e-ISSN:2582 - 7219

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING AND TECHNOLOGY

Volume 4, Issue 8, August 2021

INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 5.928

9710 583 466 9710 583 466 ijmrset@gmail.com www.ijmrset.com

International Journal Of Multidisciplinary Research In Science, Engineering and Technology (IJMRSET)

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928|| Monthly, Peer Reviewed & Referred Journal|

| Volume 4, Issue 8, August 2021 |

|DOI:10.15680/IJMRSET.2021.0408028 |

Electric Vehicle Battery Management Systems: Guaranteeing Effectiveness, Security, and Durability

Hemanth Kumar M L[1], Anil Kumar K N[2], Rajeshwari [3]

Lecturer, Department of Electrical and Electronics Engineering, Government Polytechnic, KGF, Karnataka, India[1]

Lecturer, Department of Science, Government Polytechnic, KGF, Karnataka, India[2]

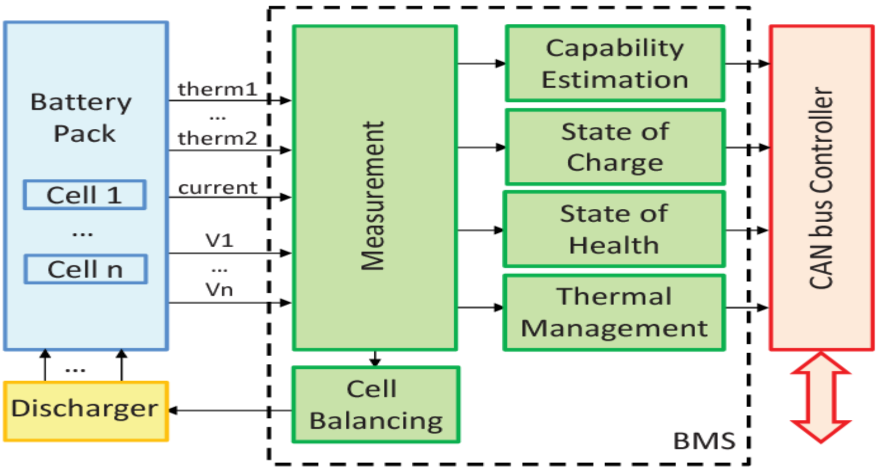
Lecturer, Department of Electrical and Electronics Engineering, Government Polytechnic, Chintamani, Karnataka, India[3]

ABSTRACT: An overview of the function of battery management systems (BMS) in electric vehicles (EVs) is given in this study. Because of their environmental friendliness and decreased reliance on fossil fuels, EVs are becoming more and more popular, and their success now depends on effective and dependable battery management. In addition to guaranteeing the longevity and peak performance of EV batteries, a BMS also improves operational safety. The many uses of a BMS, its parts, and the most recent technological developments for enhancing battery safety, efficiency, and monitoring are covered in the article.

I. INTRODUCTION

The role of electric vehicles (EVs) in the shift to a sustainable transportation system is growing. An EV's battery is its central component and has a direct impact on its performance, range, and overall efficiency. An essential part that controls, keeps an eye on, and guarantees the battery pack operates safely is a battery management system (BMS). This system is essential for extending the battery's life, avoiding deep discharge or overcharging, controlling temperature, and supplying real-time data for peak performance.

II. FUNCTIONS OF A BATTERY MANAGEMENT SYSTEM (BMS)



2.1 Battery Monitoring:

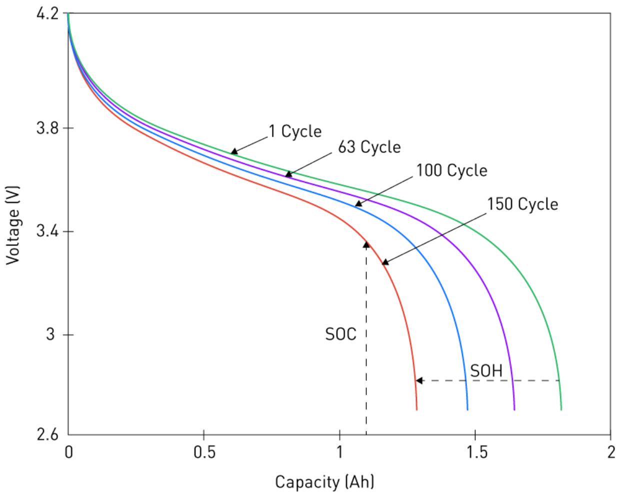
One of a BMS's primary responsibilities is battery monitoring. It entails monitoring variables such as:
• **Voltage:** To avoid overvoltage or undervoltage circumstances, make sure each cell runs within its rated voltage range.
• **Current:** Keeping an eye on the discharge and charge currents to prevent going over the battery's current limitations.
• **Temperature:** Maintaining the battery within acceptable thermal bounds helps avoid overheating, which can shorten its lifespan and performance.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928|| Monthly, Peer Reviewed & Referred Journal|

| Volume 4, Issue 8, August 2021 |

|DOI:10.15680/IJMRSET.2021.0408028 |

2.2 State of Charge (SOC) and State of Health (SOH):



State of Charge (SOC): The BMS estimates the battery's remaining charge in real-time. This is important for the driver to know how much range remains before recharging is needed.

- It is the percentage of a battery's total capacity that is now stored as electrical energy.
- The battery is fully charged when its state of charge (SOC) is 100%, and totally discharged when it is 0%.
- In order to optimize battery management systems (BMS) and determine how much energy is available for usage, SOC is an essential parameter.

State of Health (SOH): The BMS continuously tracks the battery's health over time. This includes monitoring the degradation of the battery's capacity and performance, which allows the system to predict the need for replacement or maintenance.

- It takes into account elements including capacity fade, internal resistance, and power delivery capabilities to reflect a battery's overall state and remaining usable life.
  SOH shows how much the battery's capacity has decreased from when it was brand-new.
  Predicting battery lifespan, handling second-life applications, and guaranteeing safe and dependable operation all depend on an understanding of SOH.

2.3 Relationship between SOC and SOH:
SOH is a more thorough metric that takes into account the battery's general condition and deterioration over time, whereas SOC provides a snapshot of the current capacity. It is essential to estimate SOC and SOH accurately in order to maximize battery performance, increase lifespan, and guarantee safe operation.
SOC estimation can be greatly impacted by battery fading or variations in SOH, and vice versa.

2.4 Li-Ion Cell Charging And Discharging With BMS:
Lithium-ion batteries have the most energy, are lighter, and are extremely reactive. Lithium-ion batteries charge and discharge far more quickly than other types of batteries. It is best to operate lithium-ion cells above their safe operating voltage range to prevent a number of chemical reactions, temperature increases that cause cell venting, and fire formation. In order to enable the battery to function within its safety zone, a battery management system (BMS) is employed.

2.5 Balancing Cells:
Reduced efficiency can result from unequal charge and discharge cycles among the cells in multi-cell battery packs. To avoid capacity loss and improve overall performance, the BMS makes sure that all cells are balanced and have consistent charge levels.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928|| Monthly, Peer Reviewed & Referred Journal|

| Volume 4, Issue 8, August 2021 |

|DOI:10.15680/IJMRSET.2021.0408028 |

2.6 Safety and Protection:

Safety is a major concern in EVs. The BMS provides several layers of protection:

- **Overcharge protection**: Prevents cells from exceeding their maximum voltage.
- **Over-discharge protection**: Prevents cells from discharging below their minimum voltage threshold.
- **Thermal management**: Ensures the battery operates within safe temperature limits.
- **Fault detection**: The BMS detects faults such as short circuits, which can lead to catastrophic battery failures.

2.7 Charging Control:

The BMS manages the charging process to ensure the battery is charged efficiently and safely. This includes controlling the charge rate, terminating the charge at the right point, and preventing overcharging.

III. COMPONENTS OF A BATTERY MANAGEMENT SYSTEM

3.1 Voltage and Current Sensors:

These sensors continuously monitor the voltage and current in each individual cell and throughout the battery pack. Accurate readings are crucial for the BMS to make real-time decisions.

The electric current flowing through a conductor is detected and measured by a current sensor. It converts the current into a measurable output, like a voltage, current, or digital signal, which can be used for protection, control, or monitoring in a number of ways.

The tiny current that flows when a circuit with a high resistance is subjected to a voltage can be detected using a current sensor. Digital technology-based air-core sensors, Fluxgate sensors, or improved Hall Effect voltage sensors can all measure this current.

3.2 Microcontroller (MCU):

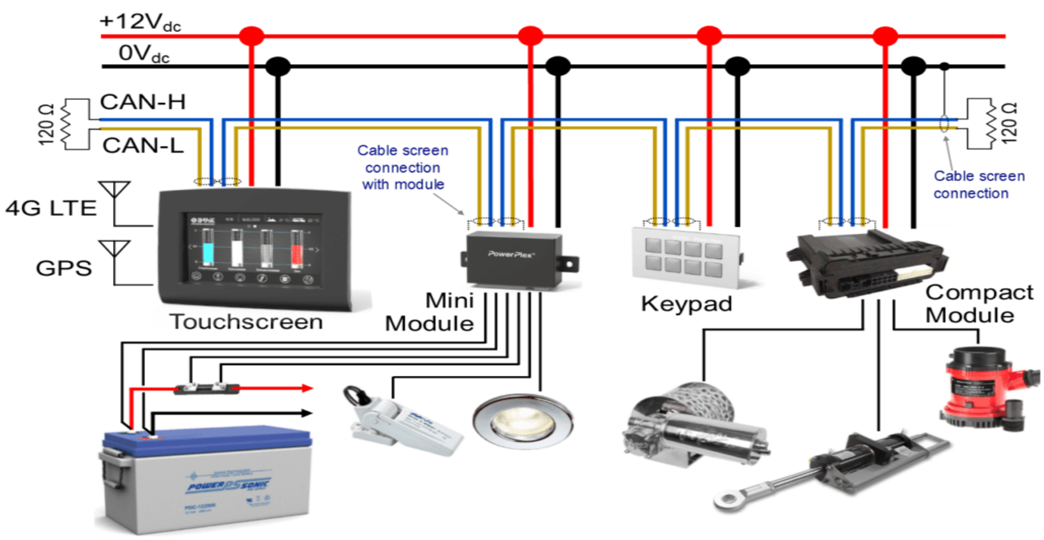
The central processing unit of the BMS, the MCU processes data from the sensors, makes decisions based on pre-set algorithms, and executes commands to control the battery's operation.

3.3 Balancing Circuits:

These circuits help to balance the charge between cells. The BMS uses two types of balancing techniques:

- **Passive balancing**: Excess energy from overcharged cells is dissipated as heat.
- **Active balancing**: Energy is redistributed from more charged cells to less charged ones, improving overall efficiency.

3.4 Communication Modules:



The BMS often includes communication modules that allow the system to interface with other vehicle systems, including the vehicle's main controller, charger, and sometimes external monitoring systems.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928|| Monthly, Peer Reviewed & Referred Journal|

| Volume 4, Issue 8, August 2021 |

|DOI:10.15680/IJMRSET.2021.0408028 |

IV. CHALLENGES IN BMS FOR ELECTRIC VEHICLES

4.1 High Voltage Management:

As EV batteries operate at higher voltages (typically between 200V to 800V), managing these high voltages safely presents significant challenges in terms of insulation, safety, and fault detection.

4.2 Battery Chemistry and Variability:

Different types of battery chemistries (e.g., lithium-ion, solid-state, etc.) come with their own sets of challenges in terms of monitoring and management. The BMS must adapt to each chemistry's unique needs.

4.3 Thermal Management:

Effective thermal management is crucial as temperature extremes can degrade battery performance and safety. Integrating the BMS with thermal management systems, such as cooling plates or fans, is essential to ensure battery efficiency.

4.4 Aging and Degradation:

Over time, battery performance degrades due to factors like temperature cycling and charge-discharge cycles. The BMS needs to account for this degradation and adjust parameters to prolong battery life.

V. FUTURE OF BATTERY MANAGEMENT SYSTEMS

Advancements in battery technology, including improvements in battery chemistry (e.g., solid-state batteries) and the integration of artificial intelligence and machine learning, are shaping the future of BMS. These technologies promise enhanced accuracy in SOC and SOH estimation, smarter balancing techniques, and the ability to predict maintenance needs proactively. Additionally, BMS systems will become more integrated with the overall vehicle control systems, optimizing energy use for the entire vehicle.

VI. INCREASING THE LIFESPAN AND DRIVING RANGE OF AN ELECTRIC VEHICLE

When many single cells are connected in series to form battery packs, production variations such as varying cell capacities, characteristics, or uneven thermal spreads throughout the pack are inevitable.

In multicell battery stacks, the subtle variations between cells are gradually amplified with each cycle of charging and discharging. The entire pack's charging process is stopped when weaker cells with lesser capacity reach the maximum voltage earlier than others; in this scenario, the battery's full capacity cannot be utilized.

Therefore, it is crucial to use the automotive cell monitoring and balancing (CMB) device to equalize the charge throughout the entire stack in order to compensate for the weaker cells and increase the driving range and lifespan of an electric car.

VII. CONCLUSION

The Battery Management System (BMS) is a critical part of the electric vehicle ecosystem. It ensures that the battery operates efficiently, safely, and for as long as possible. As electric vehicles continue to grow in popularity, innovations in BMS will enhance the performance and safety of these vehicles, making them more reliable and cost-effective.

REFERENCES

[1] H.J. Bergveld, Battery Management Systems Design by Modeling, 2001, ISBN 9074445-51-9
[2] D. Bell, "A battery management system," Master's thesis, School Eng., Univ. Queensland, St. Lucia, Australia, 2000.
[3] Sandeep Dhameja, Electric Vehicle Battery Systems, 2002, ISBN 0-7506-9916-7.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928|| Monthly, Peer Reviewed & Referred Journal|

| Volume 4, Issue 8, August 2021 |

|DOI:10.15680/IJMRSET.2021.0408028 |

[4] K. Shimitzu, N. Shirai, and M. Nihei, "On-board battery management system with SOC indicator," in Proc. Int. Electric Vehicle Symp., vol. 2, 1996, pp. 99–104.
[5] Ng, K.S.; Moo, C.S.; Chen, Y.P.; Hsieh, Y.C. Enhanced coulomb counting method for estimating state-of-charge and state-of-health of lithium-ion batteries. Appl. Energy 2009, 86, 1506–1511.
[6] Pattipati, B.; Pattipati, K.; Christopherson, J.P.; Namburu, S.M.; Prokhorov, D.V.; Qiao, L. Automotive Battery Management System. In Proceedings of IEEE AUTOTESTCON, Salt Lake City, UT, USA, 8–11 September 2008; pp. 581–58

INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 5.928

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

9710 583 466

9710 583 466

ijmrset@gmail.com

www.ijmrset.com