A Survey Paper on The Designing and Development of Electric Vehicle - Wiring Harness and Battery Selection

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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

A battery is a device that is used for providing electrical energy. It consists of one or more electrochemical cells that convert chemical energy into electrical energy. Batteries are widely used in various applications to power electronic devices, vehicles, and a multitude of other systems. Here are some key characteristics of batteries Energy Storage During charging, the battery stores energy by converting electrical energy into chemical energy, and during discharge, it converts the chemical energy back into electrical energy. This stored energy can be used to power various devices. Selecting the right battery is essential for ensuring reliable and efficient operation in a wide range of applications. Here's an introduction to battery selection. There are several types of batteries, such as lead-acid, lithium-ion, nickel-metal hydride, and more. Each type has its unique characteristics, including voltage, capacity, and cycle life.

Understanding the voltage and capacity requirements of the application is crucial. Voltage determines the electrical potential, while capacity defines how much energy the battery can store. Some applications demand batteries with long cycle life, meaning they can be charged and discharged many times without significant degradation. Considerations include the environmental impact, recycling options, and safety features, especially for applications where battery failure can lead to hazardous situations.

A wiring harness is a structured assembly of wires, connectors, and other components used to transmit electrical signals and power within various devices and systems. Wiring harnesses serve to simplify and organize complex electrical connections within an application, such as a vehicle or electronic device. They ensure efficient transmission of power and data. A wiring harness typically consists of wires, connectors, terminals, and protective materials like insulation, sheathing, and conduit. Wiring harnesses are often customized to meet the specific requirements of the application, with varying lengths, wire gauges, and connectors. Properly designed and manufactured wiring harnesses enhance safety by preventing electrical shorts and reducing the risk of fire hazards. They also improve reliability by minimizing interference and signal loss. Both battery selection and wiring harness design are essential considerations in the design and operation of various systems, and they significantly impact the efficiency, safety, and performance of these systems.

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

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-of-life 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 means for online troubleshooting.

[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 gas-powered 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 low-voltage 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. REFERENCES

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