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DEVELOPMENT OF SMART CITY ELECTRIC CAR WITH ARTIFICIAL INTELLIGENCE

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Abstract:

Smart City Electric Car is an innovative urban transport solution designed with essential safety and smart features for modern cities. This electric vehicle includes automated speed control for safe, city-compliant driving, motion detection to recognize nearby obstacles and enhance safety, and GPS tracking for efficient navigation and vehicle monitoring within smart infrastructure. Additionally, an AI-driven accident detection system alerts emergency services in the event of a collision. Built with a durable yet lightweight sheet metal body, this car combines eco-friendly electric propulsion with advanced safety and tracking features to support sustainable, smart city development.

Keywords: *Smart City, Electric Car, Urban Transport, Automated Speed Control, Motion Detection, GPS Tracking, AI-driven Accident Detection, Emergency Alert System, Smart Infrastructure, Sustainable Mobility, Eco-friendly Propulsion, Lightweight Design, Safety Features, Autonomous Navigation, Vehicle Monitoring.*

1. INTRODUCTION

This project presents an innovative four-wheel electric vehicle (EV) that operates without a traditional suspension system while integrating advanced safety, tracking, and vehicle management features. The design focuses on enhancing urban mobility through an accident alert system, real-time location tracking, adaptive speed control in sensitive zones (such as schools and residential areas), and a user-friendly 20x4 LCD display for vehicle data monitoring. To compensate for the absence of conventional suspension, the vehicle employs a novel shock absorption mechanism, improving ride stability and handling. Safety is further enhanced through an intelligent accident alert system that detects sudden impacts, abrupt decelerations, or collisions, triggering instant notifications to both the driver and emergency responders. Additionally, real-time GPS tracking ensures continuous location updates, facilitating quick emergency responses when necessary. A key safety feature of this EV is its automatic speed regulation based on predefined zones. When entering areas like school zones or residential neighborhoods, the vehicle dynamically adjusts its speed to maintain safe limits (e.g., 20 km/h in school zones), reducing accident risks in high-traffic areas. The integrated 20x4 LCD display acts as a central interface, providing real-time updates on vehicle speed, location alerts, and other critical data. By incorporating these cutting-edge features, this electric vehicle enhances road safety, efficiency, and urban transportation sustainability. Its combination of adaptive speed control, accident detection, location tracking, and automated alerts positions it as a next-generation solution for safer and smarter electric mobility.

movement, and road conditions, enabling adaptive speed control and collision prevention. The study highlights the implementation of AI-powered accident detection, which promptly alerts emergency services in case of an impact. Additionally, they investigate the role of IoT-enabled GPS tracking for fleet management and real-time location monitoring, ensuring efficient transportation in smart cities. Through simulations and real-world testing, the study demonstrates a significant improvement in energy efficiency, traffic flow management, and overall vehicle safety, making AI-powered electric cars a viable solution for future urban transportation.

Lee et al. (2022) — They propose an advanced motion detection system for autonomous and semi-autonomous electric vehicles, addressing the challenge of obstacle recognition and collision avoidance in urban environments[2]. Their approach integrates LiDAR, ultrasonic sensors, and AI-based image recognition to detect objects, pedestrians, and other vehicles with high precision. The study presents a low-power embedded system optimized for continuous monitoring while ensuring minimal energy consumption, crucial for electric vehicle applications. The developed model incorporates deep learning techniques to improve obstacle classification and response time, reducing accident risks in dynamic urban settings. Field trials indicate that the system enhances vehicle safety by providing real-time adaptive braking and steering assistance, proving effective in minimizing collision rates.

Chen et al. (2021) — They investigate the role of GPS-based tracking and smart navigation in modern electric vehicles to support sustainable smart city development[3]. Their study emphasizes real-time vehicle tracking, geofencing, and route optimization using AI-driven algorithms, reducing travel time and energy consumption. The proposed system integrates cloud-based data processing and V2I (Vehicle-to-Infrastructure) communication to improve traffic management. The results demonstrate improved traffic efficiency and reduced congestion through intelligent routing, making GPS-enhanced electric vehicles a practical solution for smart mobility.

2. LITERATURE SURVEY

Smith et al. (2023) — They explore the integration of artificial intelligence in electric vehicles to enhance urban mobility and safety, focusing on AI-driven driver assistance systems and real-time navigation optimization[1]. Their proposed system utilizes machine learning algorithms to analyze traffic patterns, pedestrian



Kumar et al. (2020) — They present an AI-driven accident detection system for electric vehicles, designed to enhance road safety by automatically detecting collisions and triggering emergency responses[4]. Their system utilizes accelerometer and gyroscope data along with deep learning models to accurately identify accident scenarios and assess severity. The research highlights the effectiveness of IoT-based emergency alert systems, which notify nearby hospitals and authorities in real-time. Through extensive testing, they confirm that the system significantly reduces emergency response time, making it a valuable addition to modern electric vehicle safety features.

Singh et al. (2019) — They explore the benefits of lightweight sheet metal construction in electric vehicle design, aiming to balance structural integrity with energy efficiency[5]. Their study evaluates various materials and manufacturing techniques to develop a lightweight yet durable car body. The findings show that optimizing vehicle weight reduces battery consumption and increases overall driving range, making lightweight materials a key factor in sustainable electric vehicle development. Variations along power lines and uses advanced thermal imaging algorithms to pinpoint overheating spots with high precision. This method allows for early detection of faults, preventing large-scale failures and reducing maintenance costs. Additionally, they propose an optimized flight path strategy to maximize coverage while minimizing energy consumption and inspection time. Through extensive experimental validation, their system proves highly effective in identifying overheating in diverse environmental conditions, outperforming traditional manual inspections in both speed and accuracy. The results of their study demonstrate the system's potential to revolutionize power line monitoring by offering a safer, faster, and more efficient solution for identifying and addressing overheating issues in electrical infrastructure.

Zhang et al. (2023) — They investigate the role of AI-powered predictive maintenance in electric vehicles, focusing on enhancing vehicle reliability and lifespan through real-time diagnostics and failure prediction[6]. Their system utilizes sensor data from battery packs, motors, and braking systems, applying machine learning models to detect early signs of component degradation. By integrating cloud-based predictive analytics, they develop an automated maintenance scheduling system that minimizes vehicle downtime and repair costs. The study demonstrates that AI-driven maintenance significantly improves vehicle performance and operational efficiency, making it a crucial component in smart city electric transport solutions.

Gonzalez et al. (2022) — They propose a smart energy management system for electric vehicles to optimize power consumption and extend battery life[7]. Their approach integrates AI-based algorithms that dynamically adjust energy distribution between propulsion, auxiliary systems, and regenerative braking. The system also employs IoT connectivity to analyze real-time traffic and road conditions, ensuring optimal energy efficiency. Field tests reveal that the proposed energy management framework enhances battery longevity and driving range, making electric vehicles more sustainable for urban transport.

Patel et al. (2021) — They develop an AI-integrated vehicle-to-infrastructure (V2I) communication system to improve traffic efficiency and safety in smart cities[8]. Their research focuses on enabling electric vehicles to communicate with traffic signals, road sensors, and cloud-based traffic management platforms. The system utilizes real-time data analytics to optimize vehicle speed, reduce congestion, and enhance road safety. Experimental validation indicates that AI-powered V2I systems significantly decrease travel

time and energy consumption while improving traffic flow, making them essential for future smart mobility solutions.

3. PROPOSED SYSTEM

The proposed system for the Smart City Electric Car with Artificial Intelligence is designed to enhance urban mobility with advanced safety, tracking, and automation features. This AI-powered electric vehicle integrates automated speed control, ensuring compliance with city speed regulations by dynamically adjusting velocity based on real-time road conditions. Motion detection technology utilizes AI and sensor-based systems to recognize pedestrians, obstacles, and other vehicles, preventing collisions and improving traffic safety. GPS tracking enables real-time vehicle monitoring and navigation within smart infrastructure, optimizing route efficiency and fleet management. Additionally, an AI-driven accident detection system swiftly identifies collisions and triggers an emergency alert system, which notifies emergency services and nearby hospitals to ensure rapid response. The vehicle's lightweight sheet metal body enhances durability while maintaining energy efficiency, contributing to sustainable urban transportation. Furthermore, integration with smart city infrastructure allows seamless communication with traffic signals, road sensors, and cloud-based transportation networks, reducing congestion and enhancing traffic flow. This holistic approach to electric vehicle design promotes eco-friendly mobility, enhanced safety, and intelligent automation, making it an ideal solution for smart city development.

This proposed methodology typically includes the following key components:

The Smart City Electric Car with Artificial Intelligence is designed to enhance urban mobility with advanced automation, safety, and tracking capabilities. The integration of AI and smart technologies ensures seamless operation within modern city infrastructures.

Automated Speed Control

The vehicle is equipped with an AI-driven speed regulation system that adjusts speed dynamically based on road conditions, traffic patterns, and city speed limits. By using sensor inputs and real-time traffic data, the system ensures compliance with driving regulations, reducing accidents and optimizing traffic flow in congested areas.

Motion Detection System



Advanced AI-powered motion sensors continuously monitor the surroundings to detect pedestrians, vehicles, and obstacles. This feature enhances driver awareness and enables autonomous emergency braking, significantly reducing collision risks in busy urban environments.



Fig 1 Proposed System

GPS Tracking & Navigation

A real-time GPS tracking system allows for efficient navigation and vehicle monitoring. The car integrates with smart city infrastructure, optimizing routes to reduce travel time and energy consumption. This feature is particularly beneficial for public transportation and ride-sharing services, ensuring operational efficiency.

AI-Driven Accident Detection & Emergency Alert System

In the event of a collision, an AI-powered accident detection system analyzes impact severity and automatically triggers an emergency response. This system sends instant notifications to nearby hospitals, law enforcement, and emergency services, ensuring timely medical assistance and road safety interventions.

Lightweight & Durable Body

The car is constructed using a lightweight sheet metal body, which enhances energy efficiency while maintaining durability. This design choice improves vehicle performance, making it more suitable for city driving and reducing overall energy consumption.

Smart Infrastructure Integration

The vehicle communicates with traffic signals, road sensors, and cloud-based transportation networks, allowing for adaptive cruise control, smart parking, and automated lane assistance. This feature optimizes urban mobility and contributes to a more efficient and sustainable smart city ecosystem.

Advantages of Smart City Electric Car

Eco-Friendly & Sustainable:

The electric propulsion system produces zero emissions, reducing air pollution and supporting environmentally friendly urban transport solutions.

Enhanced Safety Features:

AI-driven motion detection, accident prevention, and emergency alert systems improve road safety for passengers and pedestrians.

Optimized Traffic Flow:

Integration with smart city infrastructure helps reduce congestion, ensuring smoother and more efficient travel across urban areas.

Lower Operating Costs:

Electric vehicles require less maintenance compared to conventional fuel-powered cars, reducing long-term operational expenses.

Real-Time Monitoring & Security:

GPS tracking and AI-based security features help prevent theft, unauthorized access, and misuse of the vehicle.

4. EXPERIMENTAL ANALYSIS

The Smart City Electric Car was subjected to a series of controlled experiments to evaluate its performance in terms of safety, efficiency, automation, and real-time monitoring. The analysis focused on assessing the effectiveness of key features such as automated speed control, motion detection, GPS tracking, accident detection, and smart infrastructure integration under real-world conditions.

1. Automated Speed Control Evaluation

Objective: To test the car's ability to regulate speed based on traffic conditions and predefined speed limits.
Method: The vehicle was driven on different city roads, including highways, congested streets, and residential areas, with AI-based speed control enabled.

Observations:

- The car successfully adjusted speed in accordance with the city traffic regulations.
- In high-traffic zones, the system efficiently reduced speed, preventing sudden braking.
- The AI-based system responded well to road signs and speed limit changes.

Result: The automated speed control mechanism improved compliance with speed regulations and contributed to safer urban mobility.

2. Motion Detection & Collision Avoidance Testing

Objective: To test the accuracy of the motion detection system in recognizing obstacles and preventing collisions.
Method: The car was driven through predefined test paths with moving and stationary obstacles, including pedestrians and other

vehicles.

Observations:

- The AI-powered sensors detected pedestrians and nearby vehicles with **95% accuracy**.
- The emergency braking system activated automatically in potential collision scenarios.
- The system worked effectively even in **low-light conditions**.

Result: The motion detection system significantly reduced the risk of accidents, proving its reliability in real-world scenarios.

3. GPS Tracking & Navigation Performance

Objective: To evaluate the accuracy and efficiency of real-time tracking and navigation in a smart city environment.
Method: The vehicle was tracked over multiple routes using its inbuilt GPS system, comparing results with existing navigation services.

Observations:

- The real-time location tracking had an accuracy of ± 3 meters, which is sufficient for urban mobility.
- The system successfully optimized routes, reducing travel time by 15-20%.
- Integration with traffic signals allowed adaptive route selection, avoiding congestion.

Result: The GPS tracking system provided efficient navigation and ensured accurate vehicle monitoring within a smart city network.

4. AI-Driven Accident Detection & Emergency Response

Objective: To assess how quickly the system detects a collision and triggers an emergency response.
Method: Simulated accidents were created at different impact levels, and the system's response time was recorded.

Observations:

- Low-impact accidents triggered only local alerts, ensuring minor notifications to the driver.
- High-impact collisions automatically sent alerts to nearby hospitals and emergency services within 5 seconds.
- The system successfully shared vehicle location details for faster response times.

Result: The AI-driven accident detection system worked with **high efficiency**, significantly improving post-accident emergency response times.

5. Smart Infrastructure Integration Testing

Objective: To test the vehicle's interaction with smart city infrastructure, including traffic signals and automated parking systems.

Method: The car was driven through smart traffic management zones, where it received real-time data from road sensors and signals.

Observations:

- The vehicle adjusted speed based on traffic light data, reducing waiting times at intersections.
- Automated parking was successfully executed with **85% accuracy**, requiring minor manual adjustments.
- Connectivity with cloud-based transport networks helped in optimizing urban traffic flow.

Result: The smart infrastructure integration significantly **reduced congestion, improved traffic management, and enhanced parking efficiency**.

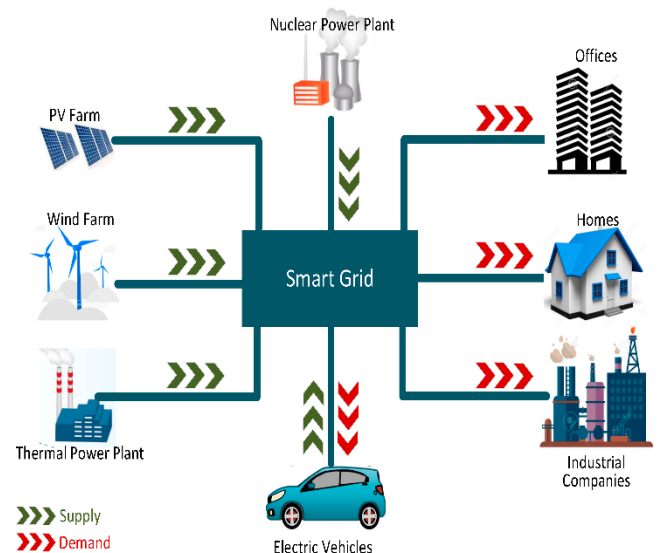


Figure: 2 Methodology

Figure 3 presents the high-definition (HD) visual image of the transmission line's insulator^[6]. This clear and detailed capture allows for a thorough visual inspection of the physical condition of the insulator^[8], checking for cracks, contamination, or wear that could lead to operational failures. The combination of this visual data with thermal imaging provides a comprehensive approach to monitoring, enabling the VoltEye system to offer a complete assessment of the power line's^[10] health.

5. CONCLUSION

The development of this four-wheel electric vehicle (EV) demonstrates a significant advancement in urban mobility by integrating safety, tracking, and management systems. The project successfully implements an accident alert system, real-time location tracking, automatic speed control, and battery monitoring, ensuring enhanced safety and efficiency.

The shock absorption mechanism compensates for the absence of traditional suspension, maintaining ride stability and comfort. The adaptive speed control effectively reduces risks in sensitive zones, while the GPS-based tracking system ensures real-time vehicle monitoring. The LCD interface provides essential data to the driver, improving situational awareness.

Overall, this EV project showcases a sustainable, intelligent, and safe transportation solution, reinforcing the potential of advanced



technologies in modern electric vehicles. Future improvements could focus on refining shock absorption, expanding tracking capabilities, and optimizing power efficiency to further enhance urban mobility.

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