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Electric Vehicle Fast Charing Stations Billing System

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Abstract— The EV Management System is a web-based platform designed to streamline the management of electric vehicle (EV) charging stations, bookings, and administrative tasks. The system offers a comprehensive solution for users, EV center operators, and administrators, ensuring a seamless experience for all stakeholders. Users can register, log in, view nearby EV centers, book charging slots, and make dummy payments. EV center operators can manage their bookings, update the status of slots, and monitor their center's activities. Admins are empowered to add new EV centers, manage user data, and oversee the overall system. With secure authentication, real-time updates, and efficient data handling, the EV Management System simplifies the EV charging experience for both users and administrators.

Keywords: EV Management, Charging Slots, User Registration, Admin Operations, Slot Status, Secure Login, Payment.

I. INTRODUCTION

The EV Management System is a comprehensive, webbased platform designed to optimize the management of electric vehicle (EV) charging stations, bookings, and related administrative operations. This system offers a seamless experience for users, EV center operators, and administrators, making it easier for all stakeholders to interact with the platform.For users, the system provides an intuitive interface where they can register, log in, search for nearby charging stations, book available charging slots, and make dummy payments. EV center operators can effectively manage their charging stations, update slot statuses in real time, and monitor bookings to ensure efficient operations. Meanwhile, administrators have full control over the system, with the ability to add new EV centers, manage user data, and monitor the overall health of the platform.

The system prioritizes security with user authentication, ensures smooth interactions between the various roles, and provides real-time updates for accurate and up-to-date information. By integrating various functionalities into one platform, the EV Management System simplifies the process of managing charging stations and enhances the overall user experience. This digital solution aims to improve the EV charging ecosystem, making it more efficient, transparent, and accessible for all users and operators. Through centralized management, secure data handling, and streamlined booking, the platform contributes to the evolving infrastructure needed to support the growing adoption of electric vehicles.

1.1 PROBLEM STATEMENT

The traditional process of managing EV charging stations involves scattered data and inefficient management of bookings and slot statuses. Users often face difficulties in finding nearby charging stations and making bookings. For



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EV center operators, tracking bookings and managing slot statuses can be time-consuming. Admins struggle to maintain accurate data on available centers and users. There is a clear need for a comprehensive digital platform that provides seamless user interaction, real-time slot updates, and centralized management of EV centers, bookings, and user profiles.

1.2 MOTIVATION

As the demand for electric vehicles continues to rise, managing charging infrastructure becomes more crucial. The lack of a unified, digital platform for EV centers and users results in inefficiencies, errors, and poor user experience. This system aims to streamline the booking process, enhance communication between users and EV centers, and provide administrators with real-time control over the system. By introducing this web-based solution, the project seeks to improve user experience, simplify administrative workflows, and ensure effective management of EV charging stations

1.3 OBJECTIVE OF THE PROJECT:

The primary objective of the EV Management System is to create a secure, user-friendly platform that enables Users to register, view nearby charging centers, book slots, and make payments. And EV Center Operators to manage bookings, update slot statuses, and oversee their facilities. And Admins to add new EV centers, manage user data, and ensure the system operates efficiently. The system will ensure secure authentication, real-time data updates, and smooth interaction across all user roles, improving the overall EV charging service

II LITERATURE REVIEW

1. Author: Zhao, L., & Wang, Y.

Title: Smart EV Charging Management: A Review **Outcome:** This paper reviews various approaches to managing electric vehicle (EV) charging stations, focusing on the integration of smart technologies such as IoT and machine learning to optimize charging schedules and station management. It also examines how real-time data sharing can improve

user experience by allowing them to find available charging slots in real time.

Disadvantage: The study highlights the challenges related to the lack of standardization across different EV charging networks, which can lead to incompatibilities and difficulties for users in accessing diverse charging stations.

2. Author: Lee, J., & Kim, S.

Title: Electric Vehicle Charging Station Management Systems: Challenges and Future Directions

Outcome: The paper discusses the technological and operational challenges faced by EV charging stations, such as fluctuating energy demand, charging slot management, and user engagement. It also proposes solutions that include integrating cloud computing to streamline operations and enhance system scalability.

Disadvantage: It mentions that the high initial cost of setting up a comprehensive management system can deter smaller operators from adopting advanced technologies, which could hinder widespread adoption of efficient charging station networks.

3. Author: Ahmed, F., & Raza, M.

Title: Real-Time EV Charging Management Systems: An Analysis of Optimization Techniques **Outcome:** This paper presents an analysis of various optimization techniques for managing real-time EV charging station operations. It emphasizes the importance of forecasting and scheduling algorithms that reduce wait times and energy costs. **Disadvantage:** While the paper highlights the benefits of optimization, it also points out the limitations in terms of the high computational costs required to implement real-time scheduling algorithms effectively.

4. Author:Singh,P.,&Sharma,V.

Title: Integration of Payment Systems in Electric Vehicle Charging Stations

Outcome: This research explores the integration of secure and seamless payment gateways into EV charging station management systems, focusing on user-friendly interfaces and multiple payment options. It



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discusses how integrating these features improves the overall customer experience by simplifying the payment process.

Disadvantage: The study identifies concerns around security risks in online payment systems, particularly with the increasing amount of sensitive data being exchanged through mobile apps and digital payment platforms.

5. Author: Zhang, R., & Liu, X.

Title: Cloud-Based EV Charging Management

Systems: Design and Implementation
Outcome: This paper investigates the use of cloudbased systems for managing EV charging stations.
It highlights the ability of cloud platforms to store and process large amounts of data, facilitating remote monitoring, real-time updates, and centralized control of charging stations.

Disadvantage: The paper notes that cloud-based solutions may face connectivity issues in rural or underdeveloped areas where reliable internet infrastructure is not available, thus limiting their usability in certain locations.

6. Author: Johnson, H., & Thomas, A. Title: Predictive Analytics in EV Charging Management: Enhancing User Experience Outcome: This research explores the use of predictive analytics in EV charging management systems to forecast charging demands, reduce wait times, and optimize energy usage. It emphasizes the role of data-driven decision-making in improving the overall charging experience.

Disadvantage: It points out that predictive models require large and accurate datasets to provide reliable forecasts, and inaccuracies in the data can lead to suboptimal decisions and customer dissatisfaction.

 Author: Sharma, M., & Gupta, R. Title: Security Challenges in EV Charging Management Systems **Outcome:** This paper examines the security concerns associated with EV charging management systems, including user data privacy, payment system vulnerabilities, and the need for robust encryption methods. It proposes a framework for ensuring secure communication between users, charging stations, and payment platforms.

Disadvantage: The authors note that while encryption and secure protocols are effective, the complexity of implementing these measures can increase the development cost and time for charging station operators.

III. SYSTEM ANALYSIS

3.1 Existing System Current EV charging management systems are typically manual, inefficient, and fragmented. Users have to rely on local information or unintegrated systems, leading to difficulties in booking, limited availability, and inaccurate data. Additionally, operators face challenges in keeping track of bookings and slot statuses. Existing systems also lack centralization, making it harder to manage data effectively. Furthermore, manual booking systems result in increased administrative overhead and errors in updating available slots and statuses.

3.1.1 Disadvantages

- Fragmented and inefficient data management.
- Limited user interaction and difficulties in finding nearby charging stations.
- Increased administrative workload due to manual processes.
- Lack of real-time updates, leading to errors and delays in bookings.
- Security concerns related to user data management.

3.2 PROPOSED SYSTEM

The proposed EV Management System will provide a unified platform that addresses the inefficiencies of current systems by offering a user-friendly interface for both users and administrators. Users will be able to easily search for nearby charging stations, book slots, and make payments. EV center operators will have access to a dashboard where



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they can manage their slots, update statuses, and view booking details. Admins will be able to add new EV centers, manage all user data, and ensure the entire system runs smoothly with real- time data updates. Secure login and authentication features will ensure that all user data is kept safe and private.

3.2.1 Advantages

User-Friendly Interface: Easy navigation for users to search for nearby charging stations and book charging slots.

Real-Time Data Management: Administrators can manage EV centers, monitor real-time slot status, and update information instantly.

Efficient Feedback Management: Users can provide ratings and comments, and admins can view and act on feedback to improve charging services.

Centralized Platform: Both users and admins can interact with a single, integrated platform for managing charging stations, bookings, and user profiles.

Real-Time Updates: Users and admins will receive accurate, up-to-date information on slot availability and booking statuses.



Functional Requirements:

User Module:

Register: Users can register by providing personal details such as name, email, phone number, and password. Location

data is also required to help users find nearby EV centers. The system validates the entered data and securely stores it in the database.

Login: Users can log in with their registered credentials (email and password). Secure authentication ensures data privacy and prevents unauthorized access. Successful login directs users to their dashboard with available services.

Search for EV Centers: Users can search for EV centers by location or available charging slots. Results are filtered by proximity, availability, and ratings.

Book Charging Slot: Users can view available slots and book a slot for their electric vehicle. After booking, users receive a confirmation with the booking details. Booking history is stored in the user's profile for future reference.

Cancel Booking: Users can cancel their bookings if necessary and receive an instant update on slot availability.

View and Manage Profile:Users can view and update their profile information, including contact details and preferences.

Logout:Users can securely log out to ensure session termination and protect their information.

Admin Module:

Register: Admins are pre-registered or can be added by a super admin, requiring credentials such as username, email, and password. Role-based access ensures proper permissions for managing the system.

Login: Admins can log in using their assigned credentials.Secure authentication ensures only authorized admins access the system.Manage EV Centers: Admins can add, update, or delete records for EV centers, ensuring accurate details of center locations, charging capacities, and slot availability.



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Manage Users: Admins can view, update, and delete user profiles, including verifying or deactivating accounts.

Generate Reports: Admins can generate reports on bookings, users, and EV center activities for analysis and strategic decisions.

Monitor System: Admins can monitor overall system health, booking statuses, and user interactions to ensure smooth operations.

Logout: Admins can securely log out after completing their tasks.

EV Owner Module:

Login: EV owners can log in using their assigned credentials to manage their center's booking slots and schedules.

Manage Booking Slots: Owners can update the availability of charging slots, marking them as "available", "booked", or "pending."

View Bookings: EV owners can view a list of all bookings made by users and update booking statuses accordingly.

Manage Center Profile: Owners can update their EV center's profile, including location, operating hours, and service details.

Logout: After completing their tasks, EV owners can securely log out of the system.

Non-Functional Requirements

Non-functional requirements define the quality attributes, performance, and constraints of the **EV Management System**. These requirements ensure the system meets operational expectations beyond core functionality.

Performance: The system should support at least 500 concurrent users without performance degradation. Booking and center search should load in under 2 seconds for a smooth user experience.

Scalability: The platform should be scalable both vertically and horizontally to handle increasing numbers of users, EV centers, and bookings. The database should be optimized for a growing number of user and booking records.

Security: All sensitive user and admin data, including personal and payment information, must be encrypted. The system should implement secure authentication protocols (e.g., password hashing, OAuth) and ensure secure login for all roles.User sessions should expire after a defined period of inactivity to prevent unauthorized access.

Availability: The system must maintain 99.9% uptime, ensuring continuous availability for users, admins, and EV owners. Maintenance activities should be scheduled during off-peak hours, with prior notifications to users.

Usability: The user interface must be intuitive, responsive, and accessible across devices (desktop, tablet, smartphone). The system should adhere to accessibility standards such as WCAG 2.1, ensuring inclusivity for users with disabilities.

Maintainability: The platform should be designed with modular architecture to allow easy updates, bug fixes, and feature additions. Clear and concise documentation should be provided for developers to facilitate system maintenance and future upgrades.

Reliability: The system should have mechanisms to recover from failures (e.g., server crashes, network outages) within 5 minutes to minimize disruptions. Regular backup and recovery processes should be in place to prevent data loss in case of system failures.

Interoperability: The platform should integrate smoothly with third-party payment gateways and notification services (email, SMS APIs). If required, the system should support integration with external scheduling systems or other management software.

Data Integrity: Data updates should be processed accurately, with no inconsistencies or data corruption. All

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database transactions must follow ACID (Atomicity, Consistency, Isolation, Durability) principles to ensure data integrity.

Compliance: The system must comply with local regulations such as GDPR for data protection and other relevant legal standards, ensuring privacy and security of user data.

Response Time: Critical functionalities such as login, searching EV centers, and booking slots should respond within 3 seconds under normal load.

Logging and Monitoring: The system must log all critical events (e.g., user logins, data updates, and booking transactions) for auditing and security purposes. Admins should have access to real-time monitoring dashboards to track system health and performance.

Extensibility: The platform should be designed to support future enhancements, such as adding new features (e.g., additional payment methods, advanced analytics) or supporting new types of electric vehicles.

V. RESUT AND DISCUSSION

The implementation of the EV Management System has successfully streamlined the management of electric vehicle (EV) charging stations by providing an integrated, webbased platform for users, EV center operators, and administrators. The system's key functionalities, including user registration, login, booking of charging slots, real-time updates, and secure payment processing, have significantly enhanced the efficiency and user experience of EV charging infrastructure.

Results: The system's performance was evaluated based on various test cases that validated its functional and nonfunctional requirements. Key findings include:

User Engagement: The system provided a seamless user experience, allowing users to register, log in, search for nearby charging stations, book slots, and make payments without any major glitches. The slot request and booking confirmation functionalities performed efficiently, ensuring real-time updates and improved accessibility.

Admin and Operator Management: Administrators successfully added, updated, and monitored EV centers, while EV operators efficiently managed booking slots and updated slot statuses. The centralized management system allowed for effective oversight and better organization.

Security and Authentication: The system implemented robust security measures, including encrypted user data, secure authentication, and session management. User credentials and payment information were securely stored, minimizing potential cybersecurity threats.

System Performance and Scalability: The platform was able to handle multiple user requests simultaneously, with no significant delays observed in retrieving charging center details or booking slots. The system demonstrated scalability, ensuring that an increasing number of users and EV centers could be accommodated efficiently.

Testing Outcomes: Unit, integration, functional, and security testing validated the system's reliability and efficiency. No major defects were encountered, and all test cases passed successfully.

Discussion: The development and deployment of the EV Management System addressed key challenges faced by traditional EV charging station management, including fragmented data handling, inefficient booking processes, and security concerns. The system's integration of real-time slot updates, user-friendly interfaces, and secure transactions contributed to a streamlined user experience.

One of the notable advantages of the system is its ability to provide real-time data, allowing users to check slot availability before arriving at charging stations. This feature significantly reduces wait times and optimizes the utilization of available slots. Additionally, administrators and operators benefit from the system's centralized platform, which facilitates the monitoring and management of multiple charging centers from a single interface.

Despite the system's successful implementation, potential areas for improvement include the integration of

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mobile applications for enhanced accessibility, AI-powered predictive analytics for optimizing charging schedules, and expanded payment options for greater user convenience. The incorporation of smart charging stations with dynamic pricing and energy management features could further enhance the system's efficiency and sustainability.

VI. FUTURE SCOPE The proposed system will provide a digital solution for managing EV charging centers, bookings, and administrative operations. Key features will include user registration and login, booking management, and secure payment handling. On the administrative side, admins will be able to add new centers, monitor user activities, and update information. The system will also offer real-time updates on slot availability and booking statuses, ensuring a smooth and transparent experience for all users. Additionally, secure authentication and data management will be prioritized to ensure user privacy and system integrity.

Future enhancements for the EV Management System could include the integration of smart charging stations for dynamic pricing and energy optimization. A mobile app for users and operators could provide greater accessibility and real-time management. Fleet management features would support businesses with multiple EVs, optimizing charging schedules. Expanding payment gateways would offer more flexibility for users. The addition of AI-powered recommendations would personalize the user experience. Carbon footprint tracking would promote sustainability by allowing users to monitor environmental impact. Finally, geofencing and proximity alerts could guide users to available charging slots in real-time

VII. CONCLUSION

In conclusion, the EV Management System has proven to be an effective solution for modernizing EV charging infrastructure. Its seamless user experience, secure transaction handling, and real-time management capabilities make it a vital tool for improving EV adoption and sustainable transportation. Future enhancements, including mobile integration and AI-driven analytics, will further bolster the system's effectiveness and usability, ensuring continued growth and efficiency in the EV ecosystem. The EV Management System offers an efficient, userfriendly platform that addresses the growing demand for electric vehicle (EV) charging infrastructure. By providing seamless registration, secure login, and real-time access to nearby EV centers, the system empowers users to easily find and book charging slots. Additionally, it enables EV center operators to manage their facilities, track bookings, and update slot statuses to ensure smooth operations. For administrators, the system provides comprehensive tools for managing EV centers, overseeing user data, and generating reports for better decision-making. The integration of secure payment processing further enhances the user experience by allowing users to make dummy payments, ensuring that the system is equipped to handle both real-time transactions and backend management efficiently. Ultimately, the EV Management System streamlines the entire process of EV charging, benefiting all stakeholders- users, operators, and administrators-while promoting the growth and infrastructure. With accessibility of EV its secure authentication, real-time updates, and robust management capabilities, the platform positions itself as a vital tool in the ongoing transition to sustainable and efficient transportation.

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