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Real Time Internet of Things Based Electric Vehicle Energy Management System

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ABSTRACT: The Smart EV Battery Monitoring System presented in this project utilizes advanced sensor technologies and the NodeMCU controller to provide comprehensive monitoring and management of electric vehicle (EV) batteries. The system is equipped with temperature, voltage, and current sensors integrated with an ADC converter, offering real-time data collection for effective analysis of the battery's health.The NodeMCU controller acts as the central hub, facilitating seamless communication between the sensors and a dedicated mobile application. Through the application, users can continuously monitor crucial parameters such as temperature, voltage, and current, ensuring a comprehensive overview of the EV battery's performance.To enhance user experience and accessibility, the system includes an LCD display that provides a local interface for instant data visualization. The LCD display showcases key metrics, enabling users to quickly assess the status of the battery without relying solely on the mobile application.The heart of the system lies in its ability to calculate the State of Charge (SOC) of the EV battery in real-time. By employing the ADC converter, precise SOC values are derived, allowing users to gauge the remaining capacity of the battery accurately. Real-time alerts are implemented to notify users when the battery reaches critical levels—alerting when the battery exceeds 90% or drops below 15%, ensuring proactive measures can be taken to optimize battery life and performance.

I.INTRODUCTION

Electrical Vehicles (EVs) are becoming more popular as gasoline price climb. As a result of these circumstances, several automakers are looking into alternative fuel sources to gas. Electric Vehicles are a promising technology for sustainable transportation. It is necessary to move to the use of Electric Vehicle, as they represent the next generation of transportation. Electrical vehicle batteries may be damaged due to overcharging or over-discharging, hence there is a need to precisely estimate the state of charge to extend their lifespan and protect the connected components they power. This project presents about the battery management and monitoring system of electric vehicles at low-cost. Real Time IoT supports users through an application supporting the IoT to display the essential information required about the battery status as battery capacity, charging and power consumption. This information of Electrical Vehicle Energy Management System is updated and displayed in real-time. The heart of the system lies in its ability to calculate the State of Charge (SOC) of the EV battery in real-time. By employing the ADC converter, precise SOC values are derived, allowing users to gauge the remaining capacity of the battery accurately. Real-time alerts are implemented to notify users when the battery reaches critical levels—alerting when the battery exceeds 90% or drops below 15%, ensuring proactive measures can be taken to optimize battery life and performance.Talks about battery storage forms the most important part of any electric vehicle (EV) as it store the necessary energy for the operation of EV. So, in order to extract the maximum output of a battery and to ensure its safe operation it is necessary that efficient battery management system exist i the same. It monitors the parameters, determine SOC, and provide necessary services to ensure safe operation of battery. Hence BMS form a important part of any electric vehicle and so, more and more research are still being conducted in the field to develop more competent Battery Management System.Discuss about one of the most vital and expensive components of electric vehicles is the battery. Of course, the battery is the only source of electricity for an electric vehicle. However, the vehicle's power supply eventually declines, resulting in decreased performance. For battery manufacturers, this is a major concern. In this paper, it is proposed to use IoT approaches to monitor and display the battery performance. Real-time data of voltage, current, and temperature may be displayed by the monitoring system, and the data can be seen on an Android smartphone and a computer at the same

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time. As a result, we might be able to improve the battery's efficiency and lifespan. The user interface and results presentation are the two main components of the proposed IoT-based battery monitoring system. According to test results, the system is able to recognize weakened battery performance and notifies the user for further action.

Electric vehicles (EVs), which are considered as dynamic electrical energy storage units, are widely used because of their outstanding electrical characteristics and versatility. However, their widespread adoption has a significant adverse effect on the grid and carries the risk of harming their batteries when they become profoundly discharged. EV batteries require a precise state of charge estimation to minimize the list of damage, prolong their lifespan, and in order to safeguard the equipment power. Based on simplicity of implementation and reduced overall complexity, this study suggests a real-time Battery Monitoring System (BMS) employing the coulomb method of counting for SOC estimation and MQTT which is messaging-based as an internal communication protocol. Utilizing an Adequate central CPU, interfacing devices, and sensor technology, the proposed BMS is implemented remaining a battery.The Internet of things (IoT) is one of the most revolutionary technologies leading experts have created today. The ever-increasing number of devices and embedded systems has made it a necessity for IoT to be implemented in every corner of the world.

II.EXISTING SYSTEM

The current landscape of electric vehicle (EV) battery monitoring is characterized by disparate and often rudimentary solutions. Many monitoring systems lack the sophistication needed to comprehensively analyse the myriad parameters influencing EV battery health. In some instances, basic voltage monitoring may be employed, providing only a limited understanding of the battery's behaviour. The absence of real-time data collection, precise State of Charge (SOC) calculations, and proactive alerts leaves EV owners and operators in the dark regarding the intricate dynamics of their batteries. Furthermore, the lack of a unified interface for data visualization contributes to a fragmented user experience, hindering the ability to make informed decisions regarding battery maintenance and optimization.

III.PROPOSED SYSTEM

The proposed Smart EV Battery Monitoring System revolutionizes the existing paradigm by introducing a holistic and intelligent approach to EV battery management. Through the integration of advanced sensor technologies, a NodeMCU embedded system, and a user-friendly interface, the system addresses the shortcomings of current monitoring solutions. The addition of temperature and current sensors, coupled with a high-precision Analog-to-Digital Converter (ADC), allows for comprehensive real-time data collection, enabling a nuanced analysis of the EV battery's health. The NodeMCU controller serves as the central hub, ensuring seamless communication between sensors and a dedicated mobile application. The incorporation of an LCD display provides users with a local interface, offering instant data visualization and empowering them to assess the battery's status at a glance. The ability to calculate SOC in real-time, coupled with proactive alerts for critical battery levels, positions the proposed system as a groundbreaking solution for EV battery management.

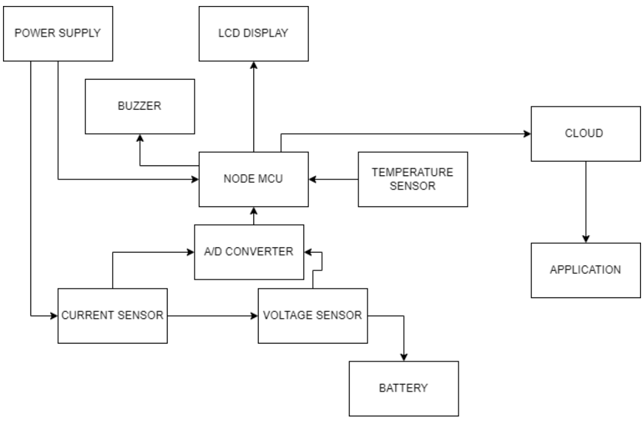

Figure.1.Block Diagram

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NODEMCU (ESP8266)

The Atmel AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in a single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

Figure.2. NODEMCU (ESP8266)

DIGITAL TEMPERATURE AND HUMIDITY SENSOR

- Humidity sensing component has two electrodes with moisture holding substrate sandwiched between them.
- The ions are released by the substrate as water vapor is absorbed by it, which in turn increases the conductivity between the electrodes.
- The change in resistance between the two electrodes is proportional to the relative humidity.
-

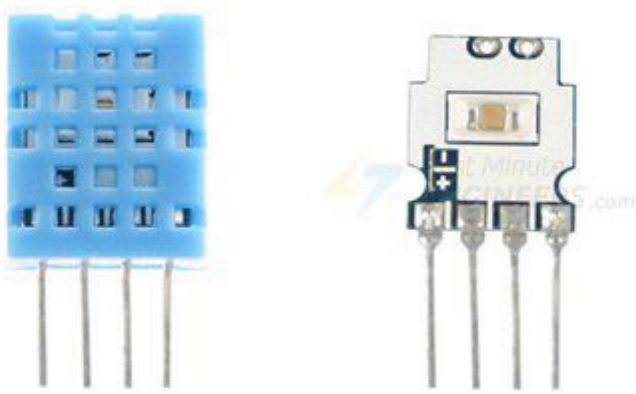

Figure 3: Digital Temperature and HumiditySensor

CURRENT SENSOR

The ACS712 Module uses the famous ACS712 IC to measure current using the Hall Effect principle. The module gets its name from the IC (ACS712) used in the module, so for you final products use the IC directly instead of the module.These ACS712 module can measure current AC or DC current ranging from +5A to -5A, +20A to -20A and +30A to -30A. You have to select the right range for your project since you have to trade off accuracy for higher range modules. This modules outputs Analog voltage (0-5V) based on the current flowing through the wire; hence it is very easy to interface this module with any microcontroller. So if you are looking for a module to measure current using a microcontroller for you project, then this module might be the right choice for you. As told earlier it is very simple to interface the ACS712 Module with Microcontrollers. The below diagram would be more illustrative.

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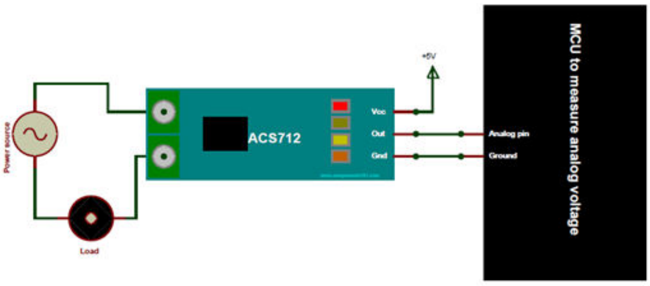

Figure.4. Current Sensor

VOLTAGE SENSOR

Voltage Detection Sensor Module is a simple and very useful module that uses a potential divider to reduce any input voltage by a factor of 5. This allows us to use the Analog input pin of a microcontroller to monitor voltages higher than it capable of sensing. For example, with a 0V - 5V Analog input range, you are able to measure a voltage up to 25V. This module also includes convenient screw terminals for easy and secure connections of a wire.

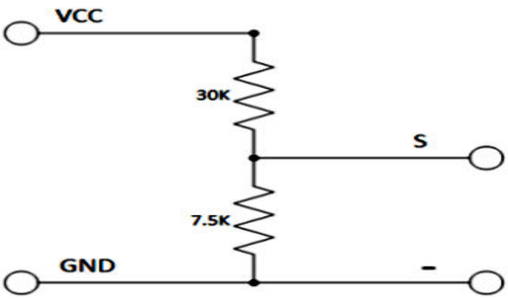

Figure.5.Voltage Sensor

LIQUID CRYSTAL DISPLAY

A Liquid Crystal Display (LCD) is an electronically-modulated optical device shaped into a thin, flat panel made up of any number of colour or monochrome pixels filled with liquid crystals and arrayed in front of a light source (backlight) or reflector. It is often utilized in battery-powered electronic devices because it uses very small amounts of electric power. LCD has material, which continues the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered from similar to a crystal. They are used in similar applications where LEDs are used. These applications are display of display of numeric and alphanumeric characters in dot matrix and segmental displays. LCD Consists of two glass panels, with the liquid crystal materials sandwiched in between them. The inner surface of the glass plates is coated with transparent electrodes which define in between the electrodes and the crystal,which makes the liquid crystal molecules to maintain a defined orientation angle. When a potential is applied across the cell, charge carriers flowing through the liquid will disrupt the molecular alignment and produce turbulence.

Figure.6.LCD Display

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IV.CONCLUSION

In this project we will achieve electric vehicle's battery management and monitoring system based on IoT, Using two current sensors INA219 to measure current in/out from battery and battery fuel gauge module MAX17043 for SoC calculation, they are connected to ESP32 microcontroller can use IoT capability through connecting the ESP32 to the internet, this allow users to manage battery charge/discharge; as well as monitoring the battery SoC status by displaying all information on the mobile application dashboard and updated in real-time. Also, the suggested management.

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