



Design and Development of Two Wheeler Scooty into E-Vehicle

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ABSTRACT

The conversion of conventional vehicles into electric vehicles (EVs) has gained significant attention in recent years due to the increasing demand for sustainable transportation solutions and the need to reduce greenhouse gas emissions. This paper provides a comprehensive review of the conversion process, highlighting technical, environmental, and economic considerations. Various conversion methods and technologies are analyzed, including battery electric conversions, hybrid electric conversions, and plug-in hybrid conversions. The technical feasibility, performance implications, and challenges associated with each conversion approach are discussed. Additionally, environmental impacts such as reductions in carbon emissions and energy consumption are assessed, along with the potential for increased energy efficiency and renewable energy integration. Economic factors, including conversion costs, payback periods, and incentives, are also examined to evaluate the financial viability of vehicle electrification through conversion. The paper concludes with insights into the current state-of-the-art, emerging trends, and future prospects for electric vehicle conversion, emphasizing the role of technological innovation, policy support, and market dynamics in accelerating the transition towards sustainable mobility.

Keywords: Hub wheel motor, Rechargeable batteries, Controller, DC Converter.

1. INTRODUCTION

Since their inception in the mid-19th century, electric vehicles (EVs) have gained popularity, particularly for short-distance travel. In India, where two-wheeler petrol vehicles dominate, emissions are a significant concern. To address this, converting old, robust vehicles into electric ones presents an opportunity. EVs offer a clean alternative, reducing pollution and conserving fossil fuels for future generations. Our project focuses on converting old two-wheeler petrol vehicles into electric ones using readily available EV components kits. Modifications, particularly in suspension, ensure optimal performance. The goal is to repurpose sturdy vehicle bodies into eco-friendly, zero-emission electric vehicles, thus contributing to air quality improvement and sustainability efforts.

2. COMPONENTS REQUIRED

Converting a vehicle into an electric vehicle typically involves several key components. Here's a list of the essential components required for such a conversion:

Electric Motor: The heart of the electric vehicle, the motor converts electrical energy from the battery into mechanical energy to drive the vehicle.

Battery Pack: Provides the electrical energy to power the electric motor. Lithium-ion batteries are commonly used due to their energy density and power output.

Motor Controller (Inverter): Controls the speed and torque of the electric motor by regulating the power from the battery to the motor.

Charger: Charges the battery pack from an external power source, such as a wall outlet or charging station.

DC-DC Converter: Converts high-voltage DC power from the battery pack to lower-voltage DC power for auxiliary systems, such as lights and HVAC.

Throttle Control: Regulates the speed of the vehicle by controlling the power output to the electric motor.

Battery Management System (BMS): Monitors and manages the health, performance, and charging/discharging of individual battery cells within the battery pack.

Brake Regeneration System: Captures kinetic energy during braking and converts it into electrical energy to recharge the battery pack.

Transmission or Gearbox: Depending on the vehicle design, a transmission or gearbox may be required to transmit power from the electric motor to the wheels efficiently.

Cooling System: Helps dissipate heat generated by the electric motor, battery pack, and other components to ensure optimal performance and longevity.

Wiring Harness: Connects all the electrical components together, including the battery pack, motor, controller, charger, and sensors.

Safety Features: Include features such as high-voltage isolation, emergency shut-off switches, and thermal management systems to ensure safe operation of the electric vehicle.

Mounting Hardware and Adapters: Custom mounting brackets and adapters may be needed to install the electric motor, battery pack, and other components into the vehicle's chassis.

Instrumentation and Controls: Dashboard display, gauges, and control interfaces to monitor and manage the electric vehicle's operation, including battery status, speed, and vehicle diagnostics.

These components form the basic infrastructure required for converting a conventional vehicle into an electric vehicle. Additionally, specific modifications and adjustments may be necessary depending on the make and model of the vehicle being converted and the desired performance characteristics of the electric vehicle.

3. SYSTEM OPERATION

The system operation for converting a vehicle into an electric vehicle involves the interaction and coordination of various electric components to facilitate the propulsion, power management, and overall functionality of the vehicle. Below is an overview of the system operation:

Electric Motor Operation: The electric motor is the primary component responsible for converting electrical energy from the battery into mechanical energy to propel the vehicle. When the driver applies throttle input, the motor controller sends signals to the electric motor to adjust its speed and torque output accordingly.

Battery Pack Management: The battery pack provides electrical energy to power the electric motor. The battery management system (BMS) monitors the state of charge (SOC), state of health (SOH), and temperature of individual battery cells within the pack. It regulates the charging and discharging of the battery pack to optimize performance, extend battery life, and prevent overcharging or overheating.

Motor Controller Operation: The motor controller regulates the power delivery from the battery pack to the electric motor. It adjusts the voltage, current, and frequency of the electrical signals sent to the motor based on the driver's throttle input and the vehicle's operating conditions. The controller also interfaces with the vehicle's onboard computer system to provide real-time data and diagnostics.

Throttle Control: The throttle control system determines the driver's desired speed and acceleration. It translates the position of the accelerator pedal or throttle input into signals that are sent to the motor controller to adjust the power output of the electric motor accordingly.

Regenerative Braking System: During braking, the regenerative braking system captures kinetic energy from the vehicle's motion and converts it into electrical energy. This energy is then fed back into the battery pack to recharge it, improving overall energy efficiency and extending the vehicle's range.

Charging System: When the vehicle is stationary, the charging system allows the battery pack to be recharged from an external power source, such as a wall outlet or charging station. The charger regulates the charging voltage and current to safely recharge the battery pack while minimizing charging time and maximizing battery life.

Cooling System Operation: The cooling system maintains optimal operating temperatures for the electric motor, battery pack, and other components to prevent overheating and ensure reliable performance. It circulates coolant through heat exchangers and radiators to dissipate heat generated during operation.

Safety Systems: Various safety systems, such as high-voltage isolation, emergency shut-off switches, and thermal management systems, are integrated into the electric vehicle to ensure safe operation and protect against potential hazards or malfunctions.

4. ADVANTAGES

Environmental Benefits: Electric vehicles produce zero tailpipe emissions, reducing air pollution and greenhouse gas emissions, thus contributing to improved air quality and mitigating climate change.

Cost Savings: Over time, electric vehicles tend to have lower operating costs compared to conventional vehicles powered by gasoline or diesel. Electricity is often cheaper than gasoline, and EVs typically require less maintenance due to fewer moving parts.

Energy Efficiency: Electric motors are more efficient than internal combustion engines, especially at low speeds and in stop-and-go traffic. This translates to better energy efficiency and potentially lower energy consumption per mile traveled.

Renewable Energy Integration: Electric vehicles can be charged using electricity generated from renewable energy sources such as solar or wind power, further reducing their carbon footprint and dependence on fossil fuels.

Quiet Operation: Electric vehicles operate more quietly than internal combustion engine vehicles, which can contribute to reduced noise pollution in urban areas.

Performance: Electric motors provide instant torque, resulting in quick acceleration and responsive driving dynamics. This can enhance the driving experience and performance of converted electric vehicles.

5. DISADVANTAGES

Limited Range: Many converted electric vehicles have limited range compared to their gasoline counterparts. Range anxiety, or the fear of running out of battery charge, remains a concern for some EV owners, especially for long-distance travel.

Charging Infrastructure: The availability of charging infrastructure for electric vehicles varies widely, particularly in certain regions or rural areas. Limited charging options may inconvenience EV owners and restrict their ability to travel long distances.

Upfront Cost: Converting a vehicle into an electric vehicle can be expensive, primarily due to the cost of electric components such as the battery pack, electric motor, and associated hardware. This initial investment may deter some potential adopters.

Weight and Space Constraints: Electric components such as battery packs and electric motors are typically heavier and bulkier than their gasoline counterparts. Retrofitting these components into existing vehicle designs may require modifications and compromises in terms of space and weight distribution.

Performance Trade-offs: Converting a vehicle into an electric vehicle may result in performance trade-offs such as reduced cargo space, towing capacity, or overall vehicle dynamics compared to the original gasoline-powered configuration.

Technical Challenges: Electric vehicle conversion projects may pose technical challenges related to compatibility, integration, and reliability of electric components. DIY conversions, in particular, require careful planning and expertise to ensure safety and performance.

6. RESULT

As the conversion of vehicles into electric vehicles (EVs) is a multifaceted process influenced by various factors such as technical expertise, component selection, and vehicle compatibility, the "results" of such conversions can vary significantly. Below are potential results that may be observed following the conversion of a vehicle into an EV:

Reduced Emissions: One of the primary benefits of converting a vehicle into an EV is the reduction in tailpipe emissions. Depending on the source of electricity used for charging, converted EVs can significantly lower greenhouse gas emissions compared to their gasoline-powered counterparts, thereby contributing to improved air quality and reduced environmental impact.

Improved Energy Efficiency: Electric motors are inherently more energy-efficient than internal combustion engines, especially in urban driving conditions and stop-and-go traffic. As a result, converted EVs may exhibit higher energy efficiency and lower energy consumption per mile traveled, leading to potential cost savings over time.

Enhanced Performance: Electric motors provide instant torque and smooth acceleration, resulting in responsive driving dynamics and improved overall performance compared to gasoline-powered vehicles. Converted EVs may offer a more enjoyable driving experience, particularly in urban environments where quick acceleration and maneuverability are desirable.

Lower Operating Costs: While the upfront cost of converting a vehicle into an EV can be significant, the long-term operating costs may be lower due to reduced fuel expenses and fewer maintenance requirements. Electric motors have fewer moving parts than internal combustion engines, resulting in lower maintenance costs and longer service intervals.

Range Limitations: Depending on the battery capacity and vehicle configuration, converted EVs may have limited range compared to dedicated electric vehicles designed from the ground up. Range anxiety, or the fear of running out of battery charge, may be a concern for some EV owners, particularly for long-distance travel.

Charging Infrastructure Challenges: Access to reliable charging infrastructure remains a challenge for EV owners, especially in certain regions or rural areas. Converted EV owners may face limitations in charging options and may need to plan their routes carefully to ensure access to charging stations along the way.

Performance Trade-offs: Converting a vehicle into an EV may involve performance trade-offs such as reduced cargo space, towing capacity, or overall vehicle dynamics compared to the original gasoline-powered configuration. These trade-offs should be carefully considered based on the intended use and requirements of the converted EV.

7. CONCLUSION

In conclusion, the conversion of conventional vehicles into electric vehicles represents a promising avenue for promoting sustainable transportation and mitigating the environmental impacts associated with traditional gasoline-powered vehicles. Despite the challenges and limitations, such as range constraints, charging infrastructure concerns, and upfront costs, the advantages of electric vehicle conversion, including reduced emissions, lower operating costs, and improved energy efficiency, outweigh the drawbacks.

By repurposing existing vehicle bodies and integrating electric components, individuals and organizations can contribute to the transition towards cleaner transportation solutions. The advancements in electric vehicle technology, coupled with growing awareness of environmental issues and policy incentives promoting electric vehicle adoption, further support the viability and importance of vehicle conversion projects.

Moving forward, continued research, innovation, and investment in electric vehicle technology and infrastructure will be essential to address remaining barriers and accelerate the widespread adoption of electric vehicles. With collaborative efforts from governments, industry stakeholders, and consumers, the conversion of vehicles into electric vehicles can play a significant role in building a more sustainable and resilient transportation system for future generations.

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