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EV Swapping Station with Location System

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Abstract— **This paper presents a smart electric vehicle (EV) battery swapping station with a locator using the Internet of Things (IoT) and cloud technology. The proposed system aims to provide convenient and efficient battery-swapping services for EVs, while also enabling real-time data monitoring and analysis to optimize the operation of the system. The system consists of a station control unit, a locator control unit, a battery swapping control unit, and a user mobile app, all connected to the cloud. The station control unit and locator control unit communicate with the battery swapping control unit, which interacts with the vehicle to swap the battery. The user's mobile app communicates with the cloud to locate the nearest station, reserve a spot, and initiate the battery-swapping process. The proposed system offers a promising solution to overcome the limitations of traditional charging methods and encourage the widespread adoption of EVs.**

***Keywords*: Electric Vehicles, Battery Swapping, IoT, Cloud, Station Control Unit, Locator Control Unit**

I. INTRODUCTION

The widespread adoption of electric vehicles (EVs) is heavily dependent on the availability and convenience of charging infrastructure. While traditional charging methods require a significant amount of time for the battery to fully charge, batteryswapping stations offer a promising alternative that enables EVs to be quickly recharged by simply swapping out the depletedbattery with a fully charged one. In this paper, we propose a smart EV battery swapping station that leverages the Internet ofThings (IoT) and cloud technology to enhance the convenience and accessibility of EV charging.

The proposed system includes a locator feature that enables EV drivers to easily find the nearest swapping station, as well asa range of IoT sensors that monitor battery health and provide real-time information to the cloud for analysis and optimizationof battery usage. Overall, this system has the potential to revolutionize the way we think about EV charging infrastructure, providing a faster, more convenient, and more sustainable approach to powering our transportation systems. Electric vehiclesare becoming increasingly popular as more people look to reduce their carbon footprint and contribute to a sustainable future.However, one of the challenges facing EV owners is the time required to charge their batteries, which can be inconvenient for those with busy schedules.

Traditional charging methods, such as plugging in a charger and waiting for the battery to fully charge, can take several hoursand may not be suitable for drivers who need to quickly recharge their vehicles. Battery swapping stations offer a solution tothis problem, allowing EV drivers to quickly swap out their depleted battery for a fully charged one in just a few minutes.

This technology has been in development for several years, and there have been several successful pilot programs and implementations of battery-swapping stations in different parts of the world. In this paper, we propose a smart EV battery swapping station that leverages the Internet of Things (IoT) and cloud technology to enhance the convenience and accessibility of EV charging. The proposed system includes a range of IoT sensors that monitor battery health and provide real-time information to the cloud for analysis and optimization of battery usage. The system also includes a locator feature that allows EV drivers to easily find the nearest swapping station, which can be particularly useful for those who are new tothe area or are traveling to an unfamiliar 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]. 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 harms performance. Battery manufacturers frequently have serious concerns about this. 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 behavior of a Li-ion cell is still not completely understood, internal battery problems are challenging to identify [5]. Overcharging, over-discharge, internal short circuits, 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 notify 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 the 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 system implemented in [3] is the application of Internet-of-things (IoT) in monitoring the performance of electric vehicle batteries. A battery serves as the sole energy source for an electric vehicle. However, the vehicle's energy supply is gradually reducing, which results in a performance decline. The manufacturing of batteries is quite concerned about this. To do the monitoring directly, it is suggested in this work that IoT approaches be used to monitor the performance of the vehicle. The monitoring device and the user interface make up the two main components of the proposed Internet of Things-based battery monitoring system. According to test results, the system can recognize diminished battery performance and notifies the user for further action.

III. PROPOSED SYSTEM

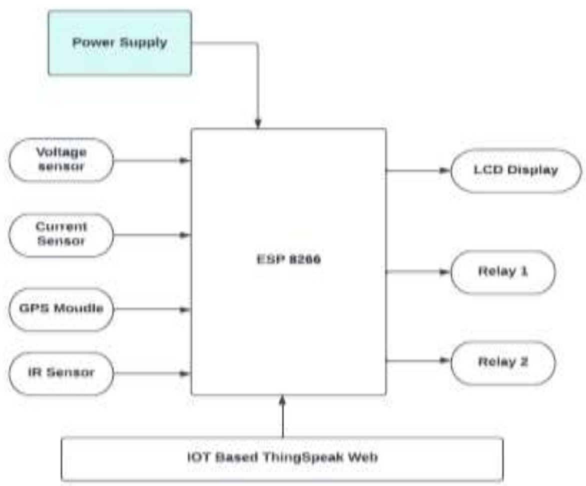


Fig. 1 - System Architecture

Battery management system for Electrical vehicles is an automated system. In this, the system generates a massage of a Nearby charging station, when the battery charged value gets low from its desired value. As we can see there is a voltage sensor and a current sensor. This sensor checks the value of a respective parameter and conveys their values to ESP 8266 with the help of ADC (Analog to Digital converter) this convert analog values of sensors to digital values after that ESP 8266 check values from sensors and if it is low than the desired value it generates a message about a nearby charging station. And show this message on thing speak and text message on mobile on telegram.

III. RESULT AND CALCULATIONS AND 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 ESP8266 . On the other side battery, +ve and -ve pins are connected to VCC and GND respectively.[14] When we connected the battery to the voltage sensor VCC and GRD it measures the voltage in analog value which is read by an analog-digital converter and converted into digital form. Now this digital value is given to ESP8266, but the user can’t understand the digital value for this we did some calculations as follows,

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

Where’s,
Vout - It is battery Voltage
Adc output – It is Value that read by ADCVref – the battery total voltage.

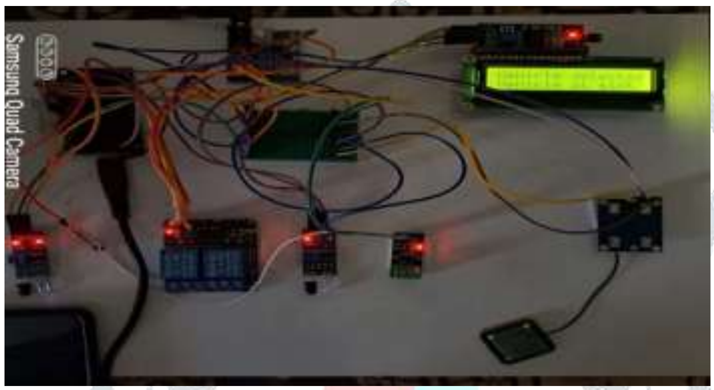
CURRENT SENSOR CALCULATIONS

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 ESP8266. Then we connect battery +ve and -ve pins are connected to VCC and GND respectively in a series connection. When we connected the battery to curent sensor VCC and GRD it measures the current in analog value which is read by an analog-digital converter and converted into digital form. Now this digital value is given to ESP8266, but the user can't understand the digital value for this we did some calculation as follows.

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

RESULT

Voltage and current sensors provide sensor data. Create a digital signal from an analogue one. The server updates and verifies digital signals. Test to see if the digital signal has reached the threshold. The user will be given location information for the closest charging station on the user message if the sensor data reaches a certain threshold. Update the sensor information, such as the voltage rating, current rating, and temperature rating, and then log this information with the date and time for later use. Additionally displays real-time power, temperature, voltage, and current ratings on the thing speak.



Fig, 2. BMS model

Fig.3 Thing Speak output

IV Conclusion

Ensure battery performance decline may be tracked online with an IoT-based battery monitoring system for electric vehicles. The goal is to demonstrate the viability of the idea's basic premise. The hardware for the battery monitoring device and a web-based user interface for battery monitoring are being developed as part of the system's development. The system incorporates a GPS system to detect the coordinate and display it on the Google Maps application, allowing it to display information such as position, battery life, and time via the internet. By including more functionalities, the system can be further modified to be improved. By creating a smartphone application that can assist users in battery monitoring and serve as a reminder of battery degeneration, the method can be employed in smartphones. Ethernet can be used to improve internet connectivity to obtain a better connection than GPRS.

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