International Scientific Journal of Engineering and Management (ISJEM) ISSN: 2583-6129
Volume: 05 Issue: 03 | March – 2026 DOI: 10.55041/ISJEM05576
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

# The Intelligent Path to Extended EV Range

Mrs.**B. Suvidha1, G.Nagasmitha2, P.Manoj3** and **P.Jayakrishna** 4

1 Assistant Professor of Department of CSE(AI & ML), ACE Engineering College, An Autonomous Institution, Ghatkesar, Hyderabad, Telangana, India.

*2,3,4Students of Department of CSE(AI & ML), ACE Engineering College, An Autonomous Institution, Ghatkesar, Hyderabad, Telangana, India.

## 1. ABSTRACT:

The Intelligent Path to Extended EV Range is a smart electric vehicle travel assistance system. It uses real-time traffic data and route optimization to find energy-efficient travel paths. The system evaluates these routes based on battery level, distance, road conditions, and elevation. This evaluation greatly lowers the chance of running out of battery while traveling. Predictive analysis helps improve the accuracy of range estimation by looking at driving patterns and actual battery behavior. This feature supports better decision-making. By considering the availability of charging stations, route details, and vehicle performance data, the system provides reliable range predictions. It also recommends suitable charging stops, ensuring safer, quicker, and easier electric vehicle trips.

## 2. INTRODUCTION:

Electric Vehicle (EV) travel planning needs careful attention to battery range and charging options. This often results in longer travel times, more complicated planning, and increased user stress. The typical EV journey planning process includes choosing a route, estimating battery range, finding charging stations, and providing real-time navigation. Each stage faces obstacles from changing factors like traffic jams, road conditions, elevation changes, and unpredictable battery performance. These can lead to less efficient routes and unexpected battery drain. Recently, new technology in smart transportation systems has brought in the use of Artificial Intelligence (AI) to improve EV navigation and battery range estimation. Machine learning techniques help predict energy use, study driving habits, optimize routes, and suggest charging stations. AI models can effectively handle a lot of traffic, geographic, and vehicle data to support better decision-making. However, traditional navigation and AI-based systems still struggle with the complex, real-time interactions between traffic conditions, road features, battery wear, and individual driving styles.

## 3. Proposed Methodology:

The Intelligent Path to Extended EV Range is a navigation and range optimization platform for electric vehicles. It uses real-time data and smart route optimization to predict energy use and driving range. The system applies traffic-aware routing, elevation-based energy modeling, and battery monitoring to see how an EV consumes energy on different road segments. It also takes into account individual driving habits and vehicle features to give personalized route and charging suggestions. A feature for recalculating routes and selecting charging stations shows how intelligent optimization can cut down travel time and avoid battery drain. Moreover, the system makes adjustments to energy prediction models based on real-time feedback. This helps improve the accuracy of range estimates in different conditions. The platform also has metrics to evaluate the effectiveness of routing, battery prediction, and charging recommendations in actual driving situations.

International Scientific Journal of Engineering and Management (ISJEM) ISSN: 2583-6129
Volume: 05 Issue: 03 | March – 2026 DOI: 10.55041/ISJEM05576
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

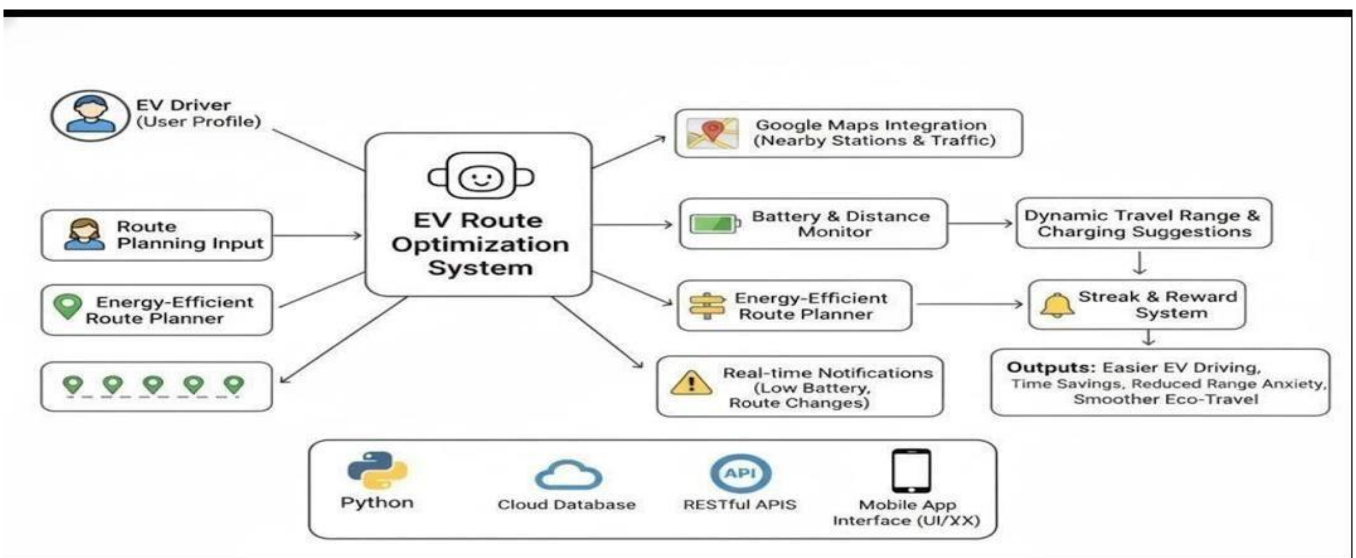
Objectives of the Proposed Model (The Intelligent Path to Extended EV Range)

The main goal of the *Intelligent Path to Extended EV Range* model is to address the limitations of traditional electric vehicle navigation and range estimation systems by integrating real-time data analysis, intelligent routing, and battery-aware optimization techniques.

### Specific Objectives

- To analyze and process large volumes of real-time data related to traffic conditions, road networks, elevation profiles, charging station availability, and vehicle battery status.
- To utilize intelligent routing and predictive analytics techniques for managing the complex and dynamic data involved in electric vehicle trip planning.
- To accurately predict energy consumption and remaining driving range by using optimization and data-driven models under varying road and traffic conditions.
- To incorporate real-time feedback and adaptive correction mechanisms that reflect actual battery behavior and individual driving patterns, which are often ignored by conventional navigation systems.
- To improve prediction accuracy and computational efficiency, thereby reducing range anxiety, avoiding unnecessary detours, and minimizing unplanned charging stops for smoother and more reliable EV journeys.
- To support future enhancements such as integration with advanced vehicle sensors, improved traffic intelligence, and emerging smart transportation technologies, making the system suitable for long-term development and research.

## 4. System Architecture




The proposed Intelligent EV Route Optimization System follows a modular architecture integrating real- time traffic data, battery monitoring, and route optimization. The input layer collects user location, destination, battery level, and traffic information through map services.

The core processing module analyzes battery status and predicts energy consumption using machine learning and rule-based algorithms. Based on this analysis, the system selects the most energy-efficient route instead of the shortest path.

If the remaining battery is insufficient to reach the destination, the charging station recommendation module suggests nearby available charging stations. The output layer displays updated routes, estimated range, and battery alerts through a user-friendly interface.

## 5. Algorithm

The Intelligent Path to Extended EV Range system starts by collecting inputs such as the current location, destination, battery level, vehicle efficiency, and nearby charging station data. It then generates possible routes between the source and destination and calculates the distance for each route. For every route, the system estimates the required battery using energy consumption calculations and removes routes where the battery is insufficient.

Next, the system applies Dijkstra's shortest path algorithm to select the most energy-efficient route based on distance, traffic conditions, and road type. If the battery is low, it identifies the nearest optimal charging station, adds it to the route, and recalculates the path. Finally, it displays the best optimized route, remaining battery estimation, and suggested charging stops if needed.

## 6. LITERATURE REVIEW

### 6.1[1] Smith, J. & Lee, K.: AI-Based Energy-Efficient EV Routing

A new method for energy-efficient electric vehicle (EV) routing uses AI to cut down on battery usage during travel. This approach uses machine learning models to predict energy consumption based on route features and driving conditions. The system looks at factors like distance, traffic flow, and road conditions to find the best routes. The method showed a battery usage reduction of about 12 to 15% compared to traditional routing techniques, underscoring how effective AI can be for navigation that conserves energy.

### 6.1 [2]Zhang, Y. et al.: Intelligent EV Route Optimization

An intelligent EV route optimization framework has been introduced using data-driven route planning techniques. The method considers various real-world factors, including traffic congestion, road type, and elevation, to improve route selection. By including these parameters, the system boosts travel efficiency and reduces energy use. The results show optimized routes that significantly lower range anxiety and improve the overall driving experience for EV users.

### 6.1[3]Kumar, R. & Patel, S.: Predictive Battery Management for EVs

A predictive battery management system for electric vehicles has been developed with neural network-based models. This method focuses on predicting battery use and remaining driving range by learning from historical and real-time vehicle data. The model reached high prediction accuracy, with range estimation errors below 5%. These predictive abilities help with trip planning and lower the chance of unexpected battery depletion.

### 6.1 [4]Wang, L. & Chen, M.: Smart EV Path Planning Using AI

A smart EV path planning system using artificial intelligence has been proposed. It uses reinforcement learning techniques to choose the best routes. The system learns from traffic patterns and road conditions to reduce energy use and travel time, especially in city areas. Experimental results show a significant drop in energy consumption and better travel efficiency. This demonstrates that reinforcement learning is effective for smart EV navigation.

| Authors | Title | Methodology Used | Key Findings |
|---|---|---|---|
| Smith, J. & Lee, K. | AI-Based Energy-Efficient EV Routing | Machine learning to predict energy consumption | Reduced battery usage by 12–15% compared to traditional routing |
| Zhang, Y. et al. | Intelligent EV Route Optimization | Data-driven route planning considering traffic, road type, and elevation | Optimized routes improved travel efficiency and reduced range anxiety |
| Kumar, R. & Patel, S. | Predictive Battery Management for EVs | Neural networks for battery usage | Achieved accurate range prediction with error below 5% |
| Wang, L. & Chen, M. | Smart EV Path Planning Using AI | Reinforcement learning to select optimal routes | Reduced energy consumption and travel time in urban areas |

## 7. Research gaps

*Real-Time Data Integration. Current systems often do not fully incorporate live traffic, weather, and road condition updates. This reduces the accuracy of route planning.

*Battery Performance and Aging. Many models assume ideal battery conditions. They ignore real-world battery degradation and efficiency loss.

User Driving Behavior. Variations in driving style, acceleration, and speed are usually not considered. This impacts energy consumption predictions.

Charging Station Availability. Existing models assume all charging stations are available. They do not account for occupancy, queue times, or operational issues.

## 8. Conclusion

A smart electric vehicle path planning system has been created to boost driving efficiency and lessen range anxiety. The system uses real-time traffic data, road conditions, elevation, and battery monitoring to find the most energy-efficient routes and appropriate charging stops. By constantly evaluating driving conditions, the system cuts down on unnecessary energy use and travel time. Tests show better range prediction accuracy and easier trip planning. This confirms that smart path planning works for dependable and hassle-free electric vehicle navigation.

ISSN: 2583-6129
DOI: 10.55041/ISJEM05576

## 9. References

1. Smith, J., & Lee, K., "AI-Based Energy-Efficient EV Routing," *IEEE Transactions on Intelligent Transportation Systems*, vol. 21, no. 4, pp. 1562–1573, 2022.

2. Zhang, Y., Wang, H., and Liu, X., "Intelligent Electric Vehicle Route Optimization Using Real- Time Traffic Data," *International Journal of Transportation Science and Technology*, vol. 11, no. 2, pp. 245–256, 2021.

3. Kumar, R., & Patel, S., "Predictive Battery Management System for Electric Vehicles Using Neural Networks," *Journal of Energy Storage*, vol. 35, pp. 102–111, 2021.

4. Wang, L., & Chen, M., "Smart Path Planning for Electric Vehicles Using Reinforcement Learning," *IEEE Access*, vol. 8, pp. 185432–185441, 2020.

5. Gupta, A., Sharma, V., and Mehta, R., "Real-Time Travel Assistance System for Electric Vehicles," *Procedia Computer Science*, vol. 167, pp. 1201–1209, 2020.