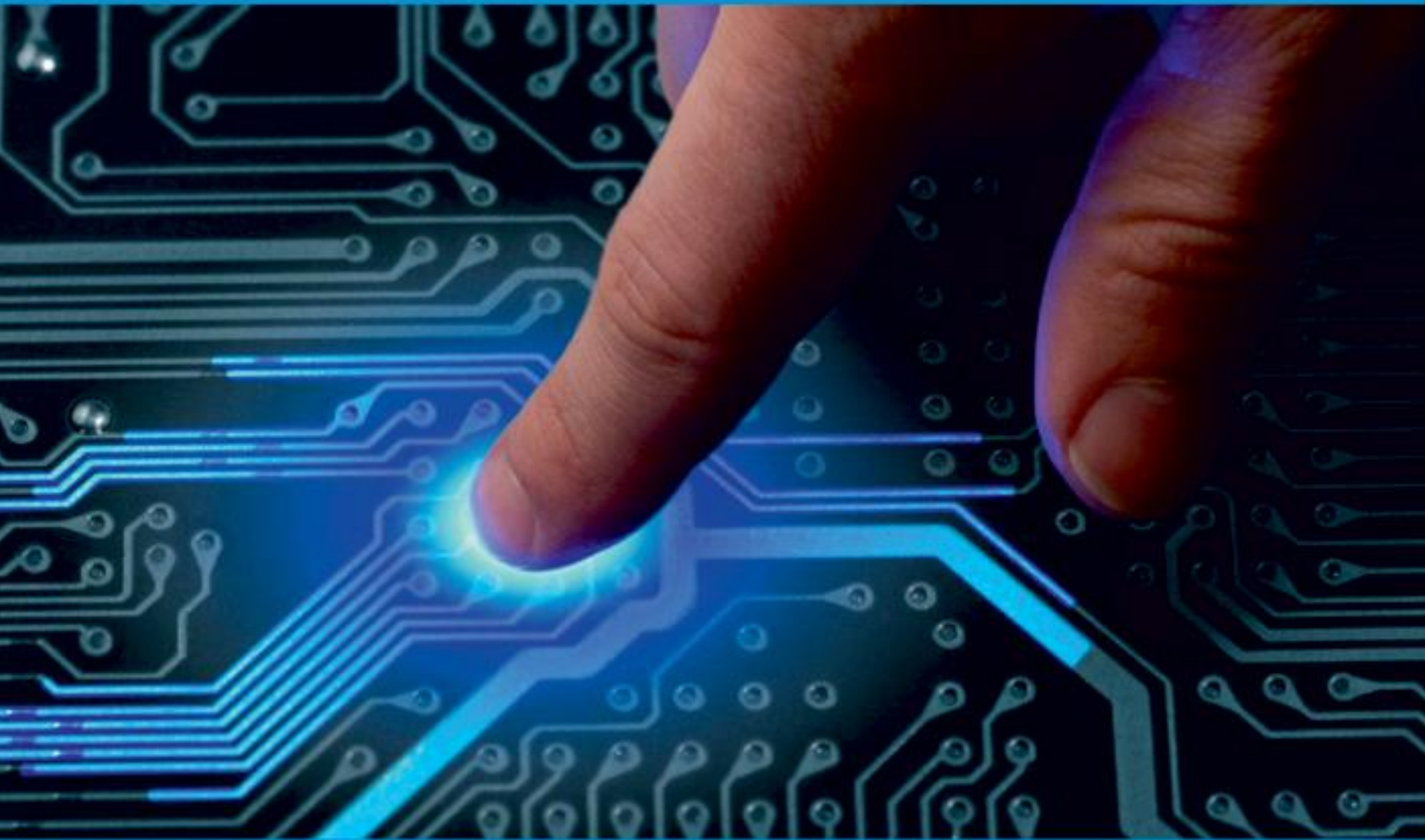
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 12, Issue 4, April 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 4, April 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1204236 |

Advanced Battery Management System for Electric Vehicle

Raj Deshmukh , Kalyani Patil, Dr. U V Patil

Student.BE, Department of Electronics and Telecommunication, MVP'S Karamveer Adv. Baburao Ganpatrao Thakare College of Engineering, Nashik, India

Department of Electronics and Telecommunication, MVP'S Karamveer Adv. Baburao Ganpatrao Thakare College of Engineering, Nashik, India

ABSTRACT: Most vehicle manufacturers now produce electric vehicles for both two and four-wheelers. As a result, the battery becomes a critical issue, improving strategies for calculating an automobile's charge capacity. It is critical to develop and expand a green battery management device so that they are not overcharged or severely discharged. Electric motors have an accurate kingdom of charge estimation to reduce the risk of damage, increase their durability, and protect the electronics they power. This project proposes a real-time Battery Monitoring System (BMS) that uses the State of Charge (Soc) method to display important parameters. The recommended advanced BMS is built on a hardware platform with appropriate sensing technology, a central processor, and interface devices.

KEYWORDS: Battery Management System, Lithium-ion Battery, Battery Pack, State of Health, State of Charge, Active Balancing, Passive Balancing

I. INTRODUCTION

Numerous cells are stacked in series to achieve higher voltage and parallel to achieve higher capacity and output current in battery packs. For each cell to function safely within the ideal voltage and temperature range, maintenance is required. An important part is played by the BMS in this regard. One important part is the battery. Installing a BMS (Battery Management System), an independent control platform, can increase the battery's dependability and safety. To guarantee dependable, secure, and seamless battery operation, tasks related to charge balancing and cell state monitoring should be integrated into the BMS.

The battery's malfunctioning state of operation can secure the entire system. Passive balancing techniques, which involved parallel shuttling resistors, were typically employed in BMS (Battery Management Systems) to balance cell SOC (State of Charge). These techniques were not only ineffective but also dangerous because they could produce heat during the balancing process and would restrict power delivery capabilities. Therefore, there is a need for more effective methods, like active cell balancing techniques, which have the potential to increase efficiencies by 90%. In this challenge, the battery management system is evaluated by examining and assessing the active cell balancing strategy and the use of inductors in MATLAB – SIMULINK simulation.

1.1 BLOCK DIAGRAM :

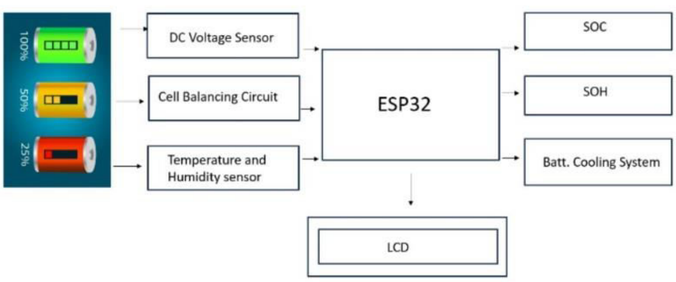


Fig -1.1 Block Diagram

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |
|| Volume 12, Issue 4, April 2024 ||
| DOI: 10.15680/IJIRCCE.2024.1204236 |

1.2 STATE OF CHARGE :

The kingdom of price (SOC) of a cell represents the capability that is now available as a function of the rated capacity. The SOC value swings between 0% and 100%. If the SOC is 100%, the battery is considered fully charged, whereas a SOC of 0% indicates that the cell is entirely discharged. In actual applications, the SOC cannot exceed 50%, thus the cell is recharged when it hits 50%. In addition, when a mobile device ages, most SOC continue to change. This means that for an elderly mobile, a 100% SOC may be equivalent to a 75%-80% SOC for a new cellular.

Battery SOC estimate is an important feature of the battery management machine. It is useful for displaying the actual energy level available at the battery. Battery mobile contemporary, mobile voltages, and cellular temperature are critical factors for estimating battery state of charge. It calculates the SOC percentage by transferring charge into and out of the battery, and in this case, standard coulomb-counting methods are applied. We can also use the battery's rated capacity (Q-rated), which is unaffected by temperature or aging. However, in order to account for SOC variations with aging, a second parameter, Q discharge, is required. This is defined as the greatest total electrical charge, expressed in Ah, that a battery can deliver as it transitions from completely charged (SOC of 100%) to totally discharged (SOC of 0%).

1.3 State of Health:

The term "state of health" (SOH) in a Battery Management System (BMS) refers to a battery's overall health or condition. It is determined by several criteria, including the battery's capacity, internal resistance, aging, and overall performance as compared to its original specs. The BMS evaluates SOH by monitoring metrics such as voltage, temperature, charge/discharge rates, and, in some cases, internal chemistry to determine the battery's health and remaining lifespan. State of Health (SOH) refers to the battery's overall health and performance during its full life cycle. SOH is influenced by elements such as age, cycle count, temperature, and usage habits. The BMS measures a variety of factors, including voltage, current, and temperature, to determine both SOC and SOH. As a battery goes through charge and discharge cycles, its capacity may decline over time, resulting in a fall in SOH.

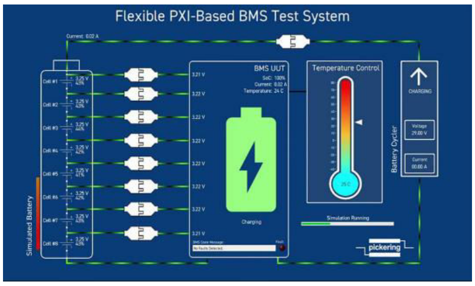


Fig -1.2 SOH

Hardware components

- Li-ion Battery
- ESP32
- DC Voltage Sensor
- DHT11
- LCD 16*2 I2C
- Cooling Fan
- Charging Circuit

Description of the above Components

1) Li-ion Battery
   Lithium-ion batteries consist of single or multiple lithium-ion cells, along with a protective circuit board. They are referred to as batteries once the cell, or cells, are installed inside a device with a protective circuit board.
2) ESP32
   ESP32 is a single 2.4 GHz Wi-Fi and Bluetooth combo chip designed with the TSMC low-power 40 nm technology. It is designed to achieve the best power and RF performance, showing robustness, versatility, and reliability in a wide variety of applications and power scenarios.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 4, April 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1204236 |

3) DC Voltage Sensor
The voltage sensor module is a 0-25 DC voltage sensing device that is based on a resistive voltage divider circuit. It reduces the input voltage signal by a factor of five and generates a corresponding analog output voltage.

4) DHT11
The DHT11 is a commonly used Temperature and humidity sensor. The sensor comes with a resolute NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%.

5) LCD 16*2 I2C
The I2C display interface is a common communication protocol for character, graphic, and segment LCDs. An I2C display consists of an LCD controller and a display module. The interface is communicated over two wires which include a data line and a clock line.

6) Cooling Fan
For the maximum heat dissipation of battery packs, it requires cooling so the fan will cool the battery pack.

7) Charging Circuit
When the lithium battery pack needs to be charged, the charger will wake up the BMS to work.

II. SIMULATION

SOH Circuit Diagram

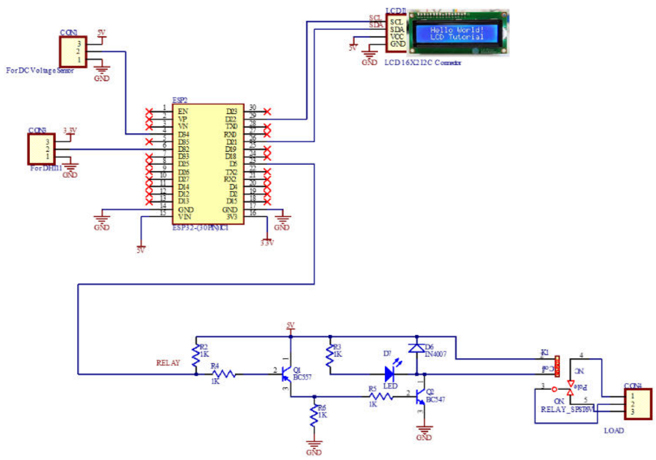
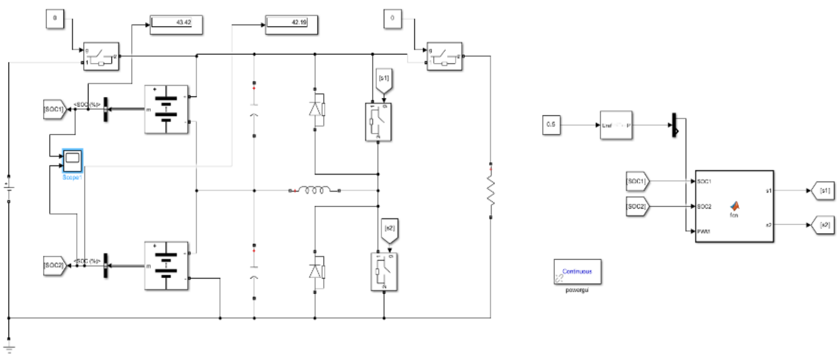


Fig -2.1: Circuit Diagram

MATLAB Simulation :
SOC:



International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 4, April 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1204236 |

Result :

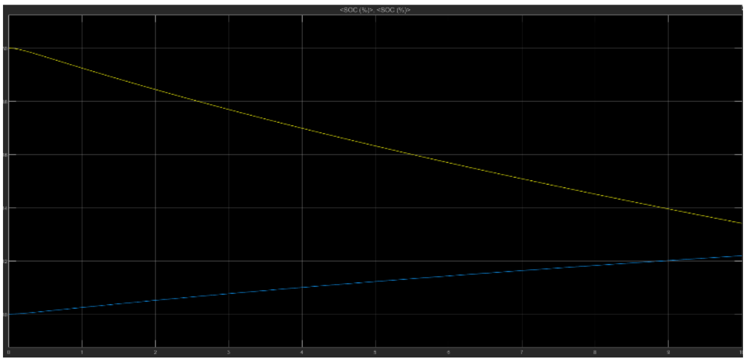


Fig -2.2: SOC

Hardware implementation

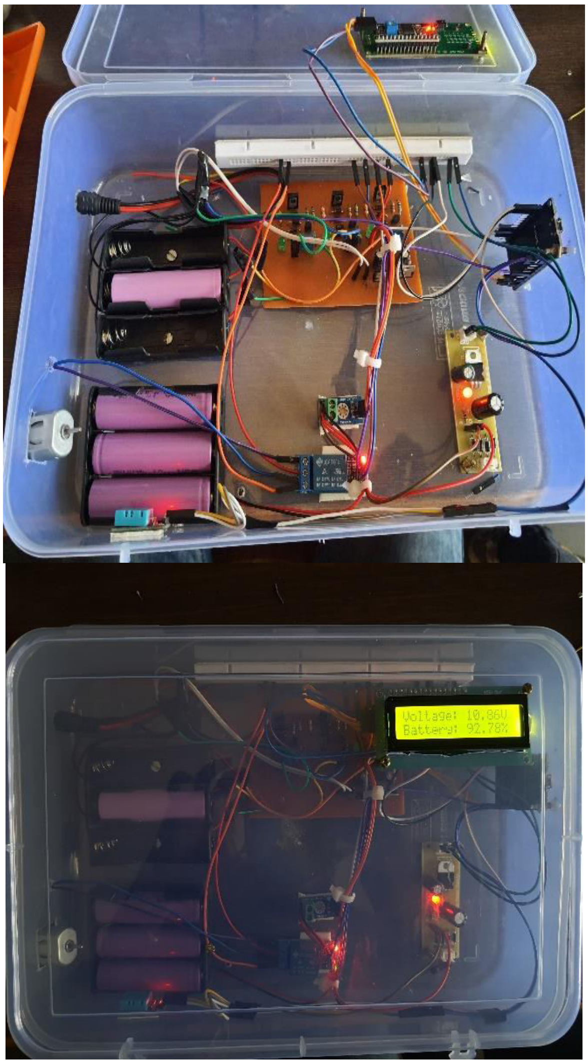


Fig -2.3: Results

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 4, April 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1204236 |

III. CONCLUSIONS

Smart BMS delivers real-time data on the battery's condition, allowing customers to make informed decisions about their EVs' energy use, range, and maintenance. The system's cell balancing capabilities ensure that individual cells in the battery pack are optimized, increasing the battery's life and improving its performance. The user interface features of smart BMS systems provide drivers with real-time data and recommendations, resulting in a seamless and informative driving experience. Furthermore, these systems include predictive maintenance capabilities, which help to estimate maintenance needs and replace components ahead of time. In the ever-changing electric car ecosystem, smart BMS models use powerful predictive analytics to model battery aging, allowing users to make more educated maintenance decisions.

REFERENCES

[1] Analysis Of Cell Balancing Techniques In BMS For Electric Vehicle Author: Amar Nath, Dr. Bhooshan Rajpathak Electrical Engineering Department Visvesvaraya National Institute of Technology Conference Paper · July 2022

[2] Investigation of active cell balancing performance for series connected lithium-ion cells in Electric Vehicle application. Author: Umapathi Krishnamoorthy, Gobichettipalyam Shanmugam Satheesh Kumar, Sourav Barua, Hady Habib Fayek. The Institution of Engineering and Technology (2023)

[3] Comparative Analysis and Evaluation of the Different Active Cell Balancing Topologies in Lithium Ions Batteries. Author: Dapynhunlang Shylla, Harikrishnan R, Radhika Swarnkar. Symbiosis Institute of Technology, Pune Campus, Symbiosis International Deemed University (SIDU), India

[4] Battery Management System With Charge Monitor and Fire Protection for Electrical Drive. Author : B.V.Manikandan, P Kiruthickroshan, M Vasantha kumar, L. Chandrasekeran

[5] Detection of Lithium-ion Battery Failure and Thermal Runaway. Author: Ting Cai [The University of Michigan 2021]