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"Retrofitting of Existing Vehicle For Converting To Electric Vehicle-BMS "

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Abstract- — Electric vehicles (EVs) represent a promising and sustainable mode of transportation that reduces greenhouse gas emissions and dependence on fossil fuels. battery and wiring harness playing key roles. This abstract provides an overview of the selection of batteries and wiring harnesses for electric vehicles. Battery selection involves evaluating various parameters, including energy density, power density, cycle life, and cost. Lithium-ion batteries are the most commonly used technology due to their high energy density, long cycle life, and low self-discharge rates. The wiring harness in an electric vehicle is a complex network of wires and connectors that connects various electrical components, including the battery, motor, inverters, and other vehicle systems appropriate wiring harness is critical to ensure the efficient flow of power and data throughout the vehicle.

Keywords - battery, wiring, charger, controller, DC-DC convertor.

I. INTRODUCTION

The project titled "Retrofitting of Existing Vehicle for Converting to Electric Vehicle – BMS" focuses on transforming a conventional internal combustion engine (ICE) vehicle into an electric vehicle (EV) using a lithium-ion battery system. With the rapid depletion of fossil fuels and the increasing impact of vehicular emissions on the environment, there is a growing need for sustainable and eco-friendly transportation solutions. Electric vehicles have emerged as a promising alternative due to their zero tailpipe emissions, higher efficiency, and lower operating costs.

Retrofitting existing vehicles into electric vehicles offers a cost-effective and practical approach compared to manufacturing new EVs. It involves replacing the internal combustion engine and associated components with an electric motor, battery pack, and control systems. Among these, the lithium-ion battery plays a crucial role as the primary energy source due to its high energy density, lightweight nature, and longer lifecycle.

A key component of this system is the Battery Management System (BMS), which ensures the safe and efficient operation of the battery pack. The BMS continuously monitors important parameters such as cell voltage, current, temperature, and state of charge. It protects the battery from overcharging, deep discharging, overheating, and short circuits, thereby enhancing battery life and overall system reliability. Additionally, the BMS helps in maintaining cell balancing, ensuring uniform performance across all battery cells.

This project highlights the integration of electrical and electronic systems required for EV conversion, along with the challenges involved in retrofitting. It demonstrates how existing vehicles can be upgraded into environmentally friendly alternatives, contributing to reduced carbon emissions and promoting sustainable mobility.

II. LITERATURE SURVEY

[1] Fayez Alanazi "Electric Vehicles: Benefits, Challenges, and Potential Solutions for Widespread Adaptation" authored by Fayez Alanazi, the author discusses the critical issues currently facing the primary modes of transportation worldwide. These issues encompass the increasing costs of oil and the escalating levels of carbon emissions. Consequently, electric vehicles (EVs) have been gaining significant popularity due to their independence from oil and their minimal greenhouse gas emissions. However, despite their numerous advantages, there remain notable operational challenges that must be addressed to facilitate the broad adoption of EVs. This research delves into the historical evolution of EVs and emphasizes their environmental advantages, such as reducing carbon emissions and mitigating air pollution. Additionally, it explores the obstacles and complexities associated with EV adoption, including the high infrastructure costs, the limited availability of charging stations, range limitations leading to range anxiety, and battery performance. To surmount these challenges, the paper suggests potential solutions, including the enhancement of charging infrastructure, the expansion of the charging station

network, the implementation of battery swapping techniques, and the advancement of battery technology to alleviate range anxiety and reduce charging durations. Governments can also play a crucial role by encouraging consumers through measures such as tax credits or subsidies and investing in the development of a robust charging infrastructure. [2] A.K.M.Ahasan Habib et al,."Lithium-Ion Battery Management System for Electric Vehicles: Constraints, Challenges, and Recommendations" by A.

K. M. Ahasan Habib and co-authors, the authors underscore the growing demand for electric vehicles driven by the need for energy storage solutions that are more flexible, manageable, and efficient. These electric vehicles rely on robust battery packs to power their electric motors. It is essential to have a deep understanding of various battery characteristics, such as power density, longevity, electrochemical behavior, and temperature tolerance. Battery management systems play a critical role in electric vehicles and renewable energy storage systems. This article vehicles. Environmental reports further indicate a reduction of approximately 70–80% in carbon emissions per vehicle after conversion. Despite these advancements, there remains a research gap in developing a low-cost and efficient BMS specifically tailored for lead-acid-based retrofitted vehicles.

comprehensively addresses the concerns, challenges, and potential solutions related to batteries. The battery management system encompasses essential functions such as monitoring voltage and current, estimating charge and discharge processes, ensuring protection and equalization, managing thermal considerations, and collecting and storing battery data. Moreover, this study delves into the characterization of various cell balancing circuit types, examining their components and considering factors like current and voltage stresses, control reliability, power loss, efficiency, size, and cost, while also evaluating their benefits and drawbacks. The paper identifies concerns and challenges in battery management systems and provides recommendations to optimize battery performance sustainably in electric vehicles and renewable energy storage systems. The paper concludes by highlighting areas that require further research. [3] Gerfried Jungmeier et al,. "Key Issues in Life Cycle Assessment of Electric Vehicles - Findings in the International Energy Agency (IEA) on Hybrid and Electric Vehicles (HEV)," authored by Gerfried Jungmeier and colleagues, the focus is on the potential of electric vehicles to substitute for conventional vehicles and contribute to the sustainable development of the global transportation sector. This contribution is primarily achieved through the reduction of greenhouse gas emissions and particle emissions. There is an international consensus that assessing the sustainability of electric vehicles comprehensively is feasible through life cycle assessment (LCA), which encompasses the entire life cycle of the vehicles, from production and operation to end-oflife considerations. The International Energy Agency (IEA) Implementing Agreement on Hybrid and Electric Vehicles (IA-HEV) conducts LCA activities across 17 member countries and operates a task on the LCA of electric vehicles. This task, known as Task 19, titled "Life Cycle Assessment of Electric Vehicles - From raw material resources to waste management of vehicles with an electric drivetrain," identifies and applies seven categories of key issues for applying LCA to electric vehicles and hybrid electric vehicles. These categories cover general issues, life cycle modeling, the vehicle cycle (production, use, and end-of-life considerations), the fuel cycle (electricity production), inventory analyses, impact assessment, and reference systems.

The paper provides detailed insights into the main relevant factors associated with these key issues. [4] Jinliang Zhang et al,. "Data Analysis of the Electric Vehicle's Current and Speed Based on the Actual Road Condition" authored by Jinliang Zhang and colleagues, the study investigates the relationship between battery current and the speed of electric vehicles. The researchers design a comprehensive electric vehicle information acquisition system, which is installed in existing electric vehicles through a well-planned wiring arrangement. They select two distinct road conditions, namely flat roads and uphill terrain, based on the actual environment, and design experimental schemes to evaluate these conditions separately. Subsequently, they analyze the collected data in detail. This research serves as a valuable foundation for validating models, establishing new models, and advancing theoretical research in the field of electric vehicles. [5] Zhou Xin Chen Shouping "Study on Insulation Detection Method of Electric Vehicles Based on Single Point of Failure Model" authored by Zhou Xin and Chen Shouping, the authors introduce an innovative approach for detecting insulation resistance in electric vehicle battery packs based on the single point of failure model. The paper provides a comprehensive analysis of the underlying principles and the derivation of relevant equations.

The method's effectiveness is evaluated by comparing the measurement results with the relevant national standards of the People's Republic of China, specifically GBT 18384.1-2001, which pertains to insulation resistance in electric vehicles. The paper discusses the feasibility and practical significance of the proposed method, particularly when a single point wiring insulation failure occurs in the battery pack. The method can pinpoint the location of the failure based on potential values and offers a convenient troubleshooting. means for online [6] Sreeram K. Preetha "Electric Vehicle Scenario in India:

Roadmap, Challenges, and Opportunities" authored by Sreeram K. Preetha and colleagues, the focus is on the growing global interest in electric vehicles (EVs) due to their potential to significantly reduce climate pollution compared to their gaspowered counterparts. The adoption of EVs in India faces several primary challenges, including a lack of sufficient charging stations, extended charging times, high initial costs, and limited driving range. The paper also discusses the efforts to transition India into an all-electric vehicle market by 2040, which includes initiatives such as the Faster Adoption & Manufacturing of Electric Vehicles (FAME) Scheme launched in 2015 to incentivize the production of eco-friendly vehicles, including Hybrid Electric Vehicles (HEVs). This paper offers a comprehensive overview of the current electric vehicle scenario in India and outlines potential areas for future growth and development.

III. METHODOLOGY

The methodology for selecting electric vehicle (EV) batteries and designing wiring harnesses involves a systematic approach to ensure that the chosen components meet performance, safety, and cost objectives. It is essential to clearly define the requirements of the application, taking into consideration factors such as voltage, capacity (energy storage), power output, cycle life, operating temperature range, and weight constraints. Calculate the necessary energy (in kWh) and power (in kW) based on the application's energy and power demands. Evaluate safety features associated with different battery chemistries, including thermal management systems, protection circuitry, and resistance to thermal runaway.

A comprehensive cost analysis, covering initial purchase costs, operational expenses, and total cost of ownership over the battery's expected lifespan, should be conducted. Also, consider the physical dimensions and weight of the battery pack to ensure it fits within the designated space and complies with weight restrictions. Designing a wiring harness for electrical systems, including those in electric vehicles (EVs), follows a systematic methodology to guarantee that the wiring harness satisfies performance, safety, and reliability requirements. Calculate the electrical load and power requirements of each component to determine wire size (gauge) and capacity. Differentiate between high-voltage and lowvoltage wiring within the harness, ensuring proper insulation and safety measures for high-voltage components. Test and validate the wiring harness under various operating conditions to ensure its reliable and safe performance.

IV. PROPOSED SYSTEM

HARDWARE REQUIREMENTS
Hardware:
Lithium-ion Battery
DC – DC Convertor Wires, Cables Electrical Equipment

V. RESULT

Wiring harness
The design of the wiring harness is crucial, with careful attention paid to factors such as wire length and gauge. Wire length directly affects resistance and voltage drop; as it increases, so does both. Using high-quality materials enhances efficiency and reduces voltage drop. Testing has shown that shorter wire lengths and better materials yield more satisfactory output.

Consequently, employing high-quality materials enhances performance and functional capacity. High-quality equipment exhibits lower resistance and higher output capacity in equipment connections. Hence, 1mm gauge wire, renowned for its reliability, is preferred.

The installation of the wiring is straightforward, and the use of high-quality materials simplifies maintenance. Employing high-quality pipe and wire insulation safeguards against high temperatures and overheating.

Wire Gauge in mm	Required current	Current capacity
1.5mm	16A	22A
2.5mm	24A	29A
4mm	34A	40A
6mm	45A	52A

Table no.1

Battery selection

In electrical vehicle most important is battery they have factor are consider forming battery
1. Safety
2. Cost

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3. Ratings
4. Lifespan
5. Specific energy

PARAMETER'S	RETING'S
Battery watt's	1500 W
Battery Capacity	30 Ah
Maximum Output Current	31.5 A
Voltage Rating	48.1 V
Efficiency	99 %
Charging Time	3.00 to 3.30 hrs

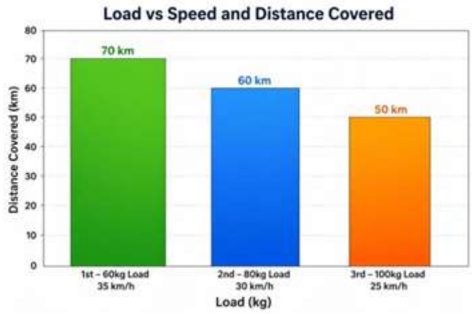
Table no. 2

A.) Effect of Load on Speed and Distance:

The experimental results demonstrate a clear relationship between load, speed, and distance covered by the electric vehicle (EV). As the load increases, both speed and travel distance decrease.

- At 60 kg load, the EV achieved a speed of 35 km/h and covered a distance of 70 km.
- At 80 kg load, the speed reduced to 30 km/h with a travel distance of 60 km.
- At 100 kg load, the speed further decreased to 25 km/h, and the distance covered was 50 km.

This indicates that higher load leads to increased energy consumption, thereby reducing overall efficiency and range.



B.) Performance Comparison: With Load vs Without Load

A comparative analysis was conducted to evaluate EV performance under loaded and unloaded conditions.

- Without Load (1 Person):
- Top Speed: 40 km/h
- Travel Distance: 60–70 km
- With Load (2 Persons):
- o Top Speed: 35 km/h
- o Travel Distance: 40–50 km

The results show that the EV performs more efficiently under no-load conditions, achieving higher speed and longer travel distance. The addition of load significantly impacts battery consumption and reduces vehicle performance.

VI. CONCLUSION

The retrofitting of an existing ICE vehicle to an electric vehicle with an integrated Battery Management System was successfully implemented and validated. The BMS effectively managed lithium-ion battery parameters including cell balancing, SoC/SoH estimation, and thermal protection, ensuring safe and stable operation under varied load conditions. Experimental results demonstrated enhanced energy efficiency, reduced carbon footprint, and improved drivetrain response compared to the original ICE system. The project confirms that BMS-based retrofitting is a technically viable approach for sustainable mobility. Future enhancements can include CAN-based communication, adaptive SoC algorithms, and IoT-enabled remote diagnostics for real-time battery health monitoring.

REFFERANCE

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