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IoT Based Electric Vehicle Battery Management System for Enhance Battery Life

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***Abstract*:** This abstract describes the concept of an IoT-based electric vehicle battery management system that can enhance the battery life of electric vehicles.By utilizing IoT technologies such as cloud computing, big data analytics, and machine learning algorithms, this system can monitor and analyze data in real-time, including charging patterns, driving habits, and battery performance. This enables the system to optimize the charging and discharging process, which in turn prolongs the battery life. In this project, we propose an Internet of Things (IoT) based BMS for EVs that integrates real-time data monitoring, analysis, and control to enhance battery life.The proposed system includes a range of sensors, such as temperature sensors, current sensors, and voltage sensors, that collect real-time data from the EV battery. This data is transmitted wirelessly to an IoT gateway, which then forwards it to a cloud-based platform for analysis and storage. The platform uses machine learning algorithms to identify patterns and anomalies in the data, and provides insights to improve battery performance and extend battery life.

Keywords -*Battery management system (BMS), electric vehicle (EV),Internet of Things (IoT),Machine learning algorithms ,Sensors.*

1. Introduction

Electric vehicles (EVs) are becoming more and more popular, which has increased need for effective and trustworthy battery management systems. An electric vehicle's battery is a crucial component, and good management is necessary to extend battery life and guarantee consistent performance The EV's battery is monitored in real-time using the Internet of Things (IoT), and its performance is optimized using advanced analytics. The IoT-based BMS has several benefits over conventional BMSs. For example, it can anticipate battery deterioration and notify the driver or service crew so they can take the appropriate steps before a breakdown happens.

Overall, managing the batteries of electric vehicles is made smart, efficient, and effective by an IoT-based BMS. The EV sector and the environment will ultimately gain from the use of IoT to extend battery life, increase dependability, and optimize performance.

1.1 Advanced Concepts In Electric Vehicle Design

The Eco-Vehicle will be a high-performance, but ultrasmall, battery powered vehicle. New designs for the Eco-Vehicle include an in-wheel motor drive system, a hollow load floor which will house the batteries, and a new battery management system. The Eco-Vehicle may also utilize other advanced concepts suitable especially for EV’s, including solar panels for battery charging and intelligent crash avoidance and guidance systems.

1.2 A Review On Battery Management System For Electric Vehicles

The efficiency of electric vehicles depends on accurate testing of key parameters and proper operation and functionality of battery management system. On the other hand, inadequate battery energy storage system monitoring and safety measures can lead to serious problems such as battery overheating, overcharging, cell unbalancing, thermal management, and fire threats. An efficient battery management system, which includes charging discharging control, precise monitoring, temperature management, battery safety, and protection, is essential for enhancing battery performance in order to alleviate these worries. This study aims to give a comprehensive analysis of different intelligent techniques and control strategies for the battery management system in electric vehicle applications.

2. Lithium-Ion Battery

One third of all fossil fuel is used by trucks, ships, freight, and aircraft. The two main sources and the main contributors to the emission of carbon dioxide (CO2), Sulphur dioxide (SO2), carbon monoxide (CO), and nitrogen oxides (NO) are ICE and industry [1]. The greenhouse effect is brought on by the air pollution that these gases produce. The EES in an EV power the EV motor and other devices like the air conditioner and navigational lights. Although the EV emits no carbon emissions, it is generally known that its release of SO2, CO2, NO, and CO has not occurred.

ES is now being installed in buses. The cumulative EV market today places a premium on factors including tax revenue, cost, cost-effectiveness, accessibility to e-commerce, and competitive advantage over other options for automating mobility . EVs have recently been steadily gaining popularity in international markets like China and Europe. Increasing the use of EVs instead of ICE vehicles can alleviate problems, such as global warming and greenhouse gases, that pose a threat to the environment.

The super-capacitor (SC), battery, and fuel cell are three energy storage devices (ESD) that have been created for use in electric vehicles (EVs). Batteries are popular forms of electrochemical storage that generate power. The engine, lighting system, and other operational components are all powered by the storage energy.

EVs employ rechargeable ESDs such nickel-zinc batteries, lead-acid batteries, lithium-ion batteries, and SCs. The need for ESDs in the realm of portable electrical devices has significantly increased due to the technical advancement of ESDs.

Nonetheless, the LIB has potential demand for bulk ESS whereas lead-acid batteries have lately enjoyed a significant global market in solar ESSs. Based on particular EV needs, several ESD kinds are taken into consideration . ESD standards for EV systems take individual cell safety, particularly energy storage capacity, into consideration. Due to under- or overcharging, the cell's internal chemical composition, and the temperature profile, the cell voltage of an ESD becomes unbalanced . By lowering the temperature dangers and stabilizing the cell voltage, the ESD lifespan may be extended.

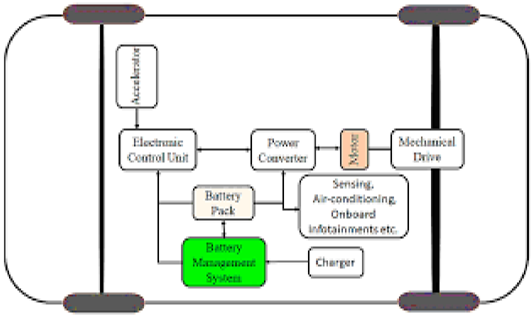

Fig 1: BMS operation inside the EV

During the charging/discharging period for internal electrochemical processes in ESD, cell voltage imbalance occurred. Cell voltage balancing is the main effort in BMS to increase cell safety and lifespan. Scientists and researchers are developing very effectivecell voltage/charge balancing systems using BMSs to balance the cell voltage/charge, safeguard the cell from dangerous explosions, and increase its dependability.

3. Electric Vehicle

3.1. EV and HEV

In the past ten years, HEV has been heavily pushed. There are HEVs from almost every manufacturer on the market . The battery energy storage issue is supposed to be solved at that time. The ability to obtain electric power from an engine is made possible by hybrid vehicles.

The series hybrid and series hybrid HEVs are the two main categories. The battery is completely coupled to the engine power in a series hybrid. The battery is the source of the entire motor's power. The motor and engine work together to provide propulsion power for the parallel hybrid. Together, engine and motor produce the torque. To absorb engine power through the gearbox, the motor also functions as a generator. Both series or hybrid can absorb power through regeneration during braking or deceleration.

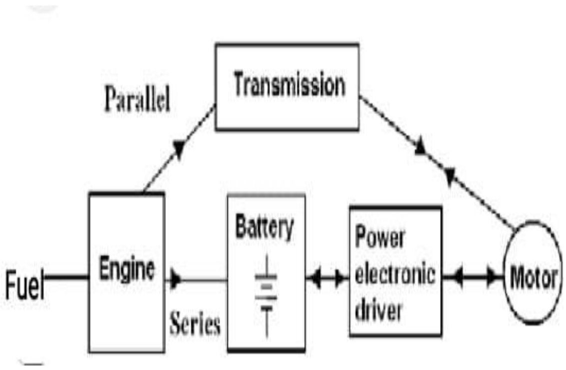

Fig 2: The series or parallel path of an HEV

Nonetheless, HEVs still produce some emissions. Plug-in HEVs were introduced, which somewhat resolves the issue . It receives electrical power from the mains via plugging into the battery. Hence, customers can use AC from the mains to charge the battery whenever it's convenient.

3.2. The Key Components In EV

The electric vehicle is rather simple in structure. The key components are the propulsion parts. Fig shows the configuration

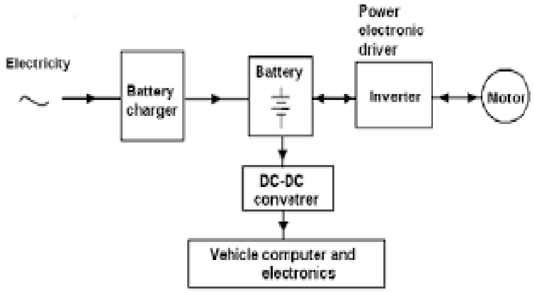

Fig3: Key components of electric vehicle

The primary energy storage is the battery. The purpose of the battery charger is to modify mains power so that it may charge the battery . To run the motor, the battery voltage, which is DC, is inverted into a switched-mode signal using a power electronic inverter. Via a DC-DC converter, which steps down the voltage from the battery pack to a lower voltage, such as 5V-20V, the other electronic components in a vehicle can be powered from the battery.

3.3. The Motor

There are a number of motors available for electric vehicle: DC motors, Induction motor, DC brushless motor, Permanent magnetic synchronous motor and Switched reluctance motor

3.3.1.DC Motor

It is a traditional motor that has long been employed in motor control. Through stationary brushes that are in rubbing contact with the copper segments of the commutator, all the power involved in electromechanical conversion is delivered to the rotor. It has a shorter lifespan and needs specific maintenance.

Nonetheless, low power applications are appropriate for it. It has uses in micro-cars, transporters, and electric wheelchairs. DC motors are now used in the majority of golf carts. Less than 4kW of power is being used.

3.3.2.Induction Motor

It is an extremely well-liked AC motor. In applications requiring variable speed drives, such air conditioning, elevators, and escalators, it also holds a significant market share. For more than 5kW, several of the higher power electric vehicles need motor with induction. Typically, torque and speed control are provided via a vector drive.

3.3.3.DC Brushless Motor

Because the field, which is the low power winding in a traditional DC motor, is motionless while the main, high power winding rotates, the motor has poor mechanical performance. It is "turned inside outthe DC brushless motor". The high power winding is mounted on the motor's stationary side, and a permanent magnet is used to excite the field on the rotor.

3.3.4 Permanent Magnet Synchronus Motor

The stator is like that of an induction motor. The rotor us mounted with permanent magnets. It is equivalent to an induction motor but the air-gap filed is produced by a permanent magnet. The driving voltage is sinewave generated by Pulse Width Modulation (PWM).

3.3.5.Switch Reluctance Motor

It is a variable reluctance machine and its famous recently because of the fault tolerance because each phase is decoupled from other. . Each phase winding is connected in a flyback circuit style .

4. Proposed Topology

An IoT-based electric vehicle battery management system can greatly enhance the battery life of electric vehiclesby optimizing charging and discharging patterns, monitoring battery health, and providing real-time data and alerts to the vehicle owner. Here are some proposed steps for designing an IoT-based electric vehicle battery management system

Battery Charging Management: By regulating the charging process, the battery management system can make sure that the battery is charged optimally to increase its lifespan. On the basis of the vehicle's usage trends, the charging procedure can also be planned.

Energy Management: The technology can help control how much energy the car uses and make sure the battery isn't being depleted needlessly. This could lengthen the battery's life and boost the car's overall effectiveness.

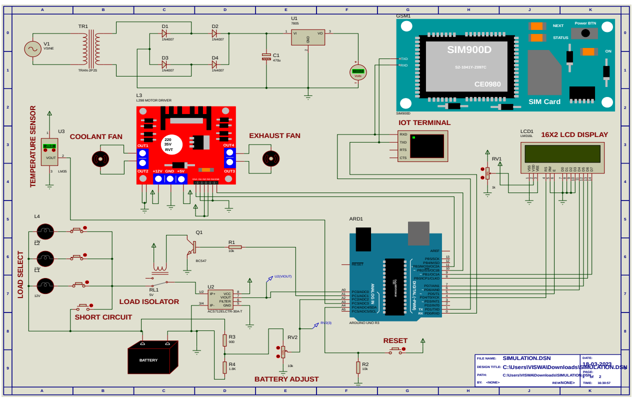

Fig 4: Simulation circuit diagram

5. Result Analysis

The performance of electric vehicles can be greatly improved and their battery life can be extended by using an IoT-based Electric Vehicle Battery Management System (BMS). The BMS is charge of controlling the battery's performance and health, and it can employ IoT technology to give fleet managers and vehicle owners real-time data and analytics.The creation of dashboards that provide key performance indicators (KPIs) such battery charge level, range, and charging times using data visualization tools is another strategy.

5.1 Simulation Working Principle

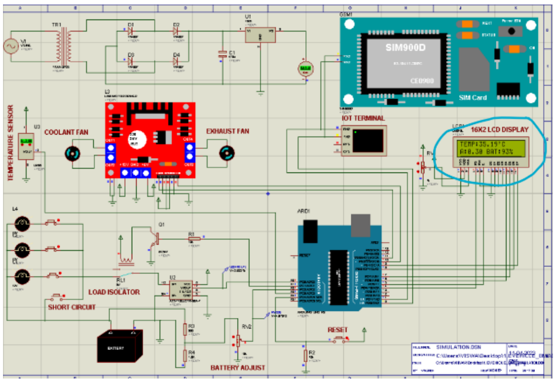

Fig 5: Circuit diagram applying the low temperature

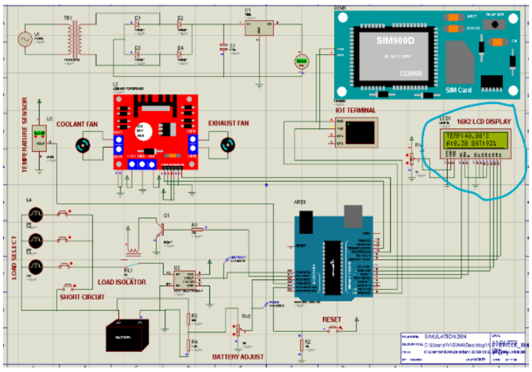

Fig 6: Circuit diagram applying the high temperature

6. Conclusion

In conclusion, an IoT-based electric vehicle battery management system can greatly e enhance the battery life of electric vehicles. By monitoring and analyzing data such as charging patterns, driving habits, and battery performance in real-time, the system can optimize the charging and discharging process to prolong the battery life.

Overall, an IoT-based electric vehicle battery management system can not only enhance the battery life of electric vehicles but also contribute to reducing the environmental impact of transportation by promoting the use of sustainable energy sources. As such, it represents a promising avenue for future research and development in the field of electric vehicletechnology.

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