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Battery Management System for Estimation of State of Charge in Electric Vehicles

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ABSTRACT:- The use of electric vehicles (EVs) has been increasing due to the need for sustainable transportation. However, the main challenge of EVs is the limited range of travel, which depends on the capacity of the battery. In order to ensure reliable and efficient use of EVs, it is necessary to monitor the state of the battery. Energy storage system (ESS) technology is still the logjam for the electric vehicle (EV) industry. Lithium-ion (Li-ion) batteries have attracted considerable attention in the EV industry owing to their high energy density, lifespan, nominal voltage, power density, and cost. In EVs, a smart battery management system (BMS) is one of the essential components; it not only measures the states of battery accurately, but also ensures safe operation and prolongs the battery life. The accurate estimation of the state of charge (SOC) of a Li-ion battery is a very challenging task because the Li-ion battery is a highly time variant, non-linear, and complex electrochemical system. This paper explains the workings of a Li-ion battery, provides the main features of a smart BMS, and comprehensively reviews its SOC estimation methods. These SOC estimation methods have been classified into four main categories depending on their nature. A critical explanation, including their merits, limitations, and their estimation errors from other studies, is provided. Some recommendations depending on the development of technology are suggested to improve the online estimation. In today's hectic environment, electric vehicles play an important role in mobility. Electric vehicles (EVs) produce no emissions and help to keep our environment clean. To help the global environment grow green, the Indian government has tackled and launched the upgrading and manufacture of electric cars in the country. Electric vehicles improve power efficiency and provide fuel alternatives. EVs are battery electric vehicles that run entirely on energy and are more efficient than others. Battery Management System (BMS) is like a smart helper for the battery.

KEYWORDS:- State Estimation, Thermal Management, Charging and Discharging of Cell, Interactive Voice Response, Peltier Plate For Cooling, kalman filter.

I.INTRODUCTION

The study is introduced by an analysis of the main characteristics concerning different kinds of storage systems to be used for stationary and on-board applications. Then, different charging devices, discharging modes and architectures are presented and described showing their characteristics and potentialities. It is necessary to monitor battery behaviour and accordingly utilise it. Range anxiety is the predominant desolation among the electric vehicles (EV's) possessors that caused by driver's ambiguity in relation to vehicle's energy needed to arrive at targeted place and state of charge (SoC). This makes the generation of alerts when any abnormalities occur and display the parameters in the virtual dash board. For batteries to operate safely and effectively, their state of charge (SoC) must be monitored and managed. This is where a battery management system (BMS) comes into play. Since SoC estimate gives real-time information on the battery's remaining energy, it is essential to the operation of In order to compute and anticipate the SOC the calculation uses sophisticated algorithms and sensors that monitor voltage, current, temperature, and other characterises Prece SoC estimation is necessary to maximize battery performance, prolong battery and avoid overcharging or over discharging, which makes BMS an indispensable part of many applications such as portable elections, renewable energy system Since SoC estimation directly affects remaining energy and the amount of time before recharging, it is essential for users to feel confident in their battery-operated products or vehicles. These system provides accurate SOC prediction also helps to enhancing the performance of the battery and life span. There are various methods for the direct estimation such as model based method ,book-keeping estimation and computer intelligence method. Out of these all methods we selected the coloumb counting method which is based on the book estimation and the kalman

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filter method which is model based method.The battery management system is component of the electrical vehicles. It helps for the estimation of how much charging is remaining in battery is known as state of charge. The state of charge is defined as the ratio of remaining capacity to the total capacity of the battery. The BMS moniters the things like temperature, voltage and how much battery is charged or used. We are using different methods of estimation of charge techniques widely used for state estimation in the various fields, it including battery state of charge estimation in electronic. It combines measurements and predictions to provide accurate estimation of the current state.In the SOC estimation for the battery the kalman filter contains voltage, current and sometimes temperature.The measurement of state of charge of battery is critical parameter in battery management system.The filter dynamically adjust it's estimation based on the quality of measurement and predictions.

II. LITERATURE SURVEY

i.Martin Murnane ,Adel Ghaze A Closer Look at State of Charge (SOC) and State of Health (SOH) Estimation Techniques for Batteries.This paper proposes The algorithms used for coulomb counting-based SOC and SOH estimates are covered in this article.

ii. Miftahul Anwar1, *, Muhammad D. Ashidqi1, Sunarto Kaleg, Feri Adriyanto1, Sukmaji. Cahyono, Abdul Hapid, Kuncoro Diharjo, State of Charge Monitoring System of Electric Vehicle Using Fuzzy Logic. The purpose of this research was to design a state of charge (SoC) monitoring device and to understand the effect of temperature on SoC during trials of an electric golf cart.

iii.Hend M. Fahmy ,Rania A. Swief , Hany M. Hasanien ,Mohammed Alharbi Hybrid State of Charge Estimation of Lithium-Ion Battery using the Coulomb Counting Method and an Adaptive unscented Kalman Filter. This research presents a precise and trustworthy study for determining the State of Charge (SoC) of lithium-ion batteries. The battery's nonlinear model's parameters are ascertained using an accurate state space model.

III. NECESSITY

To meet the unprecedented challenges on environmental protection and climate change, electric vehicles (EVs) and hybrid electric vehicles (HEVs) are developing rapidly in recent years. Compared with conventional internal combustion engine (ICE) based vehicles, EVs are powered by batteries that may be charged from renewable power generated from the wind, solar or other forms of renewable sources. Among all batteries types, Lithium-ion (Li-ion) batteries are preferable power supplies for EVs due to a number of favourable characteristics such as power density, less pollution, and long service life. For Li-ion batteries, a proper battery charging strategy is essential in ensuring efficient and safe operations. The charging strategy is a key issue in the battery management system (BMS) of EVs. An optimal charging operation will protect batteries from damage, prolong the service life as well as improve the performance. On the one hand, long charging time will inevitably affect the convenience of EV usage and limit its acceptance by customers . However, too fast charging will lead to significant energy loss and battery performance degradation. It is therefore rational to consider the charging time as one of the key factors in designing the EVs charging control. Secondly, large energy loss implies low efficiency of energy conversion in battery charging, which needs to be addressed. Finally, both the battery surface and internal temperatures may exceed permissible level when it is charged with high current, and the overheating temperatures may intensify battery aging process and even cause explosion or fire in severe situations. Thus, the battery charging time, energy loss, and temperature rises are important factors to be considered in designing the battery charging Process.

IV.FUTURE SCOPE

The market is anticipated to reach a valuation of US$ 8,633.29 million by the end of 2023. By 2033, the battery management system market is projected to grow at a 17.82% CAGR and generate US$ 44,428.28 million in revenue. Currently, there are two distinct companies in the Indian market for battery switching services, each offering a variety of battery types suitable for different types of automobiles. Finding appropriate connections and infrastructure for charging could be difficult following the aforementioned measure. There have also been instances of fires in battery-switching facilities due to the use of subpar batteries. Although the lithium reserves in Jammu and Kashmir may be substantial, they currently fall short of the world's best lithium reserves. More such lithium deposits and improved solar energy storage capabilities are necessary for India to become self-sufficient in the field of solar energy storage and EV manufacturing, independent of China for EV battery supplies. The future scope of Battery Management Systems (BMS) is quite promising and involves several key areas of development and innovation:-

Advanced Algorithms :- BMS will continue to evolve with more advanced algorithms for battery state estimation. These algorithms will provide more accurate data on State of Charge (SoC), State of Health (SoH), and other battery parameters, leading to better performance and longer battery life.

Wireless Connectivity :- BMS with wireless connectivity will allow remote monitoring, data analysis, and over-the-air updates. This will facilitate easier maintenance and the ability to receive firmware updates for improved performance and security.

V. SYSTEM MODEL AND ASSUMPTIONS

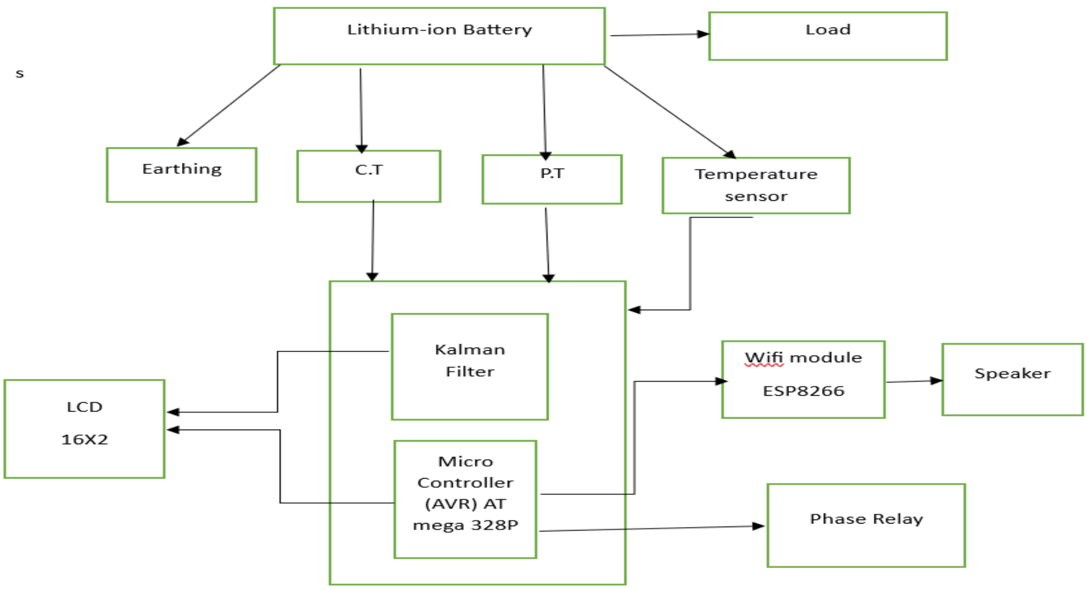
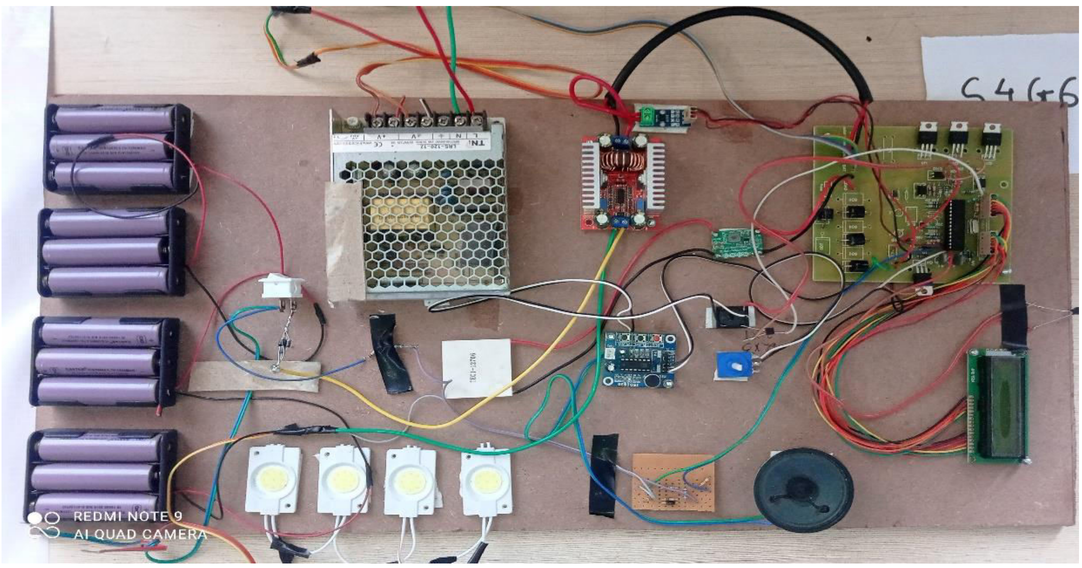


Fig (a) Block diagram



Fig(b) System Model

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Fig(a) shows the Block Diagram of our project in that C.T , P.T and Temperature Sensor is connected to Battery also one terminal of Battery is connected to earthing and the BLDC motor (Load) is connected to Lithium ion battery. Current Transformer (C.T) which is measure the current of battery & Potential Transformer(P.T) which is measure the voltage of Battery & temperature sensor which is sence the Temperature of Battery this all Three is connected to Kalman Filter also microcontroller (AVR) ATmega 328p.The microcontroller (AVR) estimate the accurate SOC in percentage (%) and this SOC will display in LCD(16*2) display. The microcontroller AVR is also connected to LCD(16*2) display. The function of microcontroller AVR is it Reduce the power full instruction into the single clock cycle execution. This microcontroller is connected to Phase Relay also connected to Voice Controller module & speaker is connected to Voice Module(ISD 1820) this speaker gives information about the present State Of Charge (SOC) of battery in the form of voice.

ASSUMPTIONS :-The 48V Lithium ion Battery will gives maximum voltage 54.55V and minimum voltage 44V. Hence for Obtaining SOC below Assumption will consider

Battery output Voltage < 44V Then SOC is 0 % Speaker is ON

44V< output Voltage < 46V Then SOC is 20%

46V < output Voltage < 48V Then SOC is 40%

48V< output Voltage < 50V Then SOC is 60%

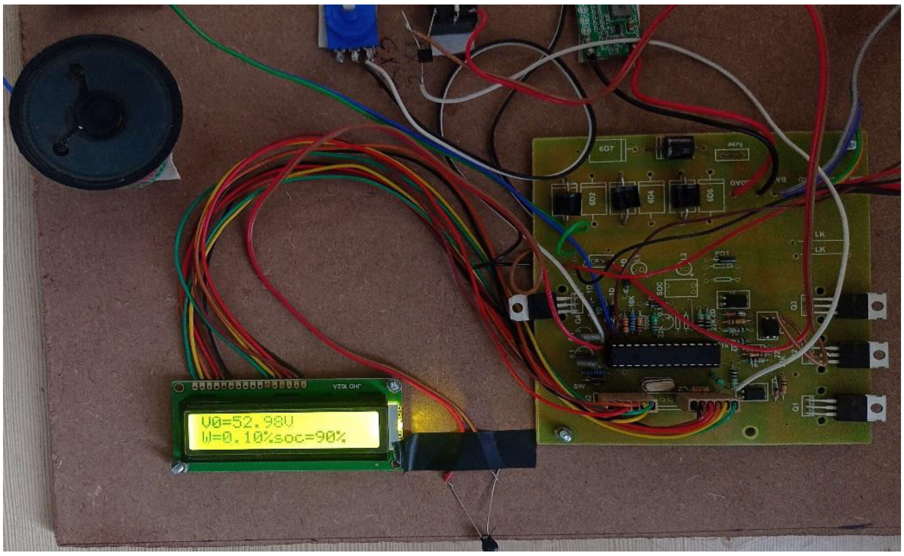
50V < output Voltage <52V Then SOC is 80%

52V< output Voltage< 54V Then SOC is 90%

output Voltage > 54V Then SOC is 100%

VI. RESULT AND DISCUSSION

1) When we Switch On the BMS System then BMS will shows output Voltage of Battery & Current State of Charge (SOC) of Battery.



2) When Battery will Discharge though Resistive load (40 Watt) then after some time the output voltage of battery decreases & SOC will decreases From 90% to 40%

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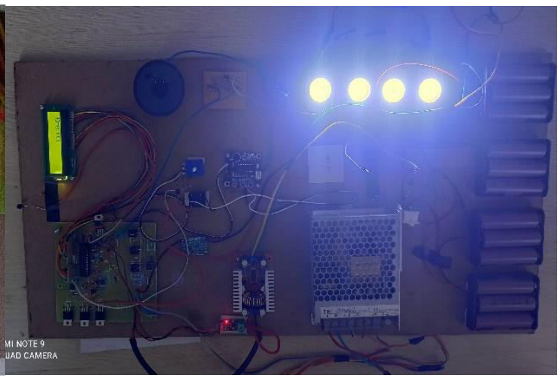
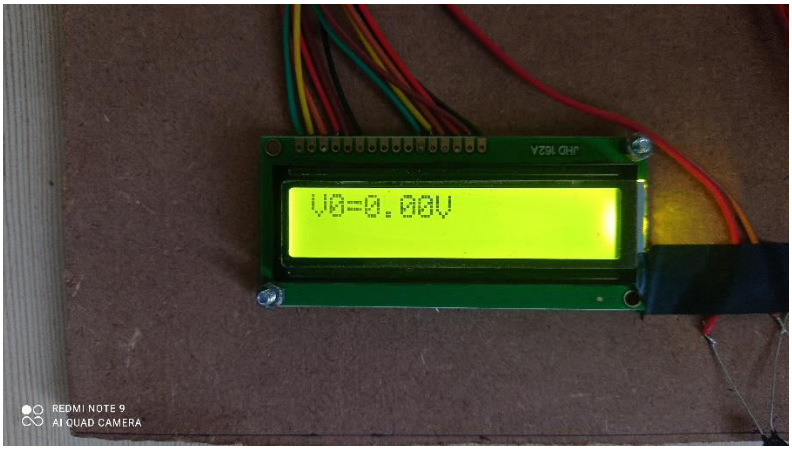


3) Then after some time the output voltage of battery will decreases & SOC will decreases From 40% to 20%

4) When output voltage of battery will less than 44V or Zero then soc is 0% and Speaker will ON & Speaker will gives low Battery Warning



VII. CONCLUSION

Based on State of Charge (SoC) assessment in Electric Vehicles (EVs), a Battery Management System (BMS) is essential for guaranteeing the secure and effective operation of EV batteries. For an EV's battery to be monitored, controlled, and protected, a BMS is necessary. It guarantees that the battery functions within safe temperature and

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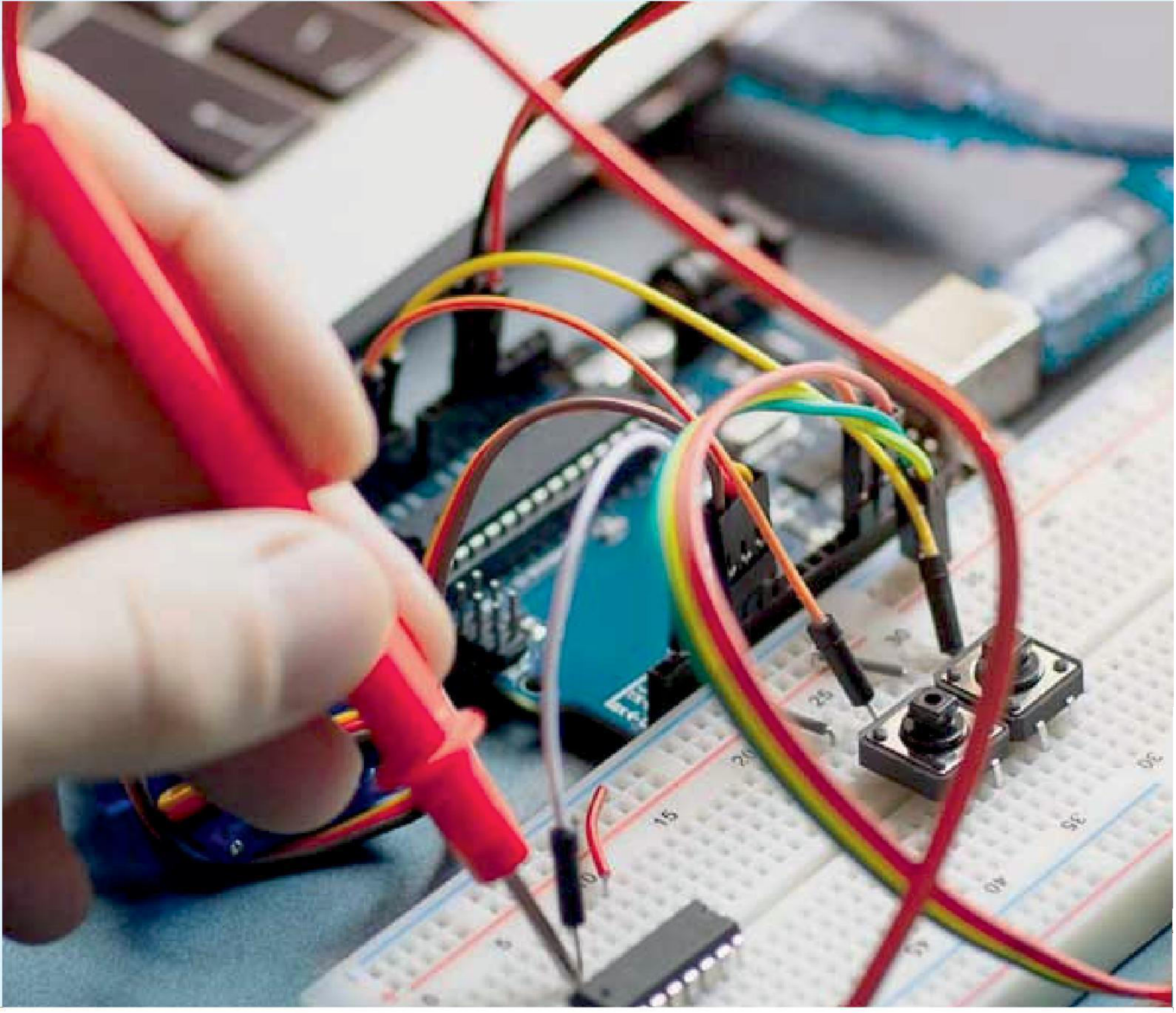
voltage ranges. Reliability of SoC estimation is essential to maximize EV range and performance. To estimate SoC, BMS algorithms combine data on voltage, current, and temperature. By controlling temperature conditions and preventing overcharging and over discharging, BMS is also essential in guaranteeing the safety of the battery. Because of issues with temperature, cost, safety, and battery life cycle, battery management is crucial to the adoption of electric vehicles. This work looks at every area of battery management, unlike other studies that focus on only one or two. Various BMS topologies, features/functions, requirements, and comparisons are covered in this study. Six key areas were emphasized for the BMS, with a particular emphasis on strategies for battery cell charge balance. Real-time SOC and SOH estimation, optimal charging issues, thermal control and runaway, and battery recycling and reuse are the key concerns facing BMS. Future BMS trends that are suggested in this study include BMS virtualization, better predictive methodologies, efficient prototype design, hybridized intelligent algorithms, and universal BMS. This research demonstrates that despite using a variety of appropriate algorithms and intricate approaches/models, BMSs still encounter a number of challenges.

REFERENCES

1. Hu, X.; Zhang, K.; Liu, K.; Lin, X.; Dey, S.; Onori, S. Advanced Fault Diagnosis for Lithium-Ion Battery Systems: A Review of Fault Mechanisms, Fault Features, and Diagnosis Procedures. IEEE Ind. Electron. Mag. 2020, 14, 65–91.
2. Liu, K.; Li, K.; Peng, Q.; Zhang, C. A brief review on key technologies in the battery management system of electric vehicles. Front. Mech. Eng. 2019, 14, 47–64.
3. Gabbar, H.A.; Othman, A.M.; Abdussami, M.R. Review of Battery Management Systems (BMS) Development and Industrial Standards. Technologies 2021, 9, 28.
4. Ramkumar, M. S., Reddy, C., Ramakrishnan, A., Raja, K., Pushpa, S., Jose, S., & Jayakumar, M. (2022). Review on Li-Ion Battery with Battery Management System in Electrical Vehicle. Advances in Materials Science and Engineering, 2022.
5. Hasan, M.K.; Mahmud, M.; Habib, A.A.; Motakabber, S.; Islam, S. Review of electric vehicle energy storage and management system: Standards, issues, and challenges. *J. Energy Storage* **2021**, *41*, 102940.



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