ISSN: 2582 - 6379
Orange Publications
International Journal for Interdisciplinary Sciences and Engineering Applications
IJISEA - An International Peer- Reviewed Journal
2025, Volume 6 Issue 2
www.ijisea.org

Smart Battery Monitoring System for Electric Vehicles

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ABSTRACT

Battery management systems (BMS) are used in electric vehicle to monitor and control the charging and discharging of rechargeable batteries which makes the operation more economical. Battery management system keeps the battery safe, reliable and increases the senility without entering into damaging state. In order to maintain the state of the battery, voltage, current, ambient temperature different monitoring techniques are used. For monitoring purpose different analog/digital sensors with microcontrollers are used. This paper addresses state of charge, state of health, and state of life and also maximum capacity of a battery. By reviewing all these methodologies future challenges and possible solutions can be obtained.

Keywords: Battery Management System(BMS),Electric Vehicles (EVs), Lithium-ion Battery, State of Charge (SoC), State of Health (SoH), Battery Safety, Battery Balancing, Battery Monitoring, Energy Management, Thermal Management, Smart BMS, EV Battery Protection.

I. INTRODUCTION

Electric vehicles (EV) are playing a key role because of its zero-emission of harmful gases and use of efficient energy. Electric vehicles are equipped by a large number of battery cells which require a effective battery management system (BMS)while they are providing necessary power. The battery installed in a electric vehicle should not only provide long lasting energy but also provide high power. Lead-acid, Lithiumion, -metal hydride are the most commonly used traction batteries, of all the setraction batteries lithium-ion is most commonly used because of its advantages and its performance. The battery capacity range for a electric vehicle is about 30 to 100 KWH or more. Battery management system (BMS)makes decisions based on the battery charging and discharging rates, state of charge estimation, state of health estimation, cell voltage, temperature, current etc.

II. LITURATURE SURVEY

Diao determined if batteries have reached their limit by using internal resistance to evaluate the state of health (SOH). However, due to capacity independence from the internal resistance, it can bring about contradicting outcomes for the SOH of the battery. The SOH is more accurately defined as the present battery status with relation to the capacity and power SOH, in which degradation, internal resistance, and inconsistency of capacity are all considered. With the use of this method, a clear advantage can be seen by analyzing data and by comparing it to other methods.

Liu. Researchers utilized probability distribution and adopted the concept of Monotonic echo sate Networks or MONESNs algorithm for tracking nonlinear degradation patterns of battery RUL estimation. Correlation model between health index and battery capacity is developed. Two sets of data of lithium- ion batteries are used to prove the efficiency of the proposed method. Hou propose calculation and monitoring of the electric vehicle's SOH, SOC, and state of function (SOF).

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III. PROPOSED METHODOLOGY

Energy and environmental problems are the most dangerous problems faced by the world automotive industry to overcome these problems world has accelerated to the new energy development.

Battery Management System (BMS):

Battery management system (BMS) is the crucial system in electric vehicle because batteries used in electric vehicle should not be get overcharged or over discharged. If that happens, it leads to the damage of the battery, rise in temperature, reducing the life span of the battery, and sometimes also to the persons using it. It is also used to maximize the range of vehicle by properly using the amount of energy stored in it. Battery management system is essential for following reasons

1. Maintain the safety and the reliability of the battery
2. Battery sate monitoring and evaluation
3. To control the state of charge
4. For balancing cells and controlling the operating temperature
5. Management of regenerative energy

State of Charge Estimation:

State of charge is defined as the available amount of battery as the percentage of rated capacity of the battery. State of charge gives a crucial support to battery management system to assess the state of the battery which helps the battery to operate within the safe operating range by controlling charging and discharging. It also increases the life span of the battery. State of charge cannot be estimated directly. It is calculated by using the equation.

$$SOC = 1 - \frac{\int idt}{C_n}$$

Where I =current and

C_n= maximum capacity that the battery can hold

State of Health Estimation:

State of health estimation describes the state of the battery with respect to the newly manufactured battery.
It gives information regarding the available amount of discharging capacity during its lifetime. The SOH in EV use to describe the ability to drive the specific distance. According to Pattipati et al capacity fade and power fade together combined as health characteristics. capacity fade describes reduced driving range with a fully charged battery and power fade describes decrease in acceleration capacity. Power fade occurs when the impedance in the cell increases during aging. Hence, total impedance (RHF+Rtc=R). where RHF and Rtc are frequency resistance and the transfer resistance.

Block Diagram of Proposed System:

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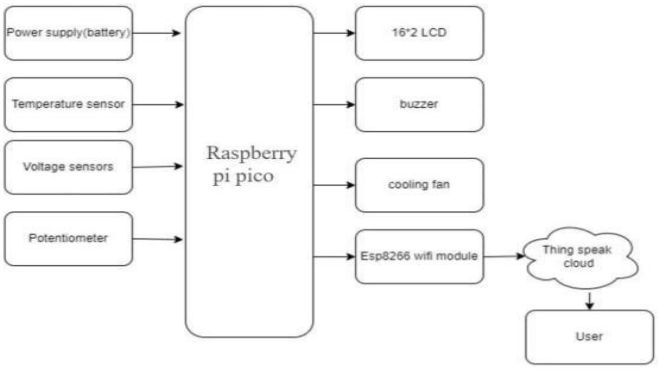

Figure 1 : Shows the Battery Management System

Battery Capacity Estimation Using Varying Loads and Environmental Temperatures:
Degradation of a battery depends upon charge and discharge cycle, environmental conditions and specific materials. The status of the battery is predicted when discharging at constant current and constant temperature. Here are few experimental factors of a lithium-ion battery at different discharge rates and temperatures.

Table 1: Shows Experiment factors—different discharge rates and temperatures.

Discharge	Rate Temperature
0.5C(350mA)	25 °C
0.5C(350mA)	50 °C
1C(700mA)	25°C
1C(700mA)	50 °C

Advantages:
1. It improves the battery performance.
2. It enhances the life span of battery.
3. It controls the charging, discharging and temperature ranges and keeps them with in their range.
4. It predicts the batteries capabilities in near future.

IV. RESULTS AND DISCUSSION

Battery management system (BMS) is the crucial system in electric vehicle because batteries used in electric vehicle should not be get overcharged or over discharged. The below Figures shows the Results of the BMS.

Without Load:

Battery Voltage: 11.67 V Current:0.00 mA
Power: 0.00 W
Temperature: 35 Degree Celsius

With Load:

Battery Voltage: 11.63 V

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Current:16.20 mA
Power: 186.00 W
Temperature: 36 Degree Celsius

Proto type of proposed work:

Based on this work, specific challenges faced by BMS and their solutions were presented as a foundation for future research. Based on the particular situation, different strategies can be applied to upgrade and optimize the performance of BMS in EV'S.

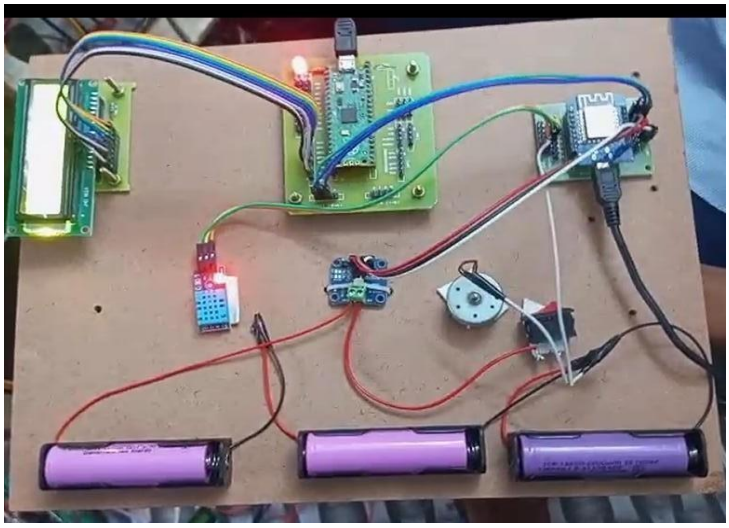

Figure 2: Show the Physical view of the Proposed System

Display indicates on voltage(V),Current(I),Power(P)& Temperature(T):



Figure 3: Shows the V, I, P ,T with and without Loads

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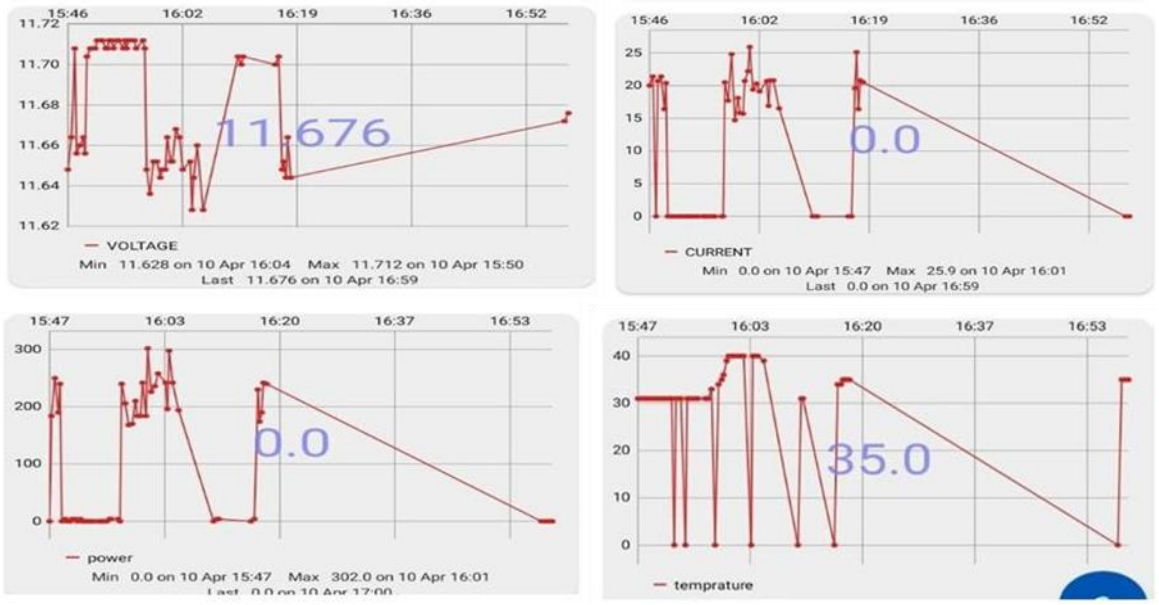

Figure 4: Shows Graphs of V, I, P ,T with and without Loads

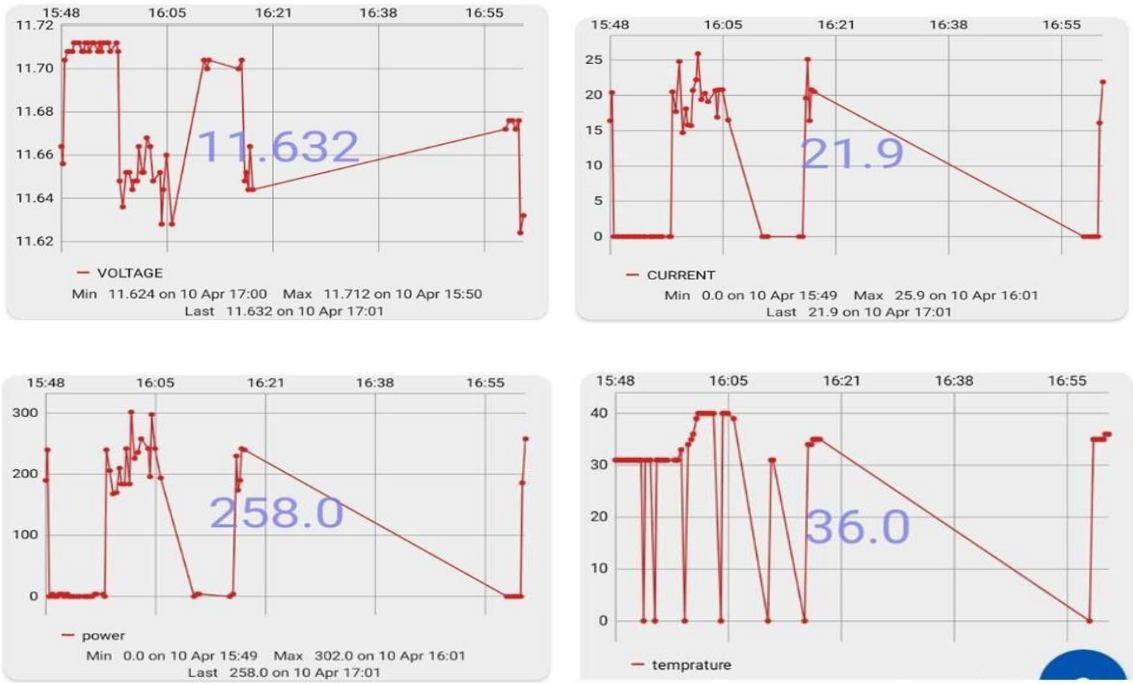

Figure 5: Shows Graphs of V, I, P ,T with and with Loads

V. CONCLUSION

In this way we are developing the system model for battery management in electric vehicle by controlling the crucial parameters such as voltage, current, state of charge, state of health, state of life, temperature. It is every important that the BMS should be well maintained with battery reliability and safety. This present paper focusses

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on the study of BMS and optimizes the power performances of electric vehicles. Moreover, the target of reducing the greenhouse gases can greatly be achieved by using battery management system.

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