IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, May 2022
Impact Factor: 6.252

Performance Optimization and Health Monitoring of Electric Vehicle Batteries using IoT

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Abstract: *Electric vehicle (EV) manufacturers are using Lithium-ion [Li-ion] batteries as a part of the vehicle's rechargeable energy storage system. Li-ion is a low-maintenance battery, but it is fragile and requires a protection circuit to maintain safe operation. The protection circuit limits the peak voltage of each cell during charge and prevents the cell voltage from dropping too low on discharge. Also, the performance of lithium-ion batteries can be optimized by monitoring different battery parameters. The cell temperature is monitored to prevent temperature extremes. The maximum charge and discharge currents can be limited, with these precautions in place, the possibility of metallic lithium plating occurring due to overcharge and overheating is virtually eliminated. It also measures the input and output voltage and current parameters and Monitoring of battery cell status (to check cell is weak). The proposed system deals with overcharge and over-discharge problems of Li-ion batteries and also proposed system protects the battery from over-temperature damage of the battery.*

Keywords: IOT, Arduino UNO, ESP, Sensors, Battery

I. INTRODUCTION

Now a day's electric vehicles (EV) market is expanding at a very high speed. As it is pollution-free, the government is also encouraging citizens to use electric vehicles. According to a study by Deloitte (a US-based professional service firm), Sales of EVs will double in the next few years. EVs will be the future of the automobile industry. In electrical vehicles, lithium-ion batteries play an important role. Surely in future demand of lithium-ion batteries and all battery-related accessories will increase. Battery Monitoring system (BMS) is a very important accessory of the battery. BMS increases the performance of the battery and also makes sure that battery life goes long. Effective BMS will surely help electric vehicle development firms to reduce the maintenance cost of vehicles which will result in an increase in sales of electric vehicles. BMS can maintain the better health of batteries and also increases the life and performance of batteries. Research and development in the field of charge storing batteries and effective battery management systems will play a vital role in the future of EVs. This detailed report discusses the development of the BMS having IOT support.

II. LITERATURE SURVEY

[1] Proposed by Jing Deng, Kang Li, David Laverty, Weihua Deng, and Yusheng Xue .The fact that electric vehicles (EVs) are becoming more popular and attracting more customers Recognized in recent years for performance improvements such as high acceleration Speed and long autonomy with a single charge. Also some recent studies Promising benefits from the integration of electric vehicles and grids. One of them is the use of electric vehicle batteries. As decentralized energy storage. Consequently, the surplus energy is generated by renewable energies Resources can be stored in electric vehicles and transferred to the grid when needed. However, Compared to traditional nickel-cadmium and lead-acid batteries, lithium -ion batteries are They operate in a narrow area and require proper monitoring, management, and protection. This problem also affects electric vehicles A centralized electrical storage device in which multiple lithium-ion batteries are connected together Ensure sufficient voltage and current. Above all, the solution is reliable and efficient Battery Management System (BMS). This research paper provides a brief overview Features of BMS, a practical guide to choosing a commercial BMS Market and develop your BMS for better control over functionality. professional

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limit. The Edition BMS is used to demonstrate the effectiveness of the BMS in management and administration. Protects lithium-ion batteries during charging and discharging.[1]

[2] Mahammad A Hannan, Dr. Murshadul Hoq, Aini Hussain, and Yushaizad Yus. He said that a variety of rechargeable batteries are currently available in the world market. Electric Vehicles (EV). Lithium-Ion (Li-Ion) batteries are considered the best of all batteries. Batteries and cell types due to their excellent properties and performance. The environmental impact and recyclability of lithium batteries have been compromised. We develop new research results to improve lithium-ion battery technology. but it costs Reduction, safe operation, and reduced negative impact on the environment. It is now a common concern for promotion. Provides comprehensive country research. Li-ion battery technology including core, structure, and overall performance Evaluation of different types of lithium batteries. Research on battery management system Lithium-ion battery storage in electric vehicle applications has been shown to include cell health Monitoring, charge and discharge control, condition assessment, protection, and balancing; Temperature control and thermal management, diagnostics, and evaluation of battery failures Improve overall system performance. Lithium-ion batteries have been observed. Its low price and lightweight make it very popular in automotive applications.

High power density [2]

Proposed by Yu Miao, Patrick Hainan, Annette von Juan, and Alexander Yokochi in [3]. In recent decades, the number of electric vehicles (EVs) has continued to increase. Increase. More than 125 million electric vehicles are expected to be on the roads worldwide. By 2030. At the heart of these advanced vehicles is a lithium-ion (Li-Ion) battery. Ensures the necessary energy supply. This article introduces and compares the main components. Describe lithium-ion batteries and associated battery management systems and approaches Improve overall efficiency, capacity, and battery life. materials and heat The properties are defined as important to the performance of the battery. positive and negative Electrode materials, electrolytes and physical implementation of lithium-ion batteries discussed. In addition, current research on new energy-dense cells, Ability to reuse and recycle batteries.[3]

III. Software Design

First Arduino will take readings of battery parameters from sensors. Then Arduino will store all parameter values and wait for an internet connection. As Arduino gets an internet connection, Arduino will send all values of battery parameters to the cloud. On the cloud, by processing this information we are going to check faults in the battery. For example, if the battery temperature exceeds maximum limits, we will disconnect the battery's load. Also , by suggesting solutions we can improve battery performance.

IV. Battery Monitoring System [BMS]

A battery management system is essentially the “brain” of a battery pack; it measures and reports crucial information for the operation of the battery and also protects the battery from damage in a wide range of operating conditions. Thus, a battery management system is necessary to observe battery conditions. As per the current world situation, the Internet of Things (IoT) are used in heterogeneous areas of research for supervising, congregating, and analyzing data from the remote locations of batteries. This system comprises numerous sensors for assessing the physical parameters. The parameters of the battery that can be assessed using these sensors are input voltage, current, temperature, and status of charging. Using this system, the real-time data can be determined and the data uploaded over the cloud is analyzed. Battery Management System is a system that monitors, balances, and protects a battery pack with four or more cells connected in series. BMS measures the voltage and temperature of each cell of the battery, and the current through the battery. Based on the measured data, the system balances the cells and protects them from overcurrent, overcharging, deep discharge and overheating. The Battery management system is about monitoring a battery during its functioning and safeguarding it from damages under various working conditions. The battery is not only used in automobiles, but also in UPS, off-grid power systems, and alternative power systems.

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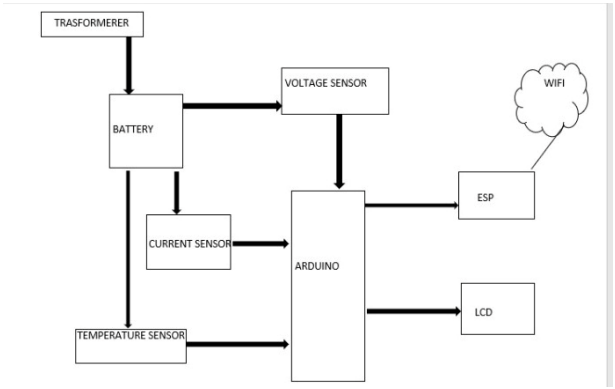
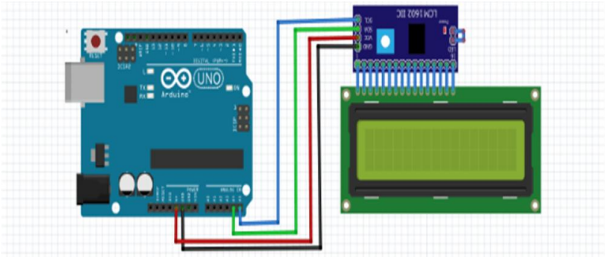
V. BLOCK DIAGRAM

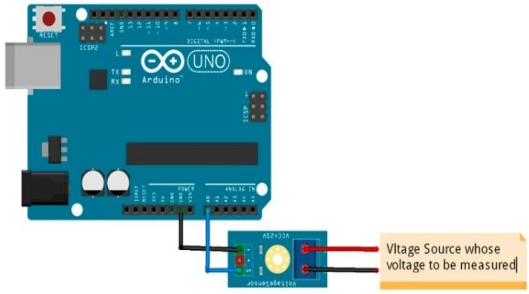


VI. HARDWARE DESIGN

6.1 Connect I2C LCD Display to Arduino



6.2 Connection of Voltage Sensor using Sensor



6.3 Connection of Current Sensor (ACS712) using Arduino

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VII CONCLUSION

In this Project, it is observed that monitoring battery parameters through IoT provides an efficient way to improve the battery performance of electric vehicles. Li-ion is a low-maintenance battery, but it is fragile and requires a protection circuit to maintain safe operation. By implementing this system, it has become easy to maintain the safe operation of the battery while charging and discharging. Also, the performance of lithium-ion battery optimized by monitoring different battery parameters. The maximum charge and discharge currents get limited, with these precautions in place, The possibility of metallic lithium plating occurring due to overcharge and overheating is virtually eliminated. This system has provided an efficient way to improve the efficient use of batteries**.**

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