

A Battery Management Sensor Network and Ergonomic in Electric Vehicle

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Abstract: *The increasing demand for eco-friendly energy-efficient transportation has led to the development of electric vehicles. This project focuses on the design and development of a three-wheeler electric scooter, which aims to provide a cost-effective, pollution-free, and efficient mode of transport for urban and rural areas.*

The system uses an electric motor powered by a rechargeable battery, eliminating the need for fossil fuels and reducing harmful emissions. Key components include a battery management system (BMS), motor controller, electric motor, and charging unit. The three-wheel conventional two-wheelers. The proposed model emphasizes low operating cost, ease of maintenance, and user-friendly operation. Additionally, the project includes design calculations, component selection, and basic simulation to evaluate performance.

Overall, this three-wheeler electric scooter contributes towards sustainable development and supports the growing need for green transportation solutions. In addition, the project involves detailed design calculations, selection of appropriate materials and components, and basic simulation analysis to evaluate performance parameters such as speed, efficiency, and power consumption. The results demonstrate that the proposed model is cost-effective, energy-efficient, and practical for daily use..

Keywords: Electric Vehicle, Battery, BLDC Motor, Sensor, Display, DC- DC Converter, Controller, Wiring

I. INTRODUCTION

In recent years, the demand for electric vehicles has increased significantly due to rising fuel costs, environmental pollution, and the need for sustainable transportation. This project focuses on the development of a three-wheeler electric scooter designed to provide an efficient, eco-friendly, and cost-effective solution for daily transportation.

The proposed system is powered by a 1 kW BLDC (Brushless DC) motor, which offers high efficiency, low maintenance, and better performance compared to conventional motors. The energy source used is a lithium-ion battery, known for its high energy density, longer life, and fast charging capability. A battery is a device that provides electrical energy. It is made up of one or more electrochemical cells that convert chemical energy into electrical energy. Batteries are widely used in electronic devices, electric vehicles, and many other systems. During charging, a battery stores energy by converting electrical energy into chemical energy. During discharging, it converts this chemical energy back into electrical energy to supply power. Batteries are important for storing energy and providing a reliable power source. Choosing the right battery is necessary for efficient and safe operation. There are different types of batteries such as lead-acid, lithium-ion, and nickel-metal hydride. Each type has different properties like voltage, capacity, and life cycle. Understanding voltage and capacity is important when selecting a battery. Voltage shows the electrical potential, while capacity indicates how much energy the battery can store. Some applications require batteries with long cycle life, meaning they can be charged and discharged many times without losing performance. Other important factors include safety, environmental impact, and recycling. This is especially important in systems where battery failure can be dangerous. A wiring harness is an organized group of wires, connectors, and related components used to transmit electrical power and signals. It helps in simplifying and managing complex wiring systems in



applications like vehicles and electronic devices. A wiring harness includes wires, connectors, terminals, and protective materials such as insulation and sheathing. These harnesses are designed according to the application, with different wire sizes, lengths, and connectors. Proper wiring harness design improves safety by preventing short circuits and reduces the risk of fire. It also increases reliability by reducing signal loss and interference. Both battery selection and wiring harness design are important for ensuring efficiency, safety, and reliable operation of any system. To improve system safety and reliability, various sensors are integrated, including a temperature sensor, voltage sensor, and current sensor. These sensors continuously monitor the operating conditions and help prevent faults such as overheating, overvoltage, and overcurrent, thereby enhancing the overall performance and lifespan of the system. The three-wheeler configuration offers better stability, balance, and safety compared to conventional two-wheelers. It is especially useful for carrying small loads and for use in congested urban areas as well as rural regions.

II. LITERATURE SURVEY

1] Faye Alanazi discusses the benefits, challenges, and possible solutions for the adoption of electric vehicles. The study highlights major issues in current transportation systems, such as rising fuel costs and increasing carbon emissions. It also suggests that electric vehicles can help reduce these problems and support a cleaner environment. Electric vehicles (EVs) are becoming popular because they do not depend on oil and produce very low greenhouse gas emissions. They help reduce pollution and are better for the environment. However, there are still some challenges in using EVs widely. These include high cost of infrastructure, limited charging stations, limited driving range (range anxiety), and battery performance issues.

This study explains the development of EVs and highlights their environmental benefits. It also discusses the problems faced in their adoption. To overcome these challenges, solutions such as improving charging infrastructure, increasing the number of charging stations, using battery swapping, and developing better battery technology are suggested. Governments can also support EV adoption by providing subsidies, tax benefits, and investing in infrastructure charging infrastructure.

2] A. K. M. Ahasan Habib et al. discuss the importance of battery management systems (BMS) in electric vehicles. The study highlights the increasing demand for EVs due to the need for efficient and flexible energy storage solutions. Electric vehicles depend on strong battery packs to operate. Therefore, it is important to understand battery characteristics such as power density, life cycle, electrochemical behavior, and temperature limits. The paper explains that the battery management system is a key component, as it helps in monitoring, protecting, and improving the performance of batteries in EVs and energy storage systems. This article The study explains the challenges and solutions related to batteries in detail. It describes the main functions of a battery management system (BMS), such as monitoring voltage and current, controlling charging and discharging, providing protection, managing temperature, and storing battery

data. It also discusses different types of cell balancing methods and compares them based on factors like efficiency, cost, size, power loss, and reliability. The paper highlights the main challenges in battery management systems and gives suggestions to improve battery performance.

3] Gerfried Jungmeier et al. focus on the role of electric vehicles in replacing conventional vehicles and supporting sustainable transportation. The study highlights that EVs help reduce greenhouse gas and particle emissions. The paper explains that the sustainability of electric vehicles can be evaluated using Life Cycle Assessment (LCA). LCA studies the complete life cycle of a vehicle, including production, usage, and end-of-life stages.

The International Energy Agency (IEA) works on LCA of electric vehicles through collaboration with multiple countries. This helps in better understanding the overall environmental impact of EVs. The study, known as Task 19, focuses on the life cycle assessment (LCA) of electric vehicles, from raw material extraction to final waste management. It identifies seven important areas for analysing EVs, including general factors, life cycle modelling, vehicle stages (production, use, and disposal), electricity generation, data analysis, environmental impact, and reference



systems. The paper explains these key factors in detail to better understand the overall performance and environmental impact of electric and hybrid vehicles.

4] Jinliang Zhang et al. study the relationship between battery current and the speed of electric vehicles under real road conditions. The researchers developed a data collection system and installed it in electric vehicles using proper wiring. They tested the vehicle on two types of roads: flat roads and uphill roads. The collected data was analysed to understand how current changes with speed in different conditions. This study helps in improving models and supports further research in electric vehicle performance.

5] Zhou Xin and Chen Shouping present a method to detect insulation faults in electric vehicle battery packs. The method is based on a single point of failure model.

The study explains the working principle of insulation detection and provides the necessary equations. This approach helps in improving the safety and reliability of electric vehicle battery systems. The effectiveness of the method is tested by comparing the results with national standards for insulation resistance. The study shows that the method is practical and useful, especially when a wiring insulation fault occurs at a single point in the battery pack. It can identify the exact location of the fault using voltage values and helps in easy online fault detection and troubleshooting.

III. OBJECTIVES

1. To design and develop a three-wheeler electric scooter using a lithium-ion battery for efficient energy storage.
2. To implement a 1 kW BLDC motor for smooth and efficient propulsion of the vehicle.
3. To integrate a controller and inverter for proper speed control and efficient power management.
4. To provide a display system for showing important parameters like speed, battery level, and system status.
5. To improve energy efficiency and reduce environmental pollution by using an electric drive system.

IV. COMPONENT

1. BLDC Motor (1 KW)

In a three-wheeler electric scooter, the BLDC motor (1 kW) is used to drive the vehicle. When the battery (48V lithium-ion) supplies power, the controller sends electrical signals to the motor. The controller converts DC power from the battery into controlled signals to rotate the motor. The BLDC motor works on the principle of electromagnetism. It uses permanent magnets in the rotor and windings in the stator. When current flows through the stator windings, it creates a rotating magnetic field. This magnetic field interacts with the rotor magnets and causes the rotor to rotate. The controller continuously switches the current in the windings to maintain smooth rotation. The speed of the motor is controlled by adjusting the input power through the controller. The inverter and controller together ensure efficient operation, smooth speed control, and better performance. The motor converts electrical energy into mechanical energy, which drives the wheels of the scooter.



2. Battery (lithium ion)

In a three-wheeler electric scooter, the lithium-ion battery is the main source of electrical energy. The battery stores energy in chemical form and supplies DC power (48V) to the controller.



When the rider gives throttle input, the battery provides current to the controller, which then powers the BLDC motor. The battery works on electrochemical reactions. During discharge, chemical energy is converted into electrical energy to run the motor. During charging, electrical energy is converted back into chemical energy and stored in the battery. The battery management system (BMS) monitors important parameters such as voltage, current, temperature, and state of charge. It protects the battery from overcharging, deep discharging, and overheating. The battery provides a discharge current of about 50–60A to support motor operation and is charged using a charger within 4–6 hours.



3. Display

In a three-wheeler electric scooter, the display unit is used to show important information to the driver. The display is connected to the controller and sensors. Sensors measure parameters such as speed, battery voltage, current, and temperature. This data is sent to the controller, which processes it and sends the required information to the display.

The display shows real-time data such as vehicle speed, battery level, distance, and system status. It helps the driver to monitor the condition of the vehicle.

If any fault occurs, such as low battery or overheating, the display shows warning messages. This helps in safe and efficient operation of the scooter. The display works continuously while the scooter is ON and provides accurate and updated information to the user.



4. Controller

In a three-wheeler electric scooter, the BLDC motor controller is the main unit that controls the motor operation.

The battery (48V DC) supplies power to the controller. When the rider gives throttle input, the controller receives the signal and regulates the power sent to the motor.



The controller converts DC power into controlled signals and supplies it to the BLDC motor in a proper sequence. This creates a rotating magnetic field in the motor, which causes it to rotate.

The controller also controls the speed of the vehicle by adjusting the voltage and current supplied to the motor. Higher throttle input increases speed, while lower input reduces it. It ensures safe operation by limiting current (40A) and providing low voltage protection. If battery voltage drops too low, the controller cuts off power to protect the battery. The controller also receives signals from sensors to maintain smooth and efficient motor operation.



5. DC-DC Converter

The DC-DC converter is used to convert high voltage DC from the battery into low voltage DC required for other components.

In this system, the converter takes input from the battery (36V–72V) and converts it into a stable 12V output. This 12V supply is used to operate devices like lights, horn, display, and other low-voltage electronics.

The converter works using electronic switching components that efficiently reduce the voltage without significant energy loss. It also maintains a constant output voltage even if the input voltage changes.

Thus, the DC-DC converter ensures safe, stable, and efficient power distribution in the electric scooter system.



6. Seat

Seat The seat in an Electric Vehicle (EV) serves the same basic purpose as in any other vehicle: to provide a comfortable and safe seating position for occupants. However, in an EV, there are some unique considerations and features that may be present. Seat





7. LED Headlight

Function. The primary task of headlights on cars is to illuminate the roadway and facilitate fatigue-free and safe driving. Headlights and their light sources are thus vehicle components that are relevant to safety. They require official approval and must not be tampered with.

Most people are aware that LED stands for Light Emitting Diode; however, less well known is that LED car headlight units can bring an increase in cost and complexity over halogen bulbs, and also an increase in efficiency and adjustability in part to the diminutive proportion and power usage of each diode.



V. PROBLEM STATEMENT

The increasing fuel cost and environmental pollution due to conventional vehicles have created a need for alternative transportation systems. Electric vehicles provide a cleaner solution, but they still face challenges such as battery performance, limited range, charging time, and system efficiency.

In addition, proper integration of components like battery, motor, controller, sensors, and wiring system is required to ensure safe and reliable operation. Many existing systems also face issues related to energy management and cost. The increasing fuel cost and environmental pollution due to conventional vehicles have created a need for alternative transportation systems. Electric vehicles provide a cleaner solution, but they still face challenges such as battery performance, limited range, charging time, and system efficiency. In addition, proper integration of components like battery, motor, controller, sensors, and wiring system is required to ensure safe and reliable operation. Many existing systems also face issues related to energy management and cost. The rapid increase in fossil fuel consumption and environmental pollution has created an urgent need for sustainable and eco-friendly transportation solutions.



VI. WORKING

The three-wheeler electric scooter operates using electrical energy stored in a lithium-ion battery, which acts as the primary power source. When the ignition key is turned ON, the battery supplies power to the controller and other electrical components, activating the system. The rider controls the speed of the vehicle using a throttle, which sends an input signal to the controller. The controller, which acts as the brain of the system, processes this signal and regulates the amount of power supplied to the motor. The scooter uses a BLDC motor (typically around 1 kW), which converts electrical energy into mechanical energy to rotate the wheels and drive the vehicle forward.

A Battery Management System (BMS) is used to monitor and protect the battery by preventing overcharging, deep discharging, and overheating, thereby ensuring safety and longer battery life. Various sensors such as temperature, voltage, and current sensors continuously monitor the system parameters and provide feedback to the controller for efficient and safe operation. A DC-DC converter is used to step down the high battery voltage to a lower level suitable for auxiliary components like lights and display. The display unit provides important information such as speed, battery level, and system status to the rider. When the brake is applied, a signal is sent to the controller, which reduces or cuts off the power to the motor, allowing the vehicle to slow down or stop safely.

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. The EV block diagram shows power flow from the Battery Pack to the BMS (Battery Management Sensor Network), which monitors cell voltages, temperatures and currents. The BMS communicates with the Motor Controller (inverter/ESC) to manage power delivery to the BLDC motor. The motor drives the wheels and drivetrain. An ergonomic interface provides driver inputs

Battery: Electric vehicles are powered by rechargeable lithium-ion or other types of batteries. These batteries store electrical energy in chemical form

Charging: To charge the battery, EV owners plug their vehicle into a charging station or at home charging unit. The electricity is converted into a form that can be stored in the battery

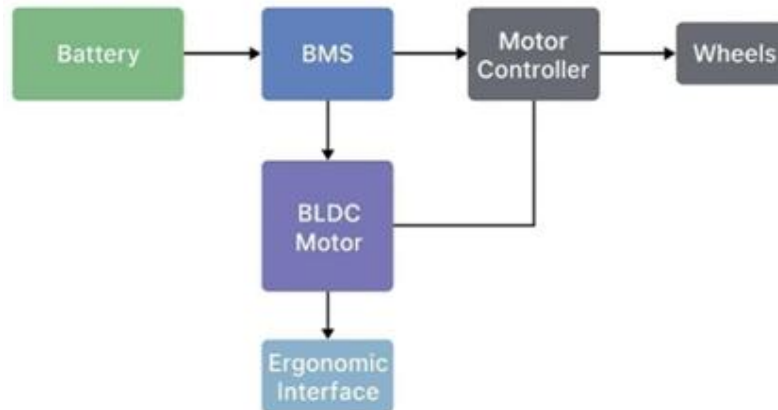
Power Inverter: The electric energy stored in the battery is direct current (DC), but the electric motor needs alternating current (AC) to operate. A power inverter converts the DC power from the battery into AC power.

Electric Motor: The AC power generated by the inverter is used to drive an electric motor. In most EVs, this motor is an alternating current induction motor or a permanent magnet synchronous motor

Transmission (if equipped): Some EVs have a transmission, while others use a single-speed direct-drive system. The transmission helps control the speed and torque delivered to the motor's power to.



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