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EV Charging Station Location Detection System

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***Abstract* - Electric vehicles are rapidly gaining popularity due to their numerous advantages such as low maintenance, reduced emissions, and lower cost of ownership. However, the lack of infrastructure for charging stations, as well as the need for better battery management, are hindering their widespread adoption. To address these issues, a cloud-based EV battery management and charging station technology can be utilized. In this project, we propose to use a Raspberry Pi database, along with temperature, voltage, and current sensors, and cloud platforms to create a comprehensive battery management system. The system's primary objective is to log all information about the battery level and display it to the user in real-time. The system will collect data on various parameters such as voltage, current, and power consumption, and will provide real-time tracking via GPS navigation. If the battery level is too low, the system will automatically notify the user via the IoT platform, indicating the need for charging. The system will also display the nearest charging station relative to the EV's current location, which will help users find charging stations quickly and conveniently. Overall, the proposed system is designed to provide a comprehensive solution for EV battery management, making it easier for users to monitor their EVs' battery levels and locate charging stations when needed. The use of cloud-based technology and the integration of various sensors and platforms will ensure the system's reliability and accuracy, while also improving the overall user experience.**

***Keywords*— Battery Management system, Electric vehicle, Internet of things, Battery, Location.**

I. Introduction

On 7th January 2013, a Boeing 787 flight was parked for maintenance, at that point, a mechanic observed smoke and flames emerging from the flight's auxiliary power unit (Lithium battery Pack).[12] An All-Nippon Airways flight with the flight number 787 experienced another battery failure on January 16, 2013, leading to an emergency landing at the Japanese airport. The lithium battery pack of the B-787 had a CT scan following a series of cooperative investigations by the US and Japan, and the results showed that one of the eight Li-ion cells had been damaged, leading to a short circuit that resulted in a thermal runaway with fire. This tragedy might have been easily prevented if the Li-ion battery pack's battery management system had been built to recognise and prevent short circuits.[13]

Battery management systems (BMS) are electronic control circuits that monitor and control how batteries are charged and discharged. Among the battery variables that must be monitored are the battery type, voltages, temperatures, capacities, charge states, power consumption, remaining runtime, and charging cycles. Making sure that a battery's remaining energy is utilised as effectively as feasible is the responsibility of battery management systems. In order to avoid overloading the batteries,[5] BMS systems protect them from deep discharge and over-voltage, which are brought on by incredibly fast charging and incredibly high discharge current. In the case of multi-cell batteries, the battery management system additionally provides a cell balancing function to guarantee that different battery cells have the same charging and discharging requirements.

This project is to develop a system which will show a complete detail of the battery level and the details will be stored in the form of logs in the system itself which includes Voltage, Current, Power, consumption of power, live tracking with GPS navigation system.[2] Moreover, if the battery level is too low it will show the IoT platform and a notification will be sent to the user. The system will show the nearest charging station with respect to the EV live location.

II. Literature Survey

The use of the Internet of Things (IoT) in monitoring the operation of an electric vehicle battery is described in this study [1]. It goes without saying that a battery serves as the sole energy source for an electric vehicle. On the other hand, the energy supplied to the vehicle is steadily decreasing, which has a negative impact on performance. Battery manufacturers frequently have serious concerns about this. In order to do direct monitoring, it is suggested in this study that IoT approaches be used to track the performance of the vehicle. The monitor and the interface are the two primary parts of the proposed IoT-based battery monitoring The system implemented in [2] supports e-mobility and can be applied to Electric Vehicles (EV). a clever battery management mechanism that can increase battery life. an approach for controlling side reactions that cause capacity loss that dynamically modifies the battery pack's series-parallel cell structure. Faults in the internal battery Since the behaviour of a Li-ion cell is still not completely understood, internal battery problems are challenging to identify [5]. Overcharge, over discharge, internal short circuit, overheating, and thermal runaway are a few instances of internal battery issues. A fault called overcharge can result in more serious issues like rapid deterioration and thermal runaway. It could be caused by the capacity change of the pack's cells, erroneous voltage and current measurements, or inaccurate SOC estimates from the BMS in Li-ion batteries [6]. A normal battery pack can also get overcharged when the charger breaks down. system. Based on test findings, the system can identify declining battery performance and notifying the user for additional action. The original two main functions of the BMS were monitoring and protecting the battery [7]. While the protecting function is in charge of getting the system to a safe state when the observed values go over or below their safe operational ranges, the monitoring function refers to the measurement of current, voltage, and temperature of the battery. [8, 9] The more recent and advanced BMS performs tasks including cell monitoring, cell balancing, battery safety and protection, state estimation, and thermal control, among others. [8, 9]

The paper referenced in the paragraph proposes an IoT-based battery monitoring system to address the issue of battery performance degradation in electric vehicles. The authors point out that the performance of an electric vehicle battery gradually decreases over time, which is a significant concern for battery manufacturers.[3] Traditional methods of monitoring battery performance rely on periodic maintenance and testing, which may not be effective in detecting degradation in real-time. To address this issue, the authors propose an IoT-based battery monitoring system that can monitor battery performance in real-time. The system consists of two major parts: a monitoring device that collects data on battery performance and a user interface that displays this data to the user. The monitoring device collects data on battery performance, such as current and voltage, and sends this data to the user interface using IoT technologies. The authors conducted experiments to evaluate the effectiveness of the proposed system in detecting degraded battery performance. The results showed that the system could detect degraded battery performance in real-time and sending notification messages to the user for further action. This approach has the potential to improve battery performance and extend the lifetime of electric vehicle batteries, which can reduce the cost of electric vehicle ownership and improve the overall sustainability of the transportation sector

III. Proposed System

The need for battery management systems for electric vehicles is becoming increasingly important as the demand for electric vehicles continues to rise. In response to this need, an automated battery management system was proposed in the paragraph above, which generates a message about nearby charging stations when the battery's charged value drops below its desired value.

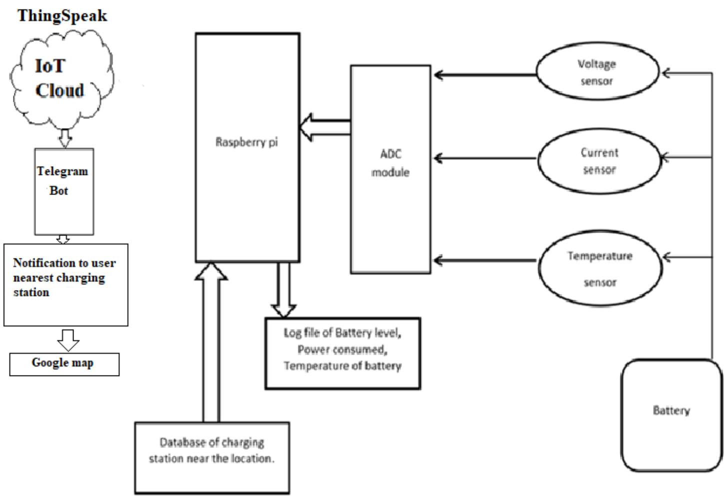

Figure 1 - System Architecture

The system includes voltage, current, and temperature sensors that check the values of their respective parameters and transmit them to a Raspberry Pi with the help of an Analog to Digital Converter (ADC). The ADC converts the analog values of sensors to digital values so that the Raspberry Pi can read them. Once the Raspberry Pi has read the values from the sensors, it checks whether they are below the desired value. If the values are lower than the desired value, the system generates a message about nearby charging stations. This message is displayed on Thingspeak, which is an Internet of Things (IoT) platform used to collect, store, and analyse data from IoT devices. Additionally, the system sends a text message to the user's mobile device using the Telegram messaging app.

This approach can help electric vehicle owners to manage their battery's charge level effectively and avoid running out of power while on the road. The ability to receive notifications about nearby charging stations can also improve the user experience and reduce the range anxiety associated with driving an electric vehicle.

IV. Result And Calculations

A. *Voltage Sensor Calculations*

As you can see from the above circuit diagram the **voltage detection sensor module** signal pin S is connected to An1 pin of analog digital converter. The -ve pin of sensor is connected to GND pin and +ve pin is connected to Vcc of Raspberry pi . On the other side battery +ve and -ve pins are connected to VCC and GND respectively.[14] When the we connected the battery to voltage sensor VCC and GRD it measures the voltage in analog value which read by analog digital converter and conver it into to digital form. Now this digital value is given to Raspberry pi, but user can’t understand the digital value for this we done some calculation as following,

$$\text{Vout} = \left[\text{adc output} \times \frac{\text{Vref}}{255}\right]$$

where,
Vout - It is battery Voltage
Adc output – It is Value that read by ADC
Vref – the battery total voltage.

B. *Current Sensor Calculations*

As you can see from the above circuit diagram the current detection sensor module signal pin OUT is connected to An2 pin of analog digital converter. The -ve pin of sensor is connected to grd pin and +ve pin is connected to Vcc of Raspberry pi. Then we connect battery +ve and -ve pins are connected to VCC and GND respectively in series connection . When the we connected the battery to cuuret sensor VCC and GRD it measures the current in analog value which read by analog digital converter and conver it into to digital form. Now this digital value is given to Raspberry pi, but user can't understand the digital value for this we done some calculation as following.

$$Current = \left[\text{adc output} \times \frac{\text{sensor Current Capacity}}{255}\right]$$

C. *Temperature Sensor*

The ADC module. To access this temperature sensor, the system uses the I2C (Inter-Integrated Circuit) protocol, which is a communication protocol used for device interfacing. With the help of the I2C protocol, the system can directly obtain the battery temperature without the need for any additional circuitry or modules. The I2C protocol is a two-wire serial communication protocol that allows multiple devices to be connected to a single bus. It is a master-slave protocol, where the master device initiates communication with the slave devices. In the battery monitoring system, the ADC module acts as the master device and the temperature sensor is the slave device. The ADC module sends a request to the temperature sensor to obtain its temperature reading. The temperature sensor then responds with the temperature data, which is in analog format. The ADC module then converts this analog signal into a digital signal, which can be easily processed by the system's microcontroller. By using the I2C protocol, the system can obtain accurate and real-time temperature readings of the battery. These temperature readings are crucial for monitoring the health of the battery and preventing any damage caused by overheating. The system can also use this temperature data to calculate the charging time required for the battery and to optimize the charging process for maximum efficiency.

In summary, the use of the I2C protocol in the battery monitoring system allows for easy and efficient access to the temperature sensor, enabling the system to obtain accurate temperature readings of the battery. This information is crucial for monitoring the health of the battery and optimizing the charging process for maximum efficiency.

RESULT

The system includes voltage, current, and temperature sensors that check the values of their respective parameters and transmit them to a Raspberry Pi with the help of an Analog to Digital Converter (ADC). The ADC converts the analog values of sensors to digital values so that the Raspberry Pi can read them. Once the Raspberry Pi has read the values from the sensors, it checks whether they are below the desired value. If the values are lower than the desired value, the system generates a message about nearby charging stations. This message is displayed on ThingSpeak, which is an Internet of Things (IoT) platform used to collect, store, and analyze data from IoT devices. Additionally, the system sends a text message to the user's mobile device using the Telegram messaging app.

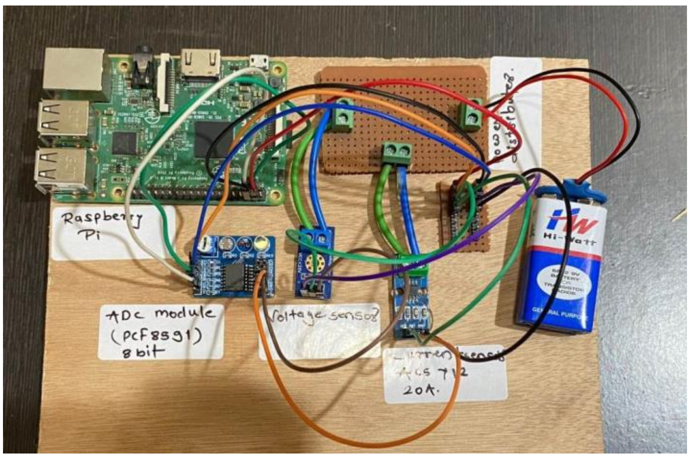

Figure 2 Battery Management System Model

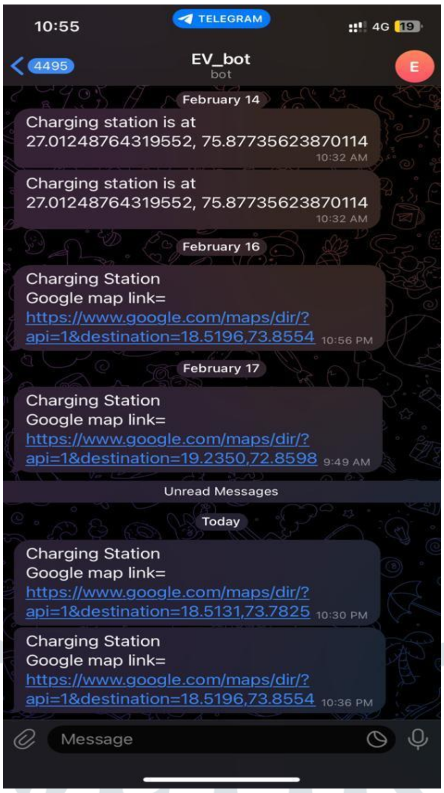

Figure 3 Telegram chatbot Output

The chatbot is used to receive notifications from the Raspberry Pi about the nearest charging station. To create a chatbot, the user needs to choose a platform or service that supports chatbot creation, such as Telegram chatbot can be configureured to receive notifications from the Raspberry Pi and send them to the user's mobile device.

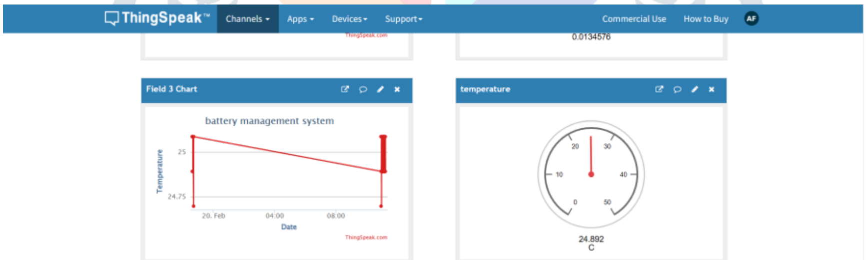

Figure 4 ThingSpeak output

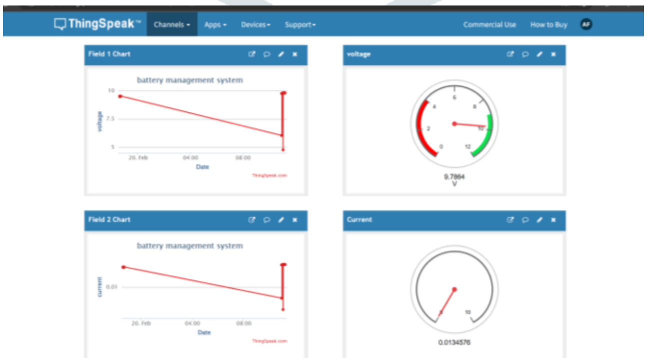

Figure 5 ThingSpeak output

ThingSpeak is an IoT platform that allows users to collect, analyze, and visualize data from sensors or devices. To use ThingSpeak, the user needs to create an account using their MatLab login credentials. Once the account is created, the user can create channels to store and visualize data, as well as set up triggers and alerts to notify the user of certain events.

V. Conclusion

The proposed battery monitoring system is a comprehensive solution that allows users to easily monitor the health and performance of their vehicle's battery. By utilizing an on-board monitoring device connected to various sensors, the system can collect and display important battery parameters such as voltage, current, and temperature in real-time through an Android smartphone with a web-based application. This enables users to easily keep track of their battery's status and take necessary actions if any abnormalities are detected. Additionally, the Android application also includes a feature that helps users locate nearby charging stations, making it easier to find a place to charge their vehicle's battery. The hardware kit for the monitoring system is designed to be easily implemented, and can be operated by anyone without requiring specialized technical knowledge.

One of the key benefits of this system is its ability to display the availability of charging slots in real-time, allowing users to plan their time accordingly for charging their vehicle. This feature saves users the time and hassle of having to search for charging stations and determine if they are available or not. Overall, the proposed battery monitoring system is a user-friendly and convenient solution for monitoring battery performance and ensuring optimal performance of electric vehicles.

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