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Electric Vehicles Temperature Monitoring System

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ABSTRACT

This paper demonstrates how to monitor the performance of an electric vehicle battery using a cloud-based IoT system. Battery serves as the source of energy for an electric vehicle. As a result, it is critical to check the battery's voltage level, as improper charging and draining of a lithium battery might result in a major safety concern. The notion of monitoring the performance of the vehicle using IoT techniques is suggested in this study. The Raspberry Pi acts as server, so that monitoring may be done immediately. Based on the measurement, the proposed cloud-based electric vehicle temperature monitoring system utilizing IoT calculates the power, State of Charge, and State of Health and assures healthiness. The system is capable of detecting and communicating with the user to take appropriate action.

KEYWORDS: Cloud-based IoT system, Battery monitoring system, Wireless battery management system, Raspberry Pi 3, Internet of Things.

1. INTRODUCTION

As gasoline prices rise, electric cars (EVs) are becoming more popular. As a result of this situation, several automakers are seeking for other energy sources. Electric energy sources could help the environment by lowering pollution. Furthermore, electric vehicles offer significant energy savings and environmental protection. Rechargeable lithium-ion batteries are used in the majority of electric vehicles. It is substantially smaller than lead-acid batteries. In reality, it provides steady power and has a 6 to 10 time's longer life cycle than a lead-acid battery. Overcharging and severe discharges can both shorten the life cycle of a lithium-ion battery. EVs on the other hand, typically have a limited range of travel due to battery capacity and body form. The safety of existing battery technology is now a key roll that limits the adoption of EVs. Overcharging a battery, for example, can drastically limit its life span while also posing substantial safety risks, such as fire. An EV battery monitoring system that can warn the user to battery conditions is essential to avoid the aforementioned difficulties. Previous battery monitoring systems simply monitored and detected the state of the battery and warned the user via a battery indicator within the vehicle. Because of improvements in notification system design, internet of things (IoT) technology can be utilized to notify the manufacturer and users about the battery state. Building a cloud-based monitoring system is very important to avoid data loss. This is one of the maintenance support procedures that the manufacturer can perform. IoT extends the usage of internet connectivity beyond traditional applications, allowing a wide range of gadgets and ordinary objects to be connected via the internet, putting the world at the user's fingertips.

Motivated by the challenges outlined, this study proposes the design and implementation of a cloud-based temperature monitoring system using IoT technology.

2. LITERATURE REVIEW

For safety, dependable battery management is required. A variety of factors contribute to battery failure, including battery degradation and design errors. The data from a manual battery monitoring system is not kept in a database like that of a conventional battery monitoring system. However, only real-time data is displayed. As a result, it is critical to use wireless technologies to remotely monitor battery systems. Several battery monitoring systems have been created for the industry that uses wireless communication, such as uninterruptible power supply (UPS), which is crucial to assure continuity of power supply for home and commercial during a power outage. Suresh et al. proposed a PLC-based UPS battery health monitoring system that uses GSM modules and SCADA to send alarm signals when batteries are in critical condition and at room temperature [6]. Sardar et al. also created a GSM-based battery monitoring system for UPS [7]. The system could monitor the battery's voltage, current, and temperature. Hommalai et al. created a battery monitoring system for UPS that uses wireless communication to identify dead battery cells [8].

There is also various research relating to the development of a wireless communication-based battery monitoring system for EVs. Dhotre et al. created an autonomous battery charging and engine management system for EVs using a GSM module [9]. An SMS is delivered to the user when the battery's health goes below a specified threshold. The user can then send an SMS command to have the engine start charging the battery automatically. Using a 2.4GHz radio transmission technology, Mathew et al. proposed a wireless battery monitoring system for electric vehicles [10]. A transmission module (monitors and batteries) and a controller module make up the modular design (receives battery status). Bacquet et al. also developed a 2.4GHz radio-based battery management system for electric vehicles [11]. They demonstrated that even in adverse conditions, radio transmission for EV battery monitoring is possible. Luo et al. developed a GPRS-based battery monitoring system for EVs, which consists of an online monitoring terminal that measures battery parameters (voltage and temperature), as well as a GPRS data transmitter unit and a battery monitoring user interface [12]. Based on ZigBee communication and point-to-point wireless architecture, Rahman et al. proposed a battery management system for electric vehicles [13]. ZigBee was chosen due to its low power consumption, low cost, high reliability, and modest data speeds. They discovered that while a wireless battery management system is required for EVs to balance the charge and extend battery life, it is poor at controlling battery temperature. Menghua et al. have presented a lithium-ion battery monitoring system for EVs that uses a smartphone to collect and show voltage, current, temperature, and other battery parameters [14]. According to the previous work, there is no automatic monitoring system available to notify the user of the battery's performance. As a result, including IoT technology into the monitoring system can help with improving preventative maintenance, ensuring battery quality, and promoting user safety.

3. MATERIALS AND METHODOLOGY

In this paper, the proposed cost-effective system uses a Raspberry Pi 3 to track the vehicle battery temperature and location. Not only does the registered device receive an alert, but so do all other users. We won't require a separate GSM module to send SMS because the warning will be delivered to the user as pushed alerts over the internet, making the system more reliable. The sensor is connected to the vehicle, and the sensor data is sent to the Raspberry Pi 3, which acts as a communication gateway. The data is then sent to a cloud database, where it is made available to the corresponding application, allowing us to monitor real-time data. The following is a list of the hardware requirements for implementing the monitoring system.

A. Prerequisites

- OBD-II Device with USB Cable
- RaspberryPi3, 4G WIFI dongle
- Compatible display, speed & temperature sensors, and GPS module.

Interfacing with the Raspberry Pi 3 and OBD-II:
With a quad-core ARM CortexA53 CPU, the Raspberry Pi 3 is said to be 10 times faster than the Raspberry Pi 1.

This was said to be extremely reliant on task management and the instruction set used. In parallelized workloads, the Raspberry Pi 3 was shown to be around 80% quicker than the Raspberry Pi 2. The ONBOARD DIAGNOSTICS (OBD) tool is responsible for monitoring the battery state, discharge, and temperature of an electric vehicle's battery.A data connection that uses the CAN protocol will be found in vehicles that conform to OBD-II regulations. PyOBD is a free and open-source OBD-II compliant scanner. It may be used to connect to low-cost ELM-USB devices. Here, it can connect the OBD-II device to the Raspberry Pi 3, and the data will be sent to our mobile app. The design is shown in Figure 1.

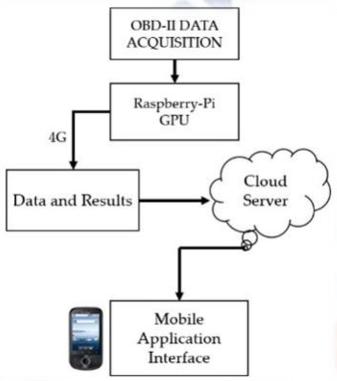

Figure 1:Design of Experiment

B. Real-time monitoring

The data is collected in the electric vehicle utilizing cloud-based IoT and transferred to the Raspberry Pi 3. The Raspberry Pi 3 is connected to the internet through a Wi-Fi dongle, which works as a gateway, and the sensor data is uploaded to a cloud database or data visualization platform.

The mobile application that offers the live stream retrieves this information. Additionally, the user may configure an alert system to notify him or her anytime the car surpasses a particular temperature or is overcharged.

C. Emergency Alert System

The impact is detected if the automobile is overcharged, has a lower voltage connection, or has a temperature difference. An alert notice is delivered to the appropriate users if the effect is greater than or equal to the average computed impact (Threshold) that poses a threat to human life. This information can also be transmitted to the manufacturer so that the sufferer can get care right away. Figure 2 illustrates the system.

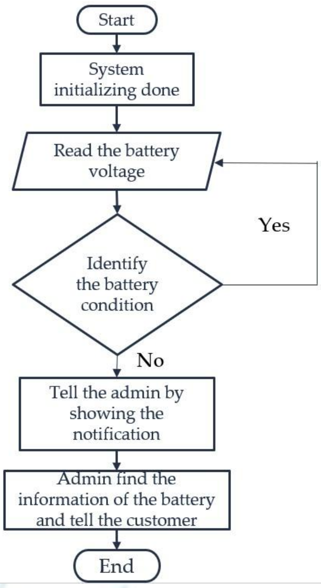

Figure 2. The layout of the proposed system.

D. Mobile Application

The user interface of the mobile application is advanced. The user may use this program to monitor their vehicle and establish different limits, such as being notified if the vehicle temperature rises. This assures the passengers' safety. This application's key feature is that it gives real-time vehicle data, as well as data visualization and comparison.

The sample application is shown in Figure 3. This low-cost efficient arrangement may be used to monitor the vehicle's life and health data.

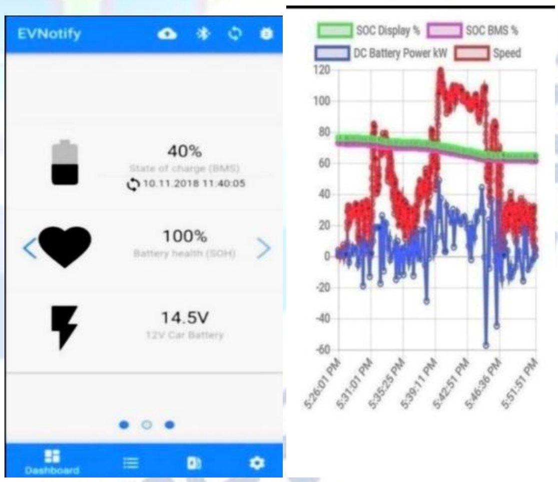

Figure 3: Example of a mobile application

4. RESULTS

As data can be gathered in real-time, this technology may be used to monitor automobiles and assure people's safety. The data acquired from the vehicle may be utilized to analyze the vehicle's condition using a cloud-based electrical vehicle temperature monitoring system that uses IoT, and alarms can be delivered if a certain threshold limit is surpassed. The manufacturer can use the mobile application to track the battery management of the vehicle, as well as identify driver behaviour. Data about the vehicle's status and location can be examined in real time, and the owner can be notified promptly if any suspicious occurrences occur. As numerous sensors monitoring can be combined with the raspberry pi, the temperature of the vehicle may be monitored. In a real-time system where pushed alerts might be sent in an unusual situation such as an accident, alerting individuals in times of emergency or accidents. This data from the car may also be utilized for other investigations and to improve the vehicle further.

5. CONCLUSION

The improvement of battery car performance is investigated in this article. The design and deployment of a cloud-based temperature monitoring system for electric vehicles that employs IoT to ensure that battery performance, temperature, and deterioration can be watched in real time were discussed in the study. The development of the system includes the production of both hardware and a web-based user interface for the battery monitoring gadget. More features could be added to the system to make it even better. The vehicle owner can quickly present information such as position, battery status, and time over the internet to monitor the health of his vehicle, and he can easily decide whether to take power from the grid or sell power to the grid by using GPS to identify the coordinate and displaying it on the Google Maps application. In the future, handling many users may allow you to compare the states of different users.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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