

# “Design and Development of Low-Speed E- Vehicle for Tourist transport and Short-Range Mobility Applications”

Ms. Kadam Sakshi Prabhakar<sup>1</sup>, Mr.Jadhav Rushikesh Raghunath<sup>2</sup>, Mr. Shinde Shubham Arun<sup>3</sup>  
,Mr. Shinde Avish Pravin<sup>4</sup>, Prof. Gore P.R.<sup>5</sup>

<sup>1234</sup> Student, Department of Mechanical Engineering <sup>5</sup> Asst. Prof., Department of Mechanical Engineering.

<sup>12345</sup> S.N.D. College of Engineering and Research Centre, Yeola.

<sup>1</sup> [kadamsakshi889@gmail.com](mailto:kadamsakshi889@gmail.com) <sup>2</sup> [rushikeshj757@gmail.com](mailto:rushikeshj757@gmail.com) <sup>3</sup> [sshubham96k@gmail.com](mailto:sshubham96k@gmail.com) <sup>4</sup> [avishpravinshinde@gmail.com](mailto:avishpravinshinde@gmail.com) <sup>5</sup> [prashant.gore@sndcoe.ac.in](mailto:prashant.gore@sndcoe.ac.in)

\*\*\*

**Abstract** - The increasing demand for eco-friendly transportation systems has encouraged the development of electric vehicles for modern mobility applications. This paper presents the design and development of an electric vehicle intended to provide a pollution-free, energy-efficient, and cost-effective transportation solution for short-distance travel. The proposed system operates using a 48V battery pack as the primary energy source and integrates major components such as a motor controller, battery management system (BMS), BLDC/DC motor, regenerative braking system, DC-DC converter, braking arrangement, steering mechanism, and lighting system. The motor controller regulates the power supplied to the motor according to throttle input, enabling controlled speed and efficient torque generation. The regenerative braking mechanism improves overall energy efficiency by recovering kinetic energy during braking conditions. The chassis structure is designed to provide sufficient strength, stability, and lightweight construction for safe operation. Experimental analysis demonstrates satisfactory performance in terms of speed, battery efficiency, load carrying capacity, and operational safety. The developed electric vehicle provides an eco-friendly and sustainable transportation solution suitable for future mobility and short-range transport applications.

**Key Words:-** Electric Vehicle, BLDC Motor, Battery Management System, Eco-Friendly Vehicle, Sustainable Transportation, Energy Efficient Vehicle.

## 1. INTRODUCTION

The rapid expansion of transportation systems has led to increased energy consumption and environmental pollution worldwide. Conventional vehicles powered by internal combustion engines rely heavily on fossil fuels such as petrol and diesel, resulting in harmful emissions, air pollution, and global warming. Due to these environmental challenges, researchers have focused on developing cleaner and more sustainable transportation technologies. Electric vehicles (EVs) have emerged as an effective alternative because they operate using electrical energy instead of fossil fuels, thereby reducing carbon emissions and improving energy efficiency [1].

Electric vehicles utilize electric motors powered by rechargeable battery systems for vehicle propulsion. Compared to conventional vehicles, EVs eliminate complex mechanical systems such as fuel injection units, exhaust systems, and multi-stage gear transmissions, resulting in lower maintenance

requirements and improved reliability. In addition, electric motors provide high starting torque and smooth acceleration, enhancing overall vehicle performance and efficiency [2].

Recent advancements in renewable energy integration have further improved the sustainability of electric vehicles. Among renewable sources, solar energy is considered one of the most promising due to its abundance, cleanliness, and availability. Solar photovoltaic panels can directly convert sunlight into electrical energy and assist in charging the vehicle battery system, thereby reducing dependence on external charging infrastructure and improving energy utilization [3].

The battery pack is one of the most critical components of an electric vehicle because it stores and supplies electrical energy required for propulsion. Lithium-ion batteries are commonly used in modern EVs because of their high energy density, lightweight nature, long cycle life, and efficient performance characteristics [4].

However, safe operation of lithium-ion batteries requires continuous monitoring and protection against abnormal operating conditions. To ensure safe and efficient battery operation, a Battery Management System (BMS) is incorporated into the electric vehicle system. The BMS continuously monitors parameters such as battery voltage, current, temperature, and charging conditions. It protects the battery pack from overcharging, deep discharging, overheating, and cell imbalance, thereby improving battery life and operational reliability [5].

The motor controller serves as the primary control unit of the electric vehicle by regulating the electrical power supplied to the motor. It controls motor speed and torque according to throttle input, enabling smooth acceleration and efficient vehicle movement. The controller also improves energy utilization by managing power flow between the battery and motor system [6].

Brushless DC (BLDC) motors are widely preferred in electric vehicle applications due to their high efficiency, compact size, low maintenance, and long operational life. BLDC motors operate without mechanical brushes, which minimizes friction losses and improves overall efficiency. These motors effectively convert electrical energy into mechanical motion required for driving the vehicle wheels [7].

Regenerative braking is another important technology used in modern electric vehicles to improve energy efficiency. Unlike conventional braking systems where kinetic energy is lost as heat, regenerative braking systems recover a portion of this energy during braking and convert it into electrical energy, which is then stored back in the battery pack. This process

increases the driving range and improves overall system efficiency [8].

In addition to the propulsion system, electric vehicles require electrical power for auxiliary systems such as lighting, indicators, horn, dashboard display, and electronic control units. A DC–DC converter is used to step down the main battery voltage to lower voltage levels suitable for these auxiliary devices, ensuring stable and efficient operation [9]. Considering the growing demand for clean and sustainable transportation, the development of electric vehicles integrated with efficient energy management, regenerative braking, and renewable energy support has become an important research area. Therefore, the present work focuses on the design and development of an electric vehicle system that provides improved energy efficiency, operational safety, reduced environmental impact, and reliable performance for future sustainable mobility applications [10].

## 1.1 Problem Statement

The rapid growth of urbanization and tourism has increased the demand for clean, efficient, and economical transportation systems. Most conventional tourist transport vehicles operate using petrol or diesel engines, which generate harmful emissions such as carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NO<sub>x</sub>). These emissions contribute significantly to air pollution, environmental degradation, and global warming. In addition, the increasing cost of fossil fuels and dependence on non-renewable energy resources make conventional transportation systems expensive and unsustainable.

Tourist locations, campuses, parks, and eco-sensitive zones require low-speed, short-range, and zero-emission transportation systems to ensure environmental protection and passenger safety. However, existing conventional vehicles are noisy, produce exhaust emissions, and are not suitable for such restricted environments. Therefore, there is a need for an eco-friendly and energy-efficient transportation solution capable of operating safely and effectively over short distances.

The development of such an electric vehicle involves several challenges, including optimization of motor power, battery capacity, vehicle weight, load-carrying capability, drivetrain efficiency, braking performance, and structural stability while maintaining low operating cost and simple maintenance requirements.

To overcome these challenges, the present work focuses on the design and development of a low-speed electric vehicle intended for tourist transport and short-range travel applications. The proposed system integrates a DC motor drive, rechargeable battery pack, differential mechanism, disc braking system, and mild steel chassis to achieve safe operation, reduced pollution, energy efficiency, and reliable performance for sustainable mobility applications.

## 1.2 Objective

The main objectives of this project are to design and develop a low-speed, eco-friendly electric vehicle that can be efficiently used for short-range travel and tourist transportation. The specific objectives are:

- To design a mild steel chassis capable of supporting a total load of approximately 670 kg (vehicle + passengers).

- To select and integrate suitable mechanical components such as a differential unit, chain drive, disc brake, and pedestal bearings.
- To incorporate an electric drive system using a 48V, 750W DC motor with a 48V battery system for optimum performance.
- To achieve a range of around 50 km per charge with a safe operating speed suitable for tourist zones (12.43 km/h).
- To ensure safety, comfort, and stability through proper design of the braking, transmission, and load distribution systems.
- To promote eco-friendly and cost-effective transportation for short-distance applications such as campuses, gardens, resorts, and eco-parks.

## 2 Literature Review

### 1. Sharma et al. (2023) – Performance Analysis of Low-Speed Electric Vehicles

Sharma et al. presented a study on the performance analysis of low-speed electric vehicles designed for tourist and intra-city transportation. The research mainly focused on optimizing motor torque and gear ratio to improve vehicle efficiency and battery performance. The authors concluded that low-speed EVs operating below 25 km/h provide better energy utilization and reduced power losses. From this paper, the concept of using a suitable gear reduction ratio and controlled low-speed operation was adopted for the present project.

### 2. Lee et al. (2022) – Battery Optimization and Energy Management in Electric Vehicles

Lee et al. proposed an improved battery energy management system for 48V electric vehicles. Their study emphasized the importance of proper battery capacity selection and efficient power management to improve driving range and battery life. The paper highlighted that optimized battery systems can significantly reduce energy losses and improve operational efficiency. This research helped in selecting a 48V battery system for the developed electric vehicle.

### 3. Kumar and Singh (2021) – Design of Electric Vehicles for Urban Mobility

Kumar and Singh developed a design methodology for lightweight electric vehicles intended for urban and short-range transportation applications. Their work focused on chassis strength, vehicle stability, and weight distribution. The study concluded that proper chassis design improves safety and load-carrying capability. This paper provided guidance for designing the mild steel chassis structure used in the proposed vehicle.

### 4. Patel et al. (2021) – Mechanical Design of Electric Vehicle Chassis

Patel et al. investigated the structural design and material selection for electric vehicle chassis systems. Their research compared mild steel and aluminum alloy structures using strength and fabrication analysis. The study concluded that mild steel offers better strength, easier fabrication, and lower cost for prototype electric vehicles. Based on this research, mild steel was selected for the chassis fabrication in the present project.

### 5. Zhang et al. (2020) – Regenerative Braking Systems for Low-Speed EVs

Zhang et al. proposed a regenerative braking system suitable for low-speed electric vehicles. The authors demonstrated that regenerative braking can recover a portion of kinetic energy during braking and improve overall vehicle efficiency. The study also discussed energy recovery methods and braking control techniques. This paper provided knowledge about future improvements that can be integrated into the proposed electric vehicle system.

### 6. Thomas et al. (2020) – Comparative Study on Braking Systems in Electric Vehicles

Thomas et al. conducted a comparative analysis between drum brakes and disc brakes used in electric vehicles. Their findings showed that disc brake systems provide better braking efficiency, improved heat dissipation, and reduced maintenance compared to drum brakes. Based on this study, a disc braking system with caliper arrangement was selected for the developed electric vehicle.

### 7. Joshi and Mehta (2019) – Differential Drive Design for Lightweight EVs

Joshi and Mehta presented research on differential drive mechanisms for lightweight electric vehicles. Their study focused on improving vehicle stability and smooth turning performance during cornering conditions. The authors concluded that mechanical differentials reduce wheel slip and tire wear while improving handling characteristics. This research supported the implementation of a differential mechanism in the proposed project.

### 8. Reddy et al. (2019) – Integration of Mechanical and Electrical Systems in Hybrid Vehicles

Reddy et al. discussed the integration of electrical drive systems with mechanical transmission components in electric and hybrid vehicles. Their study highlighted the importance of proper shaft alignment, power transmission efficiency, and component synchronization. The research findings helped in improving the drivetrain assembly and alignment process of the developed electric vehicle.

### 9. Banerjee et al. (2018) – Economic Analysis of Short-Range EVs

Banerjee et al. performed an economic analysis of electric vehicles used for campus and tourist transportation. The study concluded that electric vehicles have lower operating and maintenance costs compared to conventional fuel vehicles. The paper also highlighted the environmental benefits of electric transportation systems. This research validated the economic feasibility of the proposed low-speed electric vehicle.

### 10. Dubey and Kumar (2018) – Review of Battery-Powered Tourist Vehicles

Dubey and Kumar reviewed various battery-powered tourist vehicles used in parks, resorts, and heritage sites. Their study showed that low-speed electric vehicles with simple drivetrain systems and battery-powered operation are highly suitable for eco-sensitive areas. This paper strongly supported the objective and application area of the present project related to tourist transport and short-range travel.

## 3. Proposed System and Design

### 3.1 Mechanical System

The proposed electric vehicle is designed for tourist transport and short-range mobility applications. The mechanical structure of the vehicle is fabricated using a mild steel chassis to provide sufficient strength, durability, and stability for carrying multiple passengers safely. The chassis is designed to support the total vehicle load while maintaining structural balance during operation.

The power transmission system consists of a 48V, 750W DC motor connected to the rear axle through a chain drive mechanism with a gear reduction ratio of 3:1. This arrangement provides high torque at low speed, making the vehicle suitable for low-speed transportation in tourist areas and restricted zones. A mechanical differential is incorporated to distribute power between the rear wheels during turning conditions, ensuring smooth vehicle movement and improved stability.

The braking system uses disc brakes with brake calipers to provide effective braking performance and passenger safety. P207 pedestal bearings are used to support the rear axle and reduce friction during wheel rotation. Shock absorbers and wheels are properly mounted to ensure smooth movement and passenger comfort on uneven surfaces.

### 3.2 Electrical System

The electrical system of the vehicle consists of four 12V, 90Ah batteries connected in series to provide a total supply voltage of 48V. The battery pack supplies electrical energy to the motor through a motor controller. The controller regulates the power supplied to the motor according to throttle input, enabling smooth acceleration and speed control.

Proper wiring, fuse protection, switches, and electrical insulation are provided to ensure safe and reliable operation of the vehicle. The electrical system is designed to minimize power losses and improve overall efficiency during vehicle operation.

### 3.3 Working Principle

When the power supply is switched ON, electrical energy from the battery pack is supplied to the motor controller. The controller regulates the current supplied to the DC motor according to throttle input. The motor converts electrical energy into mechanical energy and transmits power to the rear axle through the chain drive mechanism and differential system.

The rotational motion of the axle drives the rear wheels, causing vehicle movement. During braking conditions, the disc brake system slows down the wheel rotation and safely stops the vehicle. The complete system operates with low noise, zero tailpipe emissions, and reduced operating cost, making it suitable for eco-friendly transportation applications.

### 3.4 Proposed System Block Diagram

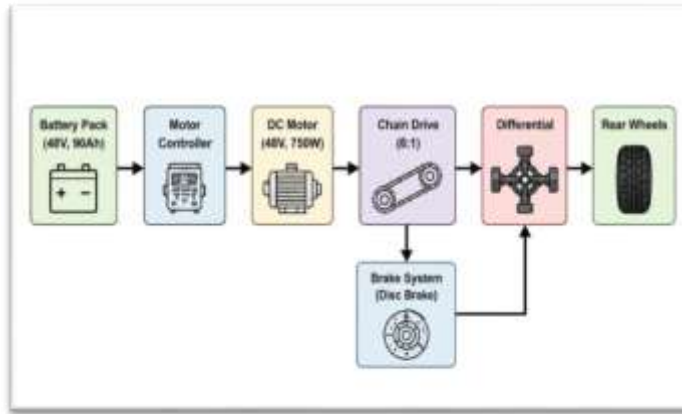


**Fig. 1: Proposed System Block Diagram**

The proposed system integrates mechanical and electrical subsystems to achieve safe, efficient, and sustainable vehicle operation for tourist transport and short-range travel applications.

### 4 Components Specification

The developed electric vehicle consists of various mechanical and electrical components integrated to achieve efficient, safe, and eco-friendly transportation. The major components used in the system include a battery pack, DC motor, motor controller, chain drive mechanism, differential system, braking system, bearings, chassis, and wheels. These components are selected based on vehicle performance, load-carrying capacity, operational efficiency, and safety requirements.

The vehicle is powered by four 12V, 90Ah batteries connected in series to provide a total supply voltage of 48V. A 48V, 750W DC motor is used to provide the required driving torque for vehicle movement. The motor is connected to the rear axle through a chain drive mechanism with a gear reduction ratio of 3:1 to obtain high torque at low speed operation.

A motor controller regulates the electrical power supplied to the motor according to throttle input and ensures smooth acceleration and speed control. The drivetrain system includes a mechanical differential to distribute power between the rear wheels during turning conditions and improve vehicle stability.

The braking system uses disc brakes with calipers to provide effective stopping performance and enhanced passenger safety. P207 pedestal bearings are used to support the rear axle and reduce friction during wheel rotation. The chassis is fabricated using mild steel to provide sufficient mechanical strength, durability, and easy fabrication. Proper wheels and tires are used to ensure smooth vehicle movement and load handling capability.

| Component        | Specification      |
|------------------|--------------------|
| Battery          | 12V, 90Ah × 4      |
| Motor            | 48V, 750W DC Motor |
| Motor Controller | 48V DC Controller  |
| Drive System     | Chain Drive        |

Total Voltage =  $12 \times 4 = 48V$

|                  |                         |
|------------------|-------------------------|
| Gear Ratio       | 3:1                     |
| Differential     | Mechanical Differential |
| Brake System     | Disc Brake with Caliper |
| Bearing          | P207 Pedestal Bearing   |
| Chassis Material | Mild Steel              |
| Wheels           | Pneumatic Rubber Wheels |

**Table 1: Components and specification**

### 5 Design Calculation

#### 5.1 Total Load Calculation

The total load acting on the vehicle consists of passenger weight and vehicle self-weight.

$$\text{Total Load} = \text{Vehicle Weight} + \text{Passenger Weight}$$

**Vehicle weight = 320 kg**

$$\text{Passenger load} = 70 \times 5 = 350\text{kg}$$

$$\text{Total Load} = 320 + 350 \quad \text{Total Load} = 670 \text{ kg}$$

#### 5.2 Wheel Diameter Conversion

Wheel diameter is given in feet and converted into meters.

$$1.3 \text{ ft} = 0.3962 \text{ m}$$

So,

$$D = 0.3962 \text{ m}$$

#### 5.3 Wheel Circumference

$$C = \pi \times D$$

$$C = 3.14 \times 0.3962$$

$$C = 1.244 \text{ m}$$

#### 5.4 Wheel RPM

$$\text{Wheel RPM} = \frac{500}{3}$$

$$\text{Wheel RPM} = 166.66 \text{ RPM}$$

#### 5.5 Vehicle Speed

$$\text{Speed} = \frac{\text{Wheel RPM} \times \text{Circumference} \times 60}{1000}$$

$$\text{Speed} = \frac{166.66 \times 1.244 \times 60}{1000}$$

$$\text{Speed} = 12.43 \text{ km/h}$$

#### 5.6 Battery Energy Calculation

The vehicle uses four 12V, 90Ah batteries connected in series.

Battery energy is calculated as:

$$E = V \times Ah \quad E = 48 \times 90 \quad E = 4320$$

$$Wh \quad E = 4.32 \text{ kWh}$$

### 5.7 Driving Range Calculation

The approximate driving range is calculated using battery energy and motor power consumption.

$$\text{Driving Time} = - \frac{\text{Battery Capacity}}{\text{Motor Power}}$$

$$\text{Driving Time} = - \frac{4320}{750}$$

$$\text{Driving Time} \approx 5.76 \text{ hours}$$

The vehicle range is calculated as:

$$\text{Range} = \text{Speed} \times \text{Time} \quad \text{Range} = 12.43 \times 5.76$$

$$\text{Range} \approx 70 \text{ km}$$

### Final Results

$$\text{Total Load} = 670 \text{ kg}$$

$$\text{Vehicle Speed} = 12.43 \text{ km/h}$$

$$\text{Battery Energy} = 4320 \text{ Wh} = 4.32 \text{ kWh Estimated}$$

$$\text{Range} = 70 \text{ km}$$

## 6. Fabrication and Assembly

The fabrication and assembly of the developed electric vehicle were carried out systematically to ensure proper integration of mechanical and electrical components. The complete process included chassis fabrication, mounting of drivetrain components, electrical wiring, and final testing of the vehicle. Initially, the chassis frame was fabricated using mild steel rectangular pipes due to their high strength, durability, and ease of welding. The chassis dimensions were selected according to the required passenger seating arrangement and load carrying capacity. Cutting, grinding, and arc welding operations were performed to prepare the vehicle frame structure.

After fabrication of the chassis, the rear axle assembly was mounted using P207 pedestal bearings to provide proper support and smooth rotational motion. A mechanical differential was installed on the rear axle to distribute power equally to both rear wheels during turning conditions. The chain drive mechanism was then connected between the motor shaft and differential sprocket using suitable chain tension adjustment.

The 48V DC motor was rigidly mounted on the chassis using motor clamps and support brackets to avoid vibration during operation. Disc brakes with brake calipers were installed on the rear axle to provide effective braking performance and improve vehicle safety. Shock absorbers and

wheel assemblies were also fitted to ensure smooth movement and passenger comfort.

The electrical assembly included installation of four 12V batteries connected in series to obtain a 48V power supply. Proper wiring connections were made between the battery pack, motor controller, throttle, switches, and DC motor. Fuse protection and electrical insulation were provided to ensure safe vehicle operation and minimize electrical losses.

After completion of the mechanical and electrical assembly, the vehicle was tested under different operating conditions to verify speed, braking performance, load carrying capability, and overall system operation. The developed electric vehicle demonstrated satisfactory performance for low-speed tourist transportation and short-range travel applications.



Fig. 2: Fabricated Mild Steel Chassis

## 7 Result and Discussion

The final assembled prototype of the developed electric vehicle is shown in Fig.3. The vehicle was tested under no-load and loaded conditions to evaluate its overall performance. Experimental testing confirmed that the developed vehicle operates smoothly with satisfactory stability and passenger comfort suitable for tourist transportation applications.

The fabricated vehicle is capable of carrying five passengers with proper load distribution and stable operation. The drivetrain system consisting of the DC motor, chain drive, and mechanical differential provided smooth power transmission to the rear wheels. The braking system demonstrated effective stopping capability and ensured safe vehicle operation during testing.

The developed electric vehicle achieved a practical operating speed in the range of 12–15 km/h under normal driving conditions. The battery system provided sufficient backup for short-distance travel applications with reduced energy consumption and low operating cost. The suspension and wheel arrangement minimized vibrations and improved ride comfort on uneven road surfaces.

The overall system performance was found satisfactory in terms of speed, braking efficiency, load carrying capacity, mechanical stability, and electrical operation. The developed vehicle provides a pollution-free, energy-efficient,

and eco-friendly solution for short-range tourist transportation and sustainable mobility applications.



Fig. 3: Front view of model



Fig. 4: Rear view of model

## 8 Advantages

The developed electric vehicle offers several advantages over conventional fuel-powered vehicles, especially for short-range and tourist transportation applications. The major advantages of the proposed system are as follows:

- The vehicle operates using electrical energy and produces zero tailpipe emissions, making it environmentally friendly.
- The operating and maintenance cost of the vehicle is lower compared to conventional petrol and diesel vehicles.
- The vehicle produces less noise and vibration, providing a smooth and comfortable travel experience for passengers.
- The simple mechanical and electrical design reduces system complexity and improves reliability.
- The use of a mild steel chassis provides sufficient strength, durability, and easy fabrication at low cost.
- The drivetrain system with differential arrangement ensures smooth turning and stable vehicle operation.
- The disc braking system improves vehicle safety and provides effective stopping performance.
- The vehicle is suitable for tourist areas, campuses, parks, industrial premises, and eco-sensitive zones.
- The system supports sustainable transportation and helps reduce dependency on fossil fuels.
- The compact design and low-speed operation make the vehicle safe for short-distance mobility applications.

## 9 Conclusion

The present work successfully demonstrates the design and development of a low-speed electric vehicle for tourist transport and short-range travel applications. The developed system integrates mechanical and electrical components such as a mild steel chassis, DC motor drive, chain transmission, differential system, disc braking mechanism, and rechargeable battery pack to achieve efficient vehicle operation.

The fabricated prototype was tested under different operating conditions and showed satisfactory performance in terms of speed, load carrying capacity, braking efficiency, and passenger safety. The vehicle operates with low noise, zero tailpipe emissions, and reduced operating cost, making it suitable for eco-friendly transportation applications.

The proposed electric vehicle provides a sustainable and economical solution for transportation in tourist areas, campuses, parks, and eco-sensitive zones. The developed system can be further improved in future by integrating advanced technologies such as lithium-ion batteries, regenerative braking systems, solar charging, and smart monitoring systems to enhance vehicle efficiency and performance.

## 10 Future Scope

The developed electric vehicle can be further improved by incorporating advanced technologies and enhanced system components to increase efficiency, performance, and operational reliability. In future, lithium-ion battery systems

can be used in place of conventional batteries to reduce overall vehicle weight and improve battery life. The implementation of regenerative braking technology can help recover braking energy and improve energy efficiency during vehicle operation. Solar charging systems may also be integrated to support renewable energy-based charging and reduce dependency on external power sources.

The performance of the vehicle can be enhanced by using high-efficiency BLDC motors with advanced motor controllers for better speed regulation and smooth operation. IoT-based monitoring systems can be incorporated for real-time battery monitoring, vehicle tracking, and performance analysis. Further improvements in suspension systems, braking mechanisms, and chassis design using lightweight materials can enhance passenger comfort, safety, and vehicle stability. Fast charging technology and smart safety features such as obstacle detection and automatic braking systems can also be implemented in future versions of the vehicle for advanced transportation and smart mobility applications.

## REFERENCES

- [1] Sharma, R., Patel, K., and Mehta, S., "Performance Analysis of Low-Speed Electric Vehicles," *International Journal of Electric Mobility*, vol. 8, no. 3, pp. 45–52, 2023.
- [2] Lee, J., Kim, H., and Park, S., "Battery Optimization and Energy Management in Electric Vehicles," *Journal of Energy Storage Systems*, vol. 15, no. 2, pp. 120–128, 2022.
- [3] Kumar, A. and Singh, R., "Design of Electric Vehicles for Urban Mobility," *International Journal of Automotive Engineering*, vol. 10, no. 4, pp. 210–218, 2021.
- [4] Patel, V., Shah, D., and Joshi, P., "Mechanical Design of Electric Vehicle Chassis," *Journal of Mechanical Design and Applications*, vol. 6, no. 1, pp. 30–38, 2021.
- [5] Zhang, Y., Liu, H., and Chen, X., "Regenerative Braking Systems for Low-Speed EVs," *International Journal of Vehicle Technology*, vol. 12, no. 5, pp. 88–95, 2020.
- [6] Thomas, A., Roy, B., and Nair, K., "Comparative Study on Braking Systems in Electric Vehicles," *Journal of Transportation Engineering*, vol. 9, no. 2, pp. 66–73, 2020.
- [7] Joshi, M. and Mehta, R., "Differential Drive Design for Lightweight EVs," *International Journal of Automotive Systems*, vol. 7, no. 3, pp. 101–108, 2019.
- [8] Reddy, P., Kumar, S., and Rao, V., "Integration of Mechanical and Electrical Systems in Hybrid Vehicles," *Journal of Hybrid Mobility Systems*, vol. 5, no. 4, pp. 55–63, 2019.
- [9] Banerjee, S., Das, P., and Ghosh, A., "Economic Analysis of Short-Range EVs," *International Journal of Sustainable Transportation*, vol. 4, no. 2, pp. 40–47, 2018.
- [10] Dubey, R. and Kumar, V., "Review of Battery-Powered Tourist Vehicles," *Journal of Green Transportation Technology*, vol. 3, no. 1, pp. 15–22, 2018.