Additionally, this experiment will ascertain the module's usefulness. The module's experimental configuration is depicted in Figure 3. Five (5) distinct target sites were used for the trials, and each location's GPS coordinates were gathered. The coordinates obtained from the Google Maps website were then contrasted with these GPS coordinates.

Fig.2: Battery voltage measurement using voltage sensor circuit.

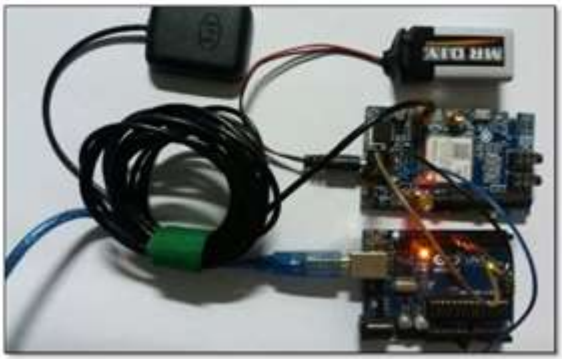

Fig.3 SIM808 module experimental setup

4.2 Battery Monitoring System

The SIM808 module plus a voltage sensor make up the suggested battery monitoring system in this study. In the preceding subsections, experiments and analysis were presented to demonstrate the features and utility of the sensor and module. Thus, the utility of the battery monitoring system is illustrated in this subsection. The battery monitoring system's built hardware circuit is displayed in Figure 4. The SIM808 module is linked to the voltage sensor in the figure. It has been confirmed that the system can concurrently show coordinates and voltage readings. With a one-minute lag, the coordinates and voltage values are updated in real time. When the battery voltage is less than 2.8V for less than 2.4 hours, the marker will bounce.

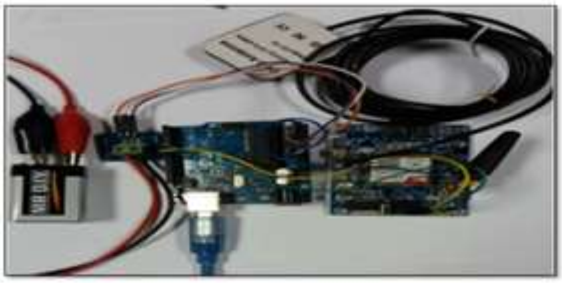

Fig.4 : Hardware for the developed battery monitoring system.

4.3 Battery Monitoring System User Interface

A web-based user interface is another feature of the designed battery monitoring system. The user interface can track the positions of several battery monitoring devices as well as the battery's status. Therefore, the scenario when it is necessary to monitor the states of many batteries has been taken into account in the design of the UserInterface.

The web-based user interface's home page is displayed in Figure 11. Before using the interface, a user must log in. The user must enter their username and password on the login screen, which is designed for safe data management.

Fig.05: User interface for the proposed battery monitoring system

V. CONCLUSION

The design and implementation of an Internet of Things (IoT)-based battery monitoring system for electric vehicles was covered in the article. This system ensures that battery performance degradation may be tracked online. The goal is to demonstrate that the idea's notion is feasible. The hardware for the battery monitoring device and an online user interface for battery monitoring comprise the system's development. By using a GPS system to determine the coordinates and display them on the Google Maps app, the system may provide information about location, battery life, and time over the internet.

By adding additional features, the system can be further modified to make it better. By creating smartphone applications, the system can be utilized on smartphones.

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