Retrofitting of Existing Vehicle for Converting to Electric Vehicle-BMS

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Abstract: The increasing demand for sustainable and eco-friendly transportation has encouraged the development of electric vehicles as an alternative to conventional fuel-powered automobiles. However, the high cost of purchasing new electric vehicles remains a major barrier for many users. This project focuses on retrofitting existing vehicles into electric vehicles by replacing the internal combustion system with an electric drivetrain powered by lead- acid batteries. The proposed system integrates a Battery Management System (BMS) designed to monitor voltage, current, temperature, and state of charge to ensure safe and efficient battery operation. Lead-acid batteries are selected for their affordability, reliability, and recyclability, making them suitable for cost-effective retrofitting applications. conversion process includes motor integration, controller configuration, and real-time power monitoring to optimize performance and extend battery life. This approach not only reduces vehicular emissions and fuel dependency but also promotes resource conservation by reusing existing vehicle infrastructure. The project demonstrates a practical and economical pathway toward sustainable electric mobility.

Keywords: *Retrofitting, Electric Vehicle (EV), Battery Management System (BMS), Lead-Acid Battery, Battery Safety, Smart Charging, Zero Emission Vehicle, Power Electronics, Eco Friendly Mobility, Battery Efficiency.*

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I. INTRODUCTION

In recent years, the global automotive sector has undergone a paradigm shift toward sustainable transportation solutions, driven by rising fuel costs, depletion of fossil fuel resources, and the urgent need to mitigate greenhouse gas emissions. Internal combustion engine (ICE) vehicles, though technologically mature and widely used, have significantly contributed to air pollution and climate change due to their dependence on petroleum-based fuels. Consequently, the transition toward electric mobility has become one of the most promising strategies for achieving cleaner and more energy- efficient transportation systems. However, the large-scale replacement of existing ICE vehicles with brand- new electric vehicles (EVs) poses considerable challenges, such as high acquisition costs, manufacturing resource requirements, and waste generation from vehicle scrappage. To overcome these barriers, vehicle retrofitting—the process of converting an existing fuel-powered vehicle into an electric vehicle—has gained substantial attention. Retrofitting enables vehicle owners to upgrade their existing automobiles into electric-powered ones without discarding the entire vehicle structure. This method not only reduces carbon emissions but also extends the useful life of the vehicle chassis and components, promoting the concept of circular economy and resource efficiency. The present project, titled "Retrofitting of Existing Vehicle for Converting to Electric Vehicle – BMS with Lead Acid Battery," aims to design and implement an electric propulsion system integrated with an efficient Battery Management System (BMS) using lead-acid batteries as the primary energy source.

II. LITERATURE SURVEY

The concept of converting existing internal combustion engine (ICE) vehicles into electric vehicles (EVs) has attracted growing research interest due to its cost-effectiveness and environmental benefits. Several studies highlight that retrofitting can significantly reduce vehicular emissions while extending the life of conventional vehicles, making it a practical step toward sustainable transportation. Researchers such as Ramesh et al. (2020) and Sharma et al. (2021) emphasized that EV retrofitting offers a transitional solution for developing nations where purchasing new

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electric vehicles remains economically challenging. The retrofitting process typically involves replacing the fuel engine and transmission system with an electric motor, controller, and battery pack while maintaining the existing mechanical structure. Among various energy storage technologies, lead-acid batteries have been widely discussed in the literature for their affordability, robustness, and recyclability. Although newer chemistries like lithium-ion provide higher energy density, lead-acid batteries continue to be preferred for low-cost conversion projects due to their simple charging characteristics and proven reliability. According to studies by Singh et al. (2019) and Mehta et al. (2020), lead-acid batteries offer a strong starting current and can be maintained easily with minimal infrastructure, making them suitable for smallscale or prototype electric vehicles. However, challenges such as limited cycle life, high weight, and susceptibility to sulfation have been reported as major limitations that affect performance and battery longevity.

To overcome these drawbacks, the inclusion of a Battery Management System (BMS) has been proposed in multiple studies. A BMS is responsible for monitoring essential parameters such as voltage, current, temperature, and state of charge (SOC) of the battery pack. Research by Patil and Kulkarni (2022) demonstrated that using a properly designed BMS with lead-acid batteries can enhance charging efficiency and prevent over-discharge, which is one of the primary causes of battery degradation. Furthermore, cell balancing circuits within the BMS ensure uniform charge distribution across all batteries in a multi-pack setup, thereby improving overall system reliability.

Previous work on EV conversions has also explored optimal motor selection, regenerative braking integration, and control strategies for efficient energy utilization. Studies on cost analysis have shown that retrofitted electric vehicles can achieve up to 60% lower operational costs compared to conventional petrol 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.

III. METHODOLOGY

The proposed system utilizes IoT and automation to develop a customer following smart cart with automatic billing. Each cart is integrated with a microcontroller such as Arduino or Raspberry Pi, RFID reader, ultrasonic sensors, and a Wi-Fi module. RFID tags on products store essential details like ID, name, and price, which are read when items are placed in the cart. The microcontroller processes the data, displays the bill on an LCD screen, and updates totals in real time. Obstacle detection sensors enable autonomous customer following, ensuring safe navigation.

➢ *Block Diagram*

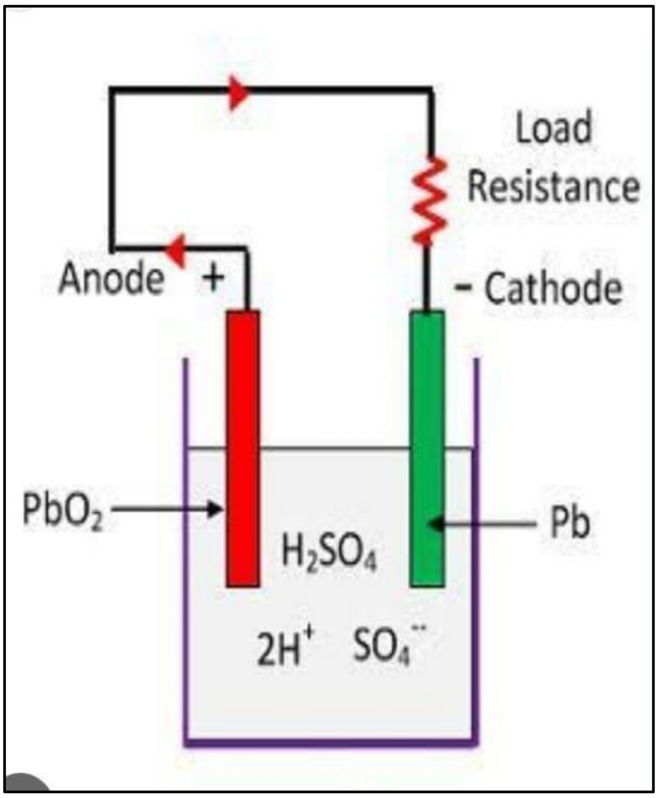

Fig 1 Lead Acid Battery

➢ *Description of the System*

The retrofit electric vehicle (EV) system using lead-acid batteries replaces the conventional petrol engine and fuel system with an electric propulsion setup designed for efficient and ecofriendly operation. The system is powered by a lead-acid battery pack that stores electrical energy through electrochemical reactions between lead dioxide, sponge lead, and sulfuric acid, supplying direct current (DC) power to the controller and motor. Although lead-acid batteries are heavier and have lower energy density compared to lithiumbased alternatives, their affordability and easy availability make them a practical choice for short-range and prototype electric vehicles. The Battery Management System (BMS) ensures operational safety by continuously monitoring parameters such as voltage, current, and temperature, balancing individual cell charge levels to enhance battery life and prevent conditions like overcharging, over-discharging, and short circuits. The controller or inverter functions as the central processing unit, regulating power flow between the battery and the electric motor, controlling acceleration, and enabling regenerative braking. The electric motor converts the stored electrical energy into mechanical motion to drive the vehicle's wheels, with its selection depending on factors like vehicle mass.

- *Working Principle: -*

✓ When the accelerator is pressed, the controller receives the signal and draws current from the Lead Acid battery.
✓ The controller regulates this current and supplies the motor with the required voltage and frequency.

- ✓ The motor generates torque, driving the wheels, while the BMS ensures the battery operates within safe limits.
- ✓ During braking, the controller can reverse the motor operation to act as a generator, charging the battery (regenerative braking).

- *Benefits:* -

- ✓ Cost-effective retrofitting solution.
- ✓ Simple charging maintenance procedure and
- ✓ Reduces fuel dependency and pollution.
- ✓ Promotes mobility. affordable electric
- ✓ Enhances energy efficiency with regenerative braking.

IV. CONCLUSION

Retrofitting existing vehicles using LeadAcid batteries offers an affordable and practical approach toward sustainable transportation. Although these batteries have limitations in energy density and lifespan, their low cost and simple design make them suitable for initial EV adoption in developing regions. With proper maintenance and charging infrastructure, Lead- Acid based retrofitted EVs can play an important role in reducing carbon emissions and promoting clean mobility.

REFFERANCES

[1]. K. M. Prakash et al., 2020, "Design and Development of Electric Vehicle Conversion Kit for Two-Wheelers ".
[2]. A. S. Kulkarni and R. G. Yadav, 2021, "Retrofitting of Existing Two- Wheelers into Electric Vehicles: A Sustainable Solution''.
[3]. Nina Konikat, 2022, "Performance Testing of Electric Motorcycle Conversion''.
[4]. [4]. A. [1] Mr. Harun Pinjari, Mr. Yash Jadhav, Mr. Dadarkar Mujtaba Mubasshir, Mr. Omar Juned Deshmukh, 2024, "CONVERSION OF SCRAP IC SCOOTER TO EV SCOOTER," Volume 06, IRJMETS.
[5]. Vaibhav Chimote, Tushar Raut, Prof. A. A. Deosant, 2022, "CONVERSION OF PETROL VEHICLE INTO THE ELECTRICAL VEHICLE," Volume 04, IRJMETS.
[6]. Jeena Joy. Anusha C.P. Joel George, 2015, "Conversion of a Gearless Scooter into an Electric," Volume 04, JAREFIE
[7]. https://www.sciencedirect.com/science/article/pii/S2590123024013021
[8]. https://evduniya.com/ev-global/function importance-of-bms-in electricvehicles.html
[9]. https://www.irjet.net/archives/V8/i4/IRJET V8I4631.pdf