Turkish Journal of Computer and Mathematics Education Vol.10 No.3(2019),1266-1271
Research Article

EV BMS WITH CHARGE MONITOR AND FIRE PROTECTION

[1]Lella Priyamvadha,[2]Vaddi Ramesh,[3]Rachapureddy Sukanya,[4]AC Jeevitha

[1234]Assistant Professor, Department Of EEE, Tadipatri Engineering College,Tadipatri,AP

ABSTRACT: Battery storage forms the most important part of any electric vehicle (EV) as it stores the necessary energy for the operation of EV.So, in order to extract the maximum o/p of a battery & to ensure its safe operations it is necessary that a efficient battery management system exist is the same .It monitors the Parameters, determine SOC and provide necessary services to ensure safe operation of battery. Hence BMS forms a integral part of any EV and safe guards both the user and the battery by ensuring that the cell operates within its safe operating parameters. The proposed system only monitor the battery and charge it safely but also protect it to avoid accidents from occurring. The proposed model has following functions current, voltage measurement, state of charge (SOC) calculation, protection, battery status detection, liquid crystal display (LCD) etc. Electric vehicles (EVs) are automobiles powered by one or more electric motors, which draw energy from rechargeable batteries instead of relying solely on internal combustion engines (ICEs) that consume fossil fuels.

A Battery Management System (BMS) is a critical component in electric vehicles (EVs) and other battery-powered systems. It monitors and controls the operation of the battery pack, ensuring its optimal performance, safety, and longevity.

State of Charge (SoC) refers to the measure of the remaining energy in a battery, expressed as a percentage of its total capacity. It indicates how much charge is available in the battery at a given time, allowing users to estimate the remaining range or usage time before recharging is required.

Keywords: Electric vehicle, Battery management, State of charge.

I. INTRODUCTION

An electric vehicle EVs is a type of vehicle that uses one or more electric motors for propulsion. Instead of using an internal combustion engine (ICE) that burns fuel, an EV use a battery pack to store electrical energy to power an electric motor, which turns the wheels.

Compared to conventional ICE vehicles, EVs provide a number of benefits, such as decreased emissions, quieter operation, and a lessened reliance on fossil fuels. Since electricity is frequently less expensive than gasoline and electric motors are more efficient than ICEs, they also typically have reduced operational expenses.

The popularity of EVs is fast rising as the globe moves towards a cleaner, more sustainable future. Governments all around the world are granting incentives to stimulate the use of EVs, and numerous automakers are already selling a variety of EV models. In addition to its benefits, common EV problems include internal cell shorts that may result in thermal runaway. An EV typically catches fire because of excessive heating. The electric vehicle's battery warms up, and when that heat interacts with petrol that has leaked, the battery simply catches fire.

A battery management system (BMS) is an electrical device that controls and keeps track of the operation of rechargeable batteries, such as those found in renewable energy sources and electric cars. By regulating the charging and discharging process, keeping track of the battery's state of charge and overall health, and guarding the battery from harm brought on by overcharging or overheating, the BMS aids in ensuring the safe and effective operation of the battery.

The BMS normally consists of a number of parts, such as sensors for measuring the temperature, voltage, and current of the battery as well as control circuits for controlling how the battery is charged and discharged in response to various conditions. Software algorithms that forecast the battery's remaining capacity and project its remaining life may also be present in the BMS.

One of the key functions of a BMS is to prevent the battery from being overcharged or over-discharged, which can cause permanent damage to the battery and reduce its lifespan. The BMS accomplishes this by controlling the charging and discharging process and shutting down the battery if any abnormal conditions are detected.

Another important function of a BMS is to ensure that the battery is operating within a safe temperature range. If the battery gets too hot, the BMS may reduce the charging rate or shut down the battery to prevent damage. If the battery gets too cold, the BMS may increase the charging rate to help warm up the battery

Overall, a BMS is an essential part of any rechargeable battery system since it ensures the battery's safe and effective operation and increases its longevity.

EV batteries that are frequently utilised are 2-cell lithium-ion (Li-ion) batteries. A 2-cell Li-ion battery should have a voltage of roughly 6.0V when it is fully depleted, and a maximum charge voltage of roughly 8.4V

The balancing charger will keep track of each cell's voltage during the charging procedure and modify the charge rate as necessary to guarantee that all of the cells receive an equal charge. The balancing charger will automatically cease charging when the battery is fully charged.

It is crucial to remember that overcharging a Li-ion battery might cause it to malfunction, which could cause a fire or explosion. As a result, it's crucial to pay close attention to the charging process and prevent leaving the battery alone while it's being charged. In our project, we keep an eye on battery voltage, temperature, and detect the presence of fire. If the battery temperature rises beyond a certain threshold, the power to the lithium-ion battery is automatically shut off using a relay.We create a little robot that can be operated by an android app and contains all the systems mentioned above.

II. LITERATURE SURVEY

2.1 Battery Energy Storage System (BESS) and Battery Management System (BMS) for Grid-Scale Applications

Due to a discrepancy between the quantity of energy consumers use and the amount of energy generated by generation sources, the current electric grid is an inefficient system that wastes a considerable amount of the electricity it generates. In order to assure adequate power quality, power plants often produce more energy than is required. Many of these inefficiencies can be eliminated by making use of the energy storage that already exists inside the grid. To accurately monitor and regulate the storage system while using battery energy storage systems (BESS) for grid storage, comprehensive modelling is needed. The storage system is controlled by a battery management system (BMS), and a BMS that makes use of sophisticated physics-based models will enable considerably more reliable operation of the storage system. The essay describes theMatthew T. Lawder; BharatkumarSuthar; Paul W. C. Northrop; Sumitava De; C. Michael Hoff; Olivia,2008

2.2 A Battery Modular Multilevel Management System (BMS) For Electric Vehicles And Stationary Energy Storage Systems.

Although the reliance of energy systems on battery storage systems is constantly growing, there are still a number of issues that need to be resolved. Current battery systems are rigid; only cells with the same electrical characteristics may be coupled; and cell flaws significantly shorten the lifespan of the entire battery or even trigger a system blackout. Additionally, the system's weakest cell restricts the system's maximum useful capacity and maximum charging current. Current Battery Management Systems (BMS) are able to enhance the maximum useful charging current as well as the useable battery capacity to some extent. A very adaptable, fault-tolerant, and economical battery system can be developed with the help of the Battery Modular Multilevel Management System (BM3) described in this work. With the current setup, it

2.3 A Battery Modular Multilevel Management System (BMS) For Electric Vehicles And Stationary Energy Storage Systems

The dependency of energy systems on battery storage systems is constantly increasing, but there are still several unsolved problems. Current battery systems are inflexible, only cells with the same electrical parameters can be combined, and cell defects cause a high reduction of the overall battery lifetime or even a system black out. In addition, the maximum usable capacity and the maximum charging current are limited by the weakest cell in the system. Current Battery Management Systems (BMS) can increase the usable battery capacity to some extend and are able to enlarge the maximum usable charging current. With the Battery Modular Multilevel Management System (BM3) presented in this paper, a very flexible, fault tolerant, and cost-efficient battery system can be implemented. With the system it is possible to establish either serial or parallel connections between neighboring cells or to bypass a cell. Thus the cells can be operated according to their needs and their state of charge (SOC). Separate balancing means for balancing the cells SOC, however, become obsolete.

2.4 Battery Management System Via Bus Network For Multi Battery Electric Vehicle

This paper proposes multi-battery design of battery management control using bus communication method based on loop shaping. The experiment of proposed method shows that the capacity dynamics of battery has been improved. The multiple of battery control system is implemented in electric vehicle's model, and we modify the origin control system using bus communication method auto tuning based on loop shaping. The result of modified control system using bus method based on loop shaping is shown in the implementation design response of battery management that the cost and reliability are improved. Moreover, this method could maintain the error steady state to be zero. of five years. The time series monthly data is collected on stock prices for sample firmsand relative macroeconomic variables for the period of 5 years. The data collection period is ranging from January 2010 to Dec 2014. Monthly prices of KSE -100 Index is taken from yahoo finance.

2.5 OUTCOMES

The BMS serves a significant function in monitoring the battery's condition and guaranteeing safe charging and discharging in electric car battery systems.

BMS should have temperature monitoring, cell balancing, overcurrent protection, fire suppression systems, and containment systems in order to prevent potential risks like thermal runaway and fire.

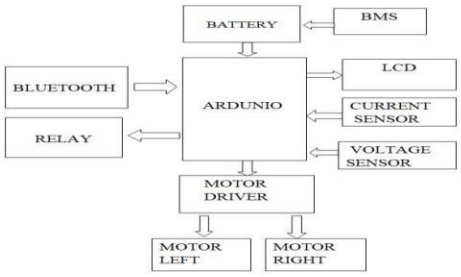
Using automatic fire extinguishers and covering battery cells with fire-resistant materials are two examples of the fire safety strategies that can be incorporated into BMS design.

By preventing overcharging, undercharging, or overdischarging, which can harm the battery and shorten its lifespan, the BMS should also be made to increase battery life.

Different designs and tactics for BMS with charge monitor and fire protection measures, such as fire detection and suppression systems, over current protection, cell balancing, and temperature monitoring, have been offered in various research investigations.

III. METHODOLOGY

BLOCK DIAGRAM



BLOCK DIAGRAM OF EV BMS WITH CHARGE MONITOR & FIRE PROTECTION

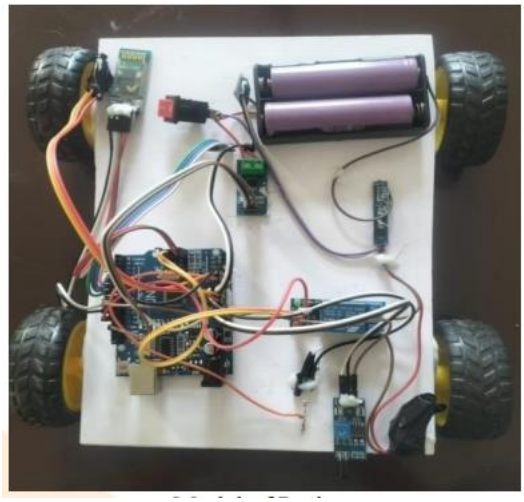
DISCRIPTION

This proposed system consist of ,Arduino microcontroller that connects to an Android app through a Bluetooth module. The Li-ion battery is balanced charged using a 2 cell li-ion battery charging circuit. The battery temperature is measured using a LM35 temperature sensor that is attached to an Arduino's analog pin.

The battery voltage is measured using a voltage sensor, and the results are shown on the app. A 5v relay linked to pin 8 of the Arduino Uno is turned off when an over temperature is detected, cutting off power to the battery. The Arduino Uno is attached to a fire sensor, which will determine whether a fire is present and disconnect the battery from electricity if it is.

Four 100 rpm motors are coupled to an Arduino Via motor driver in our robotic automobile. The LN239D motor driver that we are utilizing is linked to the Arduino UNO pins 4,5,6, and 7.

The system when turned on uses its charging and monitoring circuitry that allows user to safety charge the 3S battery. While charging the voltage sensor is used to check voltage and limit the flow of current too to the battery using charging circuitry. The LCD display also displays the current voltage level of battery. As soon as the battery is fully charged, the system cuts off the supply and displays Battery fully charged on LCD Display. When connected to a load the current sensor keeps track of current drawn from battery and displays the parameter on LCD Display. The temperature sensor is used to monitor temperature of battery while charging as well as discharging. If the battery temperature is observed to deviate from standard values, the system automatically cuts off input as well as output supply and displays the temperature as well as a buzzer alert on the LCD display. Thus the system allows for a smart and efficient battery charging as well as protection system.



Model of Project

COMPONENTS

1. Ardunio Uno
2. Li-ion Battery
3. Motor Driver LN298D
4. DC Motor
5. Bluetooth HC-05
6. IR Sensor
7. LCD Display
8. Current Sensor
9. Voltage Sensor
10. Relay Module

IV. ADVANATGES AND APPLICATIONS

4.1 ADVANTAGES

- Real Time Monitoring and Reporting
- Extended Battery Life
- Optimal Performance
- Early Fault Detection

4.2 APPLICATIONS

- Electric Vehicle Manufacturing
- Public Charging Infrastructure
- EV Service and Maintenance Centres
- EV Battery Recycling
- Energy Storage System

V. RESULTS

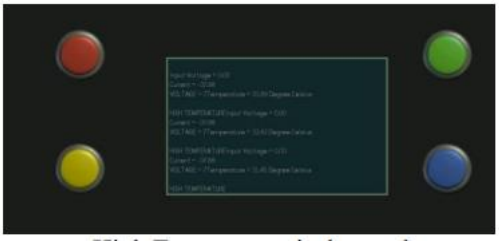
The safety and efficiency of electric vehicles have significantly improved as a result of the use of EV BMS with charge monitor and fire protection.

The battery monitoring and cell balancing features, for starters, have made sure that the battery pack operates within safe parameters and that each cell is charged and discharged equally, preventing overcharging or undercharging of individual cells. As a result, the battery pack's performance and longevity have greatly increased, allowing the electric car to go farther between charges.

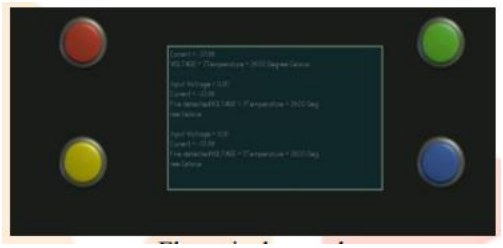
Second, the risk of thermal runaway and battery failure has been decreased thanks to the charge protection and discharge protection features, which have stopped the battery pack from being overcharged or depleted, respectively. By lowering the possibility of battery fires, this has also increased the safety of the electric car.

Thirdly, the battery pack functions within a safe temperature range thanks to the temperature management mechanism, preventing overheating, which could harm the battery and shorten its lifespan. This feature also makes sure that the cooling system functions effectively, which lowers energy use and boosts the electric vehicle's efficiency.

The fault diagnosis feature, which can identify any battery pack defects and allow the driver to take the appropriate action, is also crucial. This function makes sure that any battery pack problems are swiftly found and fixed, minimising downtime and enhancing the overall dependability of the electric vehicle.



High Temperature is detected



Flame is detected

VI. CONCLUSION

In conclusion, an essential part of electric vehicles that guarantees the security, dependability, and longevity of the battery pack is the EV BMS with charge monitor and fire prevention. By supplying crucial safety features like temperature control, fault detection, cell balancing, and fire prevention, the system lowers the possibility of battery fires and enhances the overall efficiency of electric vehicles.In order to improve the features and capabilities of EV BMS with charge monitor and fire prevention, more research and development is still possible. A few potential future work areas include eenhancing the precision and dependability of battery monitoring systems to deliver more accurate and timely data regarding the charge, health, and function of the battery pack.

REFERENCE

1. Y. Liu, X. Qian, and H. Guan, "Development of electric vehicle battery management system with charge balance control," IEEE Transactions on Power Electronics, vol. 28, no. 6, pp. 2901-2908, Jun. 2013.
2. D. Chao, C. Shen, and K. S. Low, "Real-time state-of-charge estimation for electric vehicle batteries using a coupled electrochemical-thermal model," Journal of Power Sources, vol. 329, pp. 261-268, Jan. 2017.
3. J. Li, J. Fan, and J. Li, "A novel active cell balancing scheme for series-connected battery packs of electric vehicles," IEEE Transactions on Vehicular Technology, vol. 68, no. 5, pp. 4138-4148, May 2019.
4. D. Wang, Z. Xu, and L. Xu, "An integrated thermal management system for lithium-ion battery pack in electric vehicles," Journal of Power Sources, vol. 329, pp. 337-348, Jan. 2017.
5. H. Guo, M. H. Ang, and Y. Cheng, "Development of a fire detection system for lithium-ion battery in electric vehicles," Journal of Power Sources, vol. 325, pp. 405-412, Nov. 2016.
6. W. Cheng, X. Luo, and B. Yang, "Online fault diagnosis for lithium-ion batteries in electric vehicles using neural network ensemble," IEEE Transactions on Industrial Informatics, vol. 14, no. 4, pp. 1735-1744, Apr. 2018.