Original Article

A Short Review on Battery Management System for Electric Vehicle

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Abstract

Background: Rechargeable batteries have become a key renewable energy source for various applications such as transport, grid storage and mobile systems in recent years. Much more powerful batteries and the introduction of electric cars with a greater performance than fossil fuel cars were accomplished by the advancement of power storage technology. Despite of the relative maturity of batteries, the academic industry and businesses are working hard to make vehicle electrification batteries safe and affordable. **Methods:** A battery test commonly used for charge and discharge constant voltage, Current and constant exile electric mode, record the process of testing data, such as testing time, voltage and current. The electrochemical performance parameters characterization of material capacity, columbic efficiency, charging and discharging platform and battery internal parameters. In both electric and hybrid vehicles, the battery management system is crucial. **Findings:** The battery management system (BMS) is designed to ensure the safety and reliability of the battery. With suitable safety procedures in place, it is utilised to enhance the battery's performance. When it comes to operating electrical systems, a top BMS is a need. **Novelty:** An in-depth analysis of battery management systems and their technology is provided in this study. The battery management system is also being studied in detail.

Keyword: Battery, Battery Management System, Energy Storage Safety, Electric Vehicle.

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INTRODUCTION

A low-emissions new energy vehicle is a key development path for the automotive industry's future technology. Monitoring battery current and voltage, controlling battery charge-discharge, estimating and protecting battery cells are all aspects that battery management systems take into account. BMS is a system control device that is modelled to verify the operational safety of a system battery pack (Battery Pack). For the smart grid and electric vehicles (EVs), such as accurate state-of-charge (SOC) and state-of-health estimation and deep charge/discharge prevention, a more efficient BMS is an absolute necessity. The most often utilised methodology at the moment for all types of system Ah counting, owing to its simplicity, directness, and transparency [1]. A battery's performance or "health" degrades over time due to irreversible physical and chemical changes caused by use and age, and several methods can be used to assess this degradation until the battery is no longer functional. The EMF method is one means of taking direct measurements. This method has the advantage of only relying on a few parameters to determine the EMF curve. Battery age and temperature aren't factors in this indicator, thus it might be used for state-of-charge indication. When it comes to determining the status of charge, the EMF approach falls short [2]. To account for the nonlinear Li-PB properties, a brand-new battery modelling method has been developed. Battery model and cell output voltage are used to calculate the sliding-mode observer equations. In order to prove the convergence of the sliding mode observer, the design process has been explained step-by-step. When compared to standard methods, the proposed method is able to perform better under uncertainty and noise. The UDDS cycle test clears the current system's performance. The acceptable level of SOC error is less than 3% in the majority of circumstances, and this is appropriate to real-world settings. [3]. Battery chemistry that is most commonly utilised in portable devices is Lithium-ion (Li-ion). For the sake of the user's comfort and the battery's longevity, it is crucial that portable devices have accurate methods for calculating their current state of charge (SoC) and remaining run time (RRT). Battery EMF measuring (EMF) and coulomb counting (CC) have been combined in a real-time evaluation system to provide an adaptive algorithm for battery EMF measurement. The inaccuracy in the RRT computation comes from the miscalculation of the EMF mod [4]. Li-PB batteries' SOC and SOH can be estimated for BMS using a dual-sliding-mode-observer design technique. The proposed sliding mode observer system compensated for the mistakes or uncertainties in Li-PB modelling generated by the use of a simplistic RC model [5]. In the

early 1900s, electric cars outsold their gasoline-powered counterparts in popularity and dependability, so they aren't new [6]. It is common practise to reduce the assessment of the battery SoH to a comparison of the estimated capacities and resistances of the old battery. The assessment of the battery characteristic chosen to define the battery lifespan is the first step. When it comes to the SOH, it can be a combination of both battery capacity and impedance [7]. In electric vehicles, the temperature of the battery, especially the internal temperature, is critical to the safety and behaviour of the battery, especially in high-power applications [8]. A hologram of battery operation condition in EV applications can be revealed using battery modelling and estimates of battery internal states and characteristics. To prevent battery damage, increase energy conversion efficiency, and extend battery life, it is necessary to capture these critical battery states. Only then can an appropriate battery charging strategy be developed [9]. Prior to everything else, we'd prefer to keep costs and performance in check. For low heat loads or short run times, passive BMS is the better option, whereas active BMS is better for higher heat loads or longer run times. While liquid cooling has a low consumption, forced-air BMS is more cost-sensitive [10].

Battery Management System

An electric vehicle's battery management system (BMS) is critical, as batteries in electric vehicles should not be subjected to excessive charging or discharging. As a result of this, the battery might be damaged, and it can also cause a spike in temperature, which reduces the battery's lifespan. To get the most out of an automobile's battery's capacity, it is common practise to make efficient use of the energy it contains. For maximum efficiency, the battery management system (BMS) is introduced (battery life is additionally considered here). BMS is used in vehicle applications to manage energy at various system interfaces and to assure the safety of the system against various risks. BMS. Distinct functional blocks are found in the BMS. Architecture, functional blocks, and improved circuitry all play a role in battery life extension. It is possible to purchase a variety of commercial BMSs on the market. This includes a UL 1973-recognized battery management system (BMS) for mobile and stationary energy storage. The SOC estimation can be improved significantly by using some strategies for precise modelling. It's a tool for enhancing the efficiency of battery packs. BMS is able to see,

Reasons for utilising a battery management system include these:

- Ensure that the battery is safe and reliable
- Monitoring and evaluation of the battery
- To maintain a stable charge level
- Controlling the temperature of the cells and balancing them
- Control of renewable energy sources
- Calculations of the charge state
- Protection against cell over voltage and under voltage
- Batteries are balanced intelligently (passive)
- Control of the battery charger
- Tracking of the pack's temperature
- Monitors the battery pack's condition

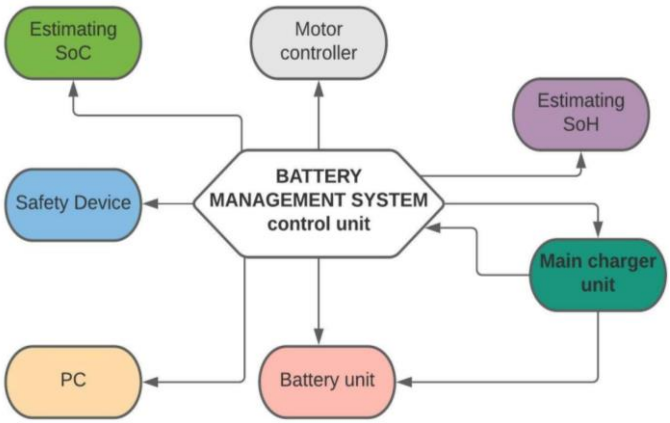

Fig.1.Diagram of the BMS system's components

2.1 State Of Charge (SOC)

The percentage of the battery's rated capacity that is now available defines the state of charge. Battery management systems rely on the state of charge to make accurate assessments of the battery's health and keep it within a safe operating range through charge and discharge regulation. It also extends the battery's life. It is impossible to assess the fee directly. The battery management system of an electric car uses terminology like "State of Charge," "current," and "voltages" quite frequently. SOC is the amount of battery capacity that is currently available. The rate at which a battery is charged and discharged has an effect on its state of charge (SOC). As a result, we can conclude that charging and discharging battery rates are constant across time.

2.2 State of Health (SOH)

When a battery's health is estimated, it's compared to a brand-new one that's been made. For the duration of its life, it provides information on the amount of discharge capacity it has. Accurate distance can be demonstrated by using the SOH in electric vehicles (EVs). Patipatiet.al. describes capacity loss and power loss as health features. Reduction in driving range and loss of acceleration are described by capacity fade, whereas loss of capacity is described by power fade. When the impedance in the cell grows with age, power fade develops. We present the most widely used battery SOH estimation methods for real-time automotive applications, with a focus on hybrid electrics. SOH can be estimated using a number of different indicators. When it comes to hybrid applications, the internal resistance of the battery is a key signal. The battery's power capacity decline

is shown by this indicator. For real-time automotive applications, the most important types of estimating approaches — experimental methods, model-based methods, and machine learning — are described and contrasted.

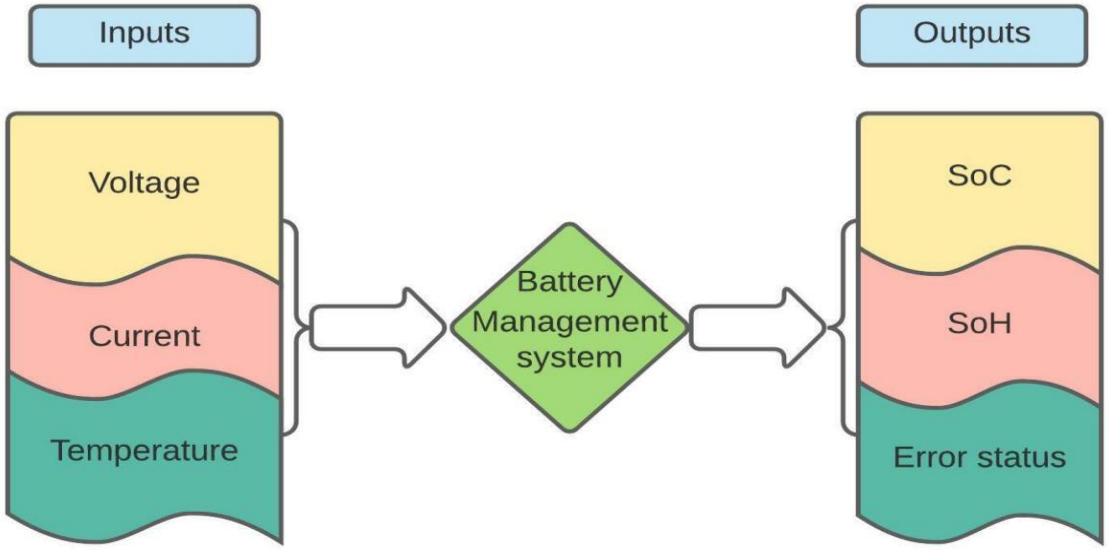

Fig.2.process diagram.

BATTERY TYPES

A device that converts energy into electrical power. There were numerous battery varieties, each with its own unique form of storage. Because lithium-ion batteries can be recharged quickly, they are commonly utilised in electric vehicles. They're found in everything from electronic devices to electric cars, to name just a few examples. Electronic systems like battery management systems are designed to maximise battery efficiency while also safeguarding it from being used outside of its safe operating range, monitoring it for changes, computing secondary data, and reporting it while also controlling its surrounding environment, authenticating it and/or balancing it out.. Self-driving cars are electric vehicles that can be recharged without the use of a charging station. E-Cars are vehicles that run on electricity as their major fuel source.

Table 1. General Parameters of the Electric Battery component

Types	**Li -Ion**	**Na -NiCl2**	**Ni -MH**	**Li -S**	**Unit**
Maximum Charge	72	80	83	82	Ah
Nominal Voltage	325	286	284	301	V
Stored Energy	23	23	23	23	kWh
Maximum/ Minimum Voltage	325 / 305	272/ 303	274 / 302	291 / 318	V
Initial Charge	100	100	100	100	%
Operating Temperature	32	265	35	31	°C
Mass of Battery	310	454	536	454	kg

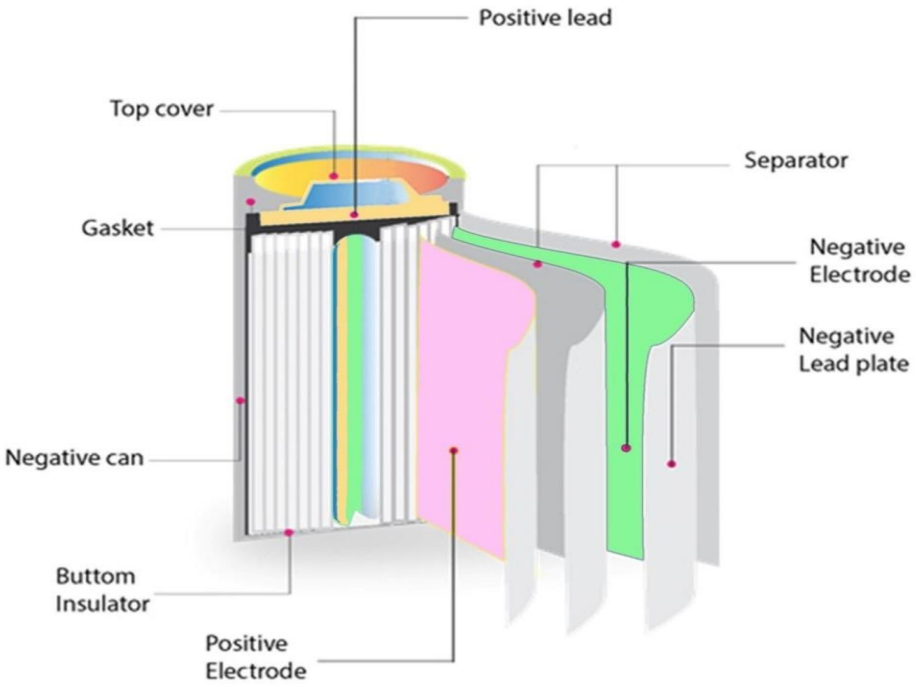

Fig.3.inside battery cell

Lithium-ion battery characteristics:-

- Densely packed power
- A long life
- Self-discharge tends to be low
- Low operating expenses
- Environmentally friendly
- Intensely reactive

Lithium-ion batteries are the most responsive, lightest, and most powerful. Lithium-ion batteries charge and discharge far more quickly than other types of batteries. In order to avoid the combination of several chemical reactions, a rise in temperature, and cell venting, lithium-ion cells should be run beyond their safe operating voltage range. Because of this, a battery management system (BMS) is utilised to keep the battery in its safe range.

CONCLUSION

To switch to electric automobiles since they are pollution-free and cost less to run than other types of vehicles. The battery's efficiency can be improved by utilising a battery management system. Using the battery management system, we're able to create a new battery for vehicles by fusing two old ones. Electric vehicles can benefit greatly from an advanced battery management system. To ensure the safety and efficiency of electric vehicles, the battery management system is a must-have component. In addition, they provide solutions for electric vehicle inclination, power, and heating issues. The diagnosis and prognostication of short circuit play an important role in improving battery safety since short circuit has been regarded a critical issue for EV safety. Short circuit diagnosis and prognosis are summarised in a comprehensive review here. For ISC, mechanical testing have low repeatability and controllability in terms of experimentation.

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