Battery Management for Electric Vehicle using IoT

S.Subbu Lakshmi[1] Dr.R.Narmatha Banu[1] A.Amalraj[1]

[*1] Department of Electrical and Electronics Engineering, Velammal College of Engineering and Technology, Madurai– 625 009, TamilNadu, India

ABSTRACT

Electric vehicles are the key technology to decarbonize road transport. It gives several benefits over conventional internal combustion engines, with reference to less local emissions, high energy efficiency, and reduced need of oil. A battery is the sole source of supremacy for an electric vehicle. Yet, there is substantial obstacles to the quick espousal of electric cars, considering the precincts of battery technology. Performance degradation is caused by a progressive decrease in the energy supplied to the vehicle. The manufacturing of batteries is quite concerned about this. This describes the use of Internet-of-things (IOT) in monitoring the enactment of electric vehicle battery. In this work, the idea of monitoring the performance of the vehicle using IOT techniques and solar hybrid e-vehicle for battery management system (BMS) is proposed. IOT-based battery monitoring system has two components, a monitoring device and a user interface. Here, the system can recognise diminished battery performance and alert the user for additional action.

Key words: internal combustion engines, Internet-of-things (IOT), Battery management system (BMS).

1. INTRODUCTION:

An electrical vehicle (EV) is depending on an electromechanical mechanism. No, torque development uses any internal combustion engine. Electric power serves as the energy source for all power that is consumed. The battery deeds as a key source of electricity for the electric car.

The benefit of having an electric motor with a highly efficient power conversion system. There are many circumstances in the biosphere today where we cannot tolerate the environment, which is why carbon emissions should be reduced. Compared to internal combustion engines (ICEs) powered by fossil fuels, electric vehicles (EVs) provide more benefits, including zero emissions, no reliance on petroleum, higher fuel economy, lower maintenance, and a better driving experience (including acceleration, reduced noise, and convenient home and opportunity recharging).

Further, when charged with clean electricity, EVs provide a viable pathway to reduce overall GHG emissions and decarbonize on-road transportation. But using clean electricity is necessary for EVs to lower GHG emissions.

Therefore, EV success is intertwined closely with the prospect of abundant and affordable renewable electricity (in particular solar electricity). Vehicle electrification is a game-changer for the transportation sector due to major energy and environmental implications driven by high vehicle efficiency (EVs are approximately 3–4 times more efficient than comparable ICEVs). It reduced petroleum dependency (great fuel diversity and flexibility exist in electricity production).

Our battery management system (BMS) uses technology to keep an eye on a battery pack i.e a group of battery cells electrically arranged in a row-by-column matrix configuration. This arrangement enables the delivery of a targeted range of current and voltage for an stretched time period against anticipated load scenarios. Monitoring the battery.

- Providing battery protection.
- Malfunction detection in battery.
- Estimating the battery's operational state.
- Continually optimizing battery performance.
- Reporting operational status to external devices.
- Monitoring output of the solar panel.
- Monitoring the battery switchover

In [1], K. Eshwar and V.K. Thippiripati, presented a Weighting- dual inverter fed open-end-winding pmsm with single dc source**.** The traditional predictive torque control (PTC) of open-end-winding PMSM drive with a single dc source addresses the issues of complex weighting factor tuning, larger zero sequence current (ZSC) ripples, and increased flux and torque ripples. An efficient weighting-factor-less PTC approach is suggested to lessen the aforementioned shortcomings. In the beginning, three different system's accessible zero sequence voltages (ZSV) forms have been considered to assess the ZSC objective of cost function. The size of ZSV that minimises the ZSC error is chosen. The optimized ZSV is utilized to arrange six to seven candidate voltage vectors. The chosen candidate voltage vectors can be employed for getting the torque and flux aim since the ZSC possesses an important effect on torque and current performance. This article suggests a better incremental merit-based system that further eliminates the flux weighting component. The suggested PTC approach does not use weighting-factor adjustment, which reduces ZSC, improves current performance, reduces flux and torque ripples, and places less of a burden on the computer. Experimentally confirming and contrasting the efficiency of the suggested PTC approach with the PTC methods currently in use. In [2] O. N. Nezamuddin et al, The problem of electric vehicle charging: State-of-the-art and an innovative solution. This study gives a thorough assessment of the literature considering a highlight on the challenges that electric vehicles (EVs) encounter when trying to recharge their batteries while travelling, and it suggests a workable solution without the need for an expensive upgrade to the existing infrastructure. Vehicle-to-vehicle recharging (VVR), the name given to the proposed approach, is a way to charge EVs while they are travelling. The system's goal is to provide an inventive method for EVs to recharge their batteries without deviating from the path on a roadway. The approved charger car can provide this service upon demand, and the electric vehicle can wirelessly receive electricity while travelling a trip. To engage/disengage during wireless power transfer (WPT), the cars that give energy (charger vehicles) simply consider as a semi-autonomous. The state-of-the-art is divided as three domains that are pertinent to the suggested system and contain the mainstream of the advancements to make charging EVs easier: Infrastructure upgrades, device-level advancements, and autonomous cars are the first three. The infrastructure changes highlight few proposed systems that aim to help EVs become a convenient result to the public. Few literature on technology that discusses EVs with WPT focuses on device-level advances. Finally, the section on autonomous vehicles discusses the significance of this technology for the VVR system considering safety and dependability. Furthermore, modelling, analysis, and simulation is presented for authorizing the viability of the projected system. In [3] P.Li, X. Jiao et al,, fuzzy inference system for plug-in hybrid e vehicle was discussed. As stated by the adaptive updating legislation with traffic recognition, with the inclusion of the vehicle battery SOC, the real-time A-ECMS's adaptive equivalent factor (A-EF) is modified online in accordance with traffic statistics on the actual route. This is the reason that the initial A-EF and the proportional-integral coefficients of the A-EF adjuster can be optimised by particle swarm optimisation (PSO) in accordance with the various initial SOC and the actual historical driving cycles of each segment. The simulation test platform with integrated GT-Suite simulator and MATLAB/Simulink are utilized to implement the suggested strategy. The simulation findings demonstrate that, in defined moving condition, the suggested technique can achieve a best energy distribution on a level that is close to the global optimal level. In [4] S. F. da Silva et al, Dual Hess discussed about the design of e- vehicle power train and fuzzy control based on multi-objective optimization to increase driving range and battery life cycle. This paper uses the interactive adaptive-weight genetic algorithm (I-AWGA) method to propose a thorough multi-objective optimisation methodology for a dual HESS-based electric vehicle (EV) power train. The aim of the twin HESS EV concept is to demonstrate the benefits of integrating separate traction systems that are supplied by different energy sources. By considering design factors from components like batteries, electric motors, differentials, and ultra capacitors, the important objective of this optimisation is for simultaneously maximising driving autonomy and battery longevity and minimise HESS size. The three independent fuzzy logic controllers, which govern the power distribution between the hybrid energy storage systems, have been tuned in accordance with the applied limitations at the same time.

The optimal trade-off approach, with a 332.34 kg dual HESS mass, produced a front battery life cycle of 36585 hours and a driving range of 285.56 km. The dual HESS EV improved the ratio between the driving range and energy storage system's overall mass by 3%, reaching a driving range 19.57% longer and extending the battery life by up to 22.88% when compared to a comparable EV powered by a single HESS and optimised under the same driving conditions.

2. METHODOLOGY:

The design teams alleged existing system calls for connecting the generator to the vehicle's heating system and battery charger, and when the generator activates, it would provide power to the vehicle indirectly through the charger. The vehicle would still draw current from the motor’s connection to the batteries, but the batteries would be recharging under generator power, with the charger providing additional current to the motor to power it. The proposed system uses battery management system is the crucial system in e-vehicle. Because batteries used in e- vehicle should not be get overcharged or over discharged. If that occurs, the battery is damaged, the temperature rises, the battery's life span is reduced, and occasionally the people using the device are also affected. Control and operation of the vehicle is operated by using IoT, which operates using a microcontroller with an inbuilt Wi-Fi module. The main operation in the battery management system, is to observe the battery and providing battery protection, and to estimating the battery's operational state and to continually optimizing battery performance by reporting operational status to external devices. If any fault occurs in the primary battery due to leakage of acid, and overheating issues in battery. It indicates to the user and automatically switch over to the secondary battery. This system prefers a cloud application which is deployed in a cloud atmoshphere instead of being held on a local server or machine, this makes the easy monitoring process. All the information regarding the control of vehicle is saved in the server and control is shared to the consumers or user. Figure 1 shows the block diagram for the proposed work.

3. HARDWARE REQUIREMENTS:

ESP8266

A highly integrated chip created for satisfying the demands of a modern, networked society. With its comprehensive and independent Wi-Fi networking solution, it can either host the application or delegate all Wi-Fi networking tasks to another application processor. A self-contained SOC with an integrated TCP/IP protocol stack, the ESP8266 Wi-Fi Module enables any microcontroller to connect to your Wi-Fi network.

SOLAR PANEL

Solar photovoltaic (PV) panels convert sunlight into usable electricity, here we use the mono crystalline solar cell is fabricated by using a single crystal of silicon. It has the highest efficiency of 15-20%. It requires less space than the other types because of their high efficiency and the manufactures state that this form of solar cell the longest. PV panels are more long-lasting and sturdy since they are manufactured with high-quality components. They can survive inclement weather including snow, rain, and severe winds. Solar panels can produce more power in hot summer days once the sun is shining brightest.

BATTERY

Here, the batteries used are DC batteries. We use two batteries primary and secondary battery. The both batteries are of same volt of 12V. DC batteries are classified as lead-acid, lithium-ion [7], nickel-cadmium, and nickel-metal hydride batteries.

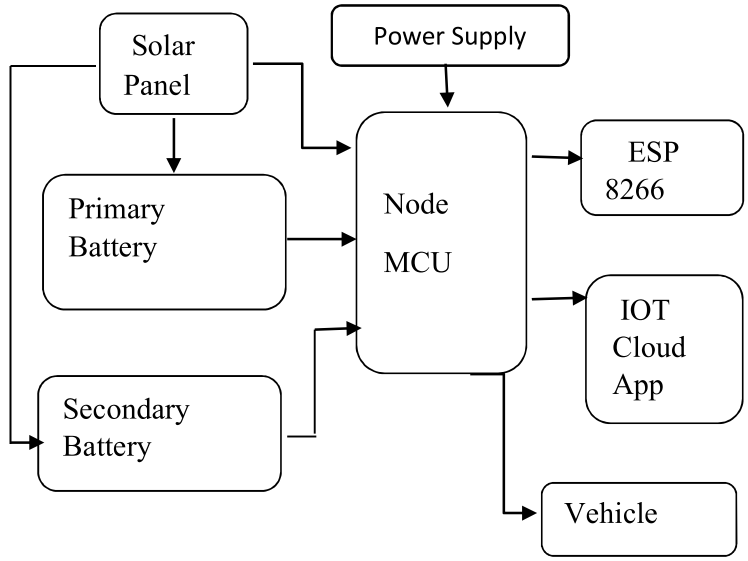

Figure 1: Block diagram

Lead-acid batteries are the frequently used type of DC battery and are commonly found in cars, boats, and backup power systems. Lithium-ion batteries are frequently applied in portable electronics, electric vehicles, and home energy storage systems. DC batteries are an important component in solar panel systems, as they store the energy produced by the solar panels during the day for usage at night or once little or no sunshine. They are also used in backup power systems for supplying electricity during power outages or emergencies [5-10]

NODE MCU

The board is compatible with the Arduino IDE and is designed using the scripting language or the Arduino programming language. USB-to-serial converter, which makes it easy to upload code to the board using a standard USB cable is considered. It board has a wide range of built-in peripherals, including GPIO pins, PWM pins, ADC pins, and I2C and SPI interfaces. It also has a 10-bit analog-to-digital converter (ADC) which can read analog signals from sensors. Board has built-in Wi-Fi connectivity, which allows it to link with other devices over a Wi-Fi network. This makes it easy to build IoT projects which will be controlled and monitored remotely. It can also act as a web server, allowing it to serve web pages and receive commands from a web browser. It is widely used in IoT applications, including home automation, environmental monitoring, and robotics. Its low cost and ease of use make it an ideal platform for hobbyists and DIY enthusiasts who want to build their own connected devices.

POWERSUPPLY

The ESP8266's maximum voltage is 3.6V, so the Thing has an on board 3.3V regulator to deliver a safe, consistent voltage to the IC. That means the ESP8266's I/O pins also run at 3.3V. It has an onboard LDO voltage regulator to keep the voltage steady at 3.3V.

4. SOFTWARE REQUIREMENTS:

The software section of the project deals with Arduino software (IDE). The ESP8266 has a complete and self-contained Wi-Fi networking solution. The software code for the proposed model is written. Once the command from the mobile phone reaches the processor then the vehicle control is processed and it starts to respond the command. The software used here is Arduino software (IDE) and language used is embedded C.

5. RESULTS AND DISCUSSION:

The Electric vehicle system was originally built with the design requirements in mind. When our working model was undergone to the test, the ensuing observations were made.On the basis of this work, specific difficulties encountered by BMS and their solutions were laid out as a framework for future study. Different approaches are applied to improve and optimise the BMS in EVs depending on the specific circumstances. Output model of the e-vehicle including integrated solar panel is shown in figure 2

Figure 2: Electric Vehicle model

The figure3 shows the control of the electric vehicle in mobile   using IoT.

Figure 3: IoT based Electric Vehicle

6. CONCLUSION:

System model is developed for battery management in e-vehicle by controlling the crucial parameters such as voltage, current, state of charge, state of life and temperature in the proposed work. It is important that   the battery management system should be well maintained with battery reliability and safety. The paper focussed on the optimized performance of the electric vehicle. Moreover, the reduction in greenhouse gases will be achieved by using the battery management system.

REFERENCES:

[1] Y. Zhou, S. Zhang, X. Cui, C. Zhang, and X. Li, “An accurate torque output method for open-end winding permanent magnet synchronous motors drives,” IEEE Trans. Energy Convers., pp. 1–1, May 2021.

[2] K. Eshwar and V. K. Thippiripati, “Weighting-factor less predictive torque control scheme for dual inverter fed open-end-winding pmsm with single dc source,” IEEE Trans. Power Electron., vol. 36, no. 11,pp. 12 968–12 978, Nov. 2021.

[3] O. N. Nezamuddin, C. L. Nicholas, and E. C. d. Santos, “The problem of electric vehicle charging: State-of-the-art and an innovative solution,” IEEE Trans. Intel. Transp. Syst., pp. 1–11, Jan. 2021.

[4] P. Li, X. Jiao, and Y. Li, “Adaptive real-time energy management control strategy based on fuzzy inference system for plug-in hybrid electric vehicles,” Control Engineering Practice, vol. 107, p. 104703, 2021.

[5] S. F. da Silva, J. J. Eckert, F. C. Corrˆea, F. L. Silva, L. C. Silva, and F. G. Dedini, “Dual Hess electric vehicle power train design and fuzzy control based on multi-objective optimization to increase driving range and battery life cycle,” Applied Energy, vol. 324, p. 119723, 2022.

[6] X. Zhang, L. Guo, N. Guo, Y. Zou, and G. Du, “Bi-level energy management of plug-in hybrid electric vehicles for fuel economy and battery lifetime with intelligent state-of-charge reference,” Journal of Power Sources, vol. 481, p. 228798, 2021.

[7] 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.

[8] 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. 581–586.

[9] H.J. Bergveld, Battery Management Systems Design by mode2001, ISBN 9074445-51-9

[10] D. Bell, “A battery management system”, Master’s thesis, School Eng., Univ. Queensland, St. Lucia, Australia, 2000.