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EV CHARGING STATION MANAGEMENT SYSTEM USING AI CHATBOT SUPPORT: A REVIEW

Prof. Vandana P. Tonde[*1], Ankit Patle[*2], Paras Batra[*3], Saisagar Ambekar[*4], Mangesh Lakade[*5]

[*1,2,3,4,5]Department Of Information Technology, Sinhgad Institute Of Technology, Lonavala, Pune, Maharashtra (MH), India.

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ABSTRACT

The shift towards Electric Vehicles (EVs) is driven by the urgent need to address environmental concerns and reduce our reliance on fossil fuels. Our project, a comprehensive Electric Vehicle Station Management System (EVSMS), aims to contribute to this transition. This survey explores the design and implementation of our EVSMS, highlighting its role in promoting the adoption of EVs over traditional fuel-powered vehicles. Our EVSMS offers features such as user registration, owner dashboards, and an admin panel, making it user-friendly for both EV owners and station operators. Through integration with the Google Maps API, users can easily locate nearby charging stations, but what makes our system stand out is its real-time station occupancy information. This feature not only aids users in finding available charging slots but also prompts them to consider alternative stations when their preferred choices are occupied. In addition to enhancing convenience, our system supports slot booking with initial payment, streamlining the charging process. Furthermore, it keeps users informed through notifications about station availability and promotions, reinforcing the advantages of EV usage. Our project emphasizes the significance of EVs as a sustainable alternative to traditional fuel powered vehicles. By offering a user-friendly, technologically advanced EVSMS, we contribute to the broader goal of reducing carbon emissions and mitigating environmental impact, thereby making EVs a more attractive choice. This survey provides insights into our system's design and its alignment with the global transition towards sustainable, eco-friendly mobility.

Keywords: Electric Vehicles (Evs), Electric Vehicle Station Management System (EVSMS), Slot Booking, Map, Chatbot.

I. INTRODUCTION

In recent years, global warming and the depletion of fossil fuels due to mass consumption of energy resource has become an increasingly recognized world problem[1]. To control these problems, the installation of renewable energy systems, which do not depend on fossil fuels, is an effective countermeasure. In Japan, since the government has introduced Feed-in tariffs(Fit), the introduction of photovoltaic systems has been expanded rapidly[2]. However, the output power from increased number of photovoltaic systems is extremely large and tends to have a bad effect on the system frequency and distribution voltage. To address this problem, the Japanese government has begun reconsidering the Fit system. Adding to this problem, the cost of PV installation is decreasing year by year. Therefore, in the future, the price of PV power is expected to decrease greatly. In this study, EV charging stations that near-exclusively purchases power from PV systems on smart houses and sells power to electric vehicles (EV) and smart houses is proposed as an aggregator. The EV charging station has the need to utilize a fixed battery for electricity trading[5].

- As we know EV Automobiles going to be future of the world but these machines need charging stations for charging.
- In this project work, system will provide the platform to book charging slots to available charging station according to need of customer.
- In this system user will get facilities like AI chatbot to book station via vocal commands, Maps features for direction sensing, Digital payment option, Notifications, Mails and SMS of each activity.

II. LITERATURE SURVEY

The Smart Electric Vehicle Charging Management system for smart cities focuses on enhancing efficiency in slot allocation through the implementation of a [1]Scheduling Algorithm. The primary metrics used for optimization

are Output Power and Price/kWh. The system operates through a centralized server and aims to minimize waiting times, optimize charging allocations, and ultimately improve satisfaction for electric vehicle (EV) users. Referred to as the SecCharge system, it efficiently coordinates with Centralized Service Operators (CSOs) to facilitate charging services for EV drivers, contributing to the overall advancement of smart city infrastructure.

The design and development of the CHATBOT involve the implementation of a [2] rule-based and natural language processing (NLP) algorithm with a primary improvement goal of enhancing the chatbot's design. The metric used for evaluation is intent-based variants, measuring the chatbot's ability to accurately understand and respond to user intentions. The topology is focused on creating an effective conversational flow. The assessment method involves testing the chatbot by engaging in conversations as a human, ensuring its conversational abilities meet the desired standards. The intended usage spans across organizations, customer service, and various industries, showcasing the chatbot's versatility and applicability in diverse settings.

In the context of optimizing the shortest route search for dynamic locations, the chosen algorithm is [3] Bellman Ford, with the primary focus on minimizing memory usage while maintaining optimality in the route calculations. The dynamic location aspect involves a combination of node variations. The evaluation criteria include memory usage, optimality, and topology. The assessment method involves a comparative analysis with other algorithms such as Dijkstra, A*, and Ant Colony, considering their effectiveness in the context of dynamic location and geographic information. This optimization effort aims to enhance the efficiency of online transportation services and geographic information systems by providing a more resource-efficient and optimal solution for route planning in dynamic environments.

III. RESULTS AND DISCUSSION

The development and implementation of the EV Charging Station Management System, enhanced with ChatBot support, have led to significant improvements in managing EV charging operations. This system addresses key challenges faced by users and station operators, focusing on user experience, efficiency, and real-time support.

1. Real-Time Station Availability and Booking

The system provides up-to-date information about charging station availability, including station locations, charging point availability, and current station status. Users can book charging slots in advance, reducing wait times and enhancing convenience. The ChatBot assists by guiding users to available charging points based on their preferences, like fast-charging options. This booking and availability-checking process improves user satisfaction and reduces station congestion.

2. ChatBot Support for User Assistance

The ChatBot is trained to handle common user questions and troubleshooting needs. It provides directions to the nearest stations, charging station hours, and information on compatible EV models. For more complex queries, the ChatBot can escalate cases to human support, ensuring users receive the help they need efficiently. This feature enhances the user experience by providing quick and intuitive responses.

3. Load Management and Optimization

The system includes a load management feature that balances demand across available stations, especially during peak times. By analyzing historical usage patterns, it optimizes energy distribution and reduces peak loads, helping to lower operational costs and ensure uninterrupted service.

4. Performance and Efficiency

The system's real-time data analysis and predictive features enable efficient charging station operations. The ChatBot reduces manual support requests, freeing up resources, while advanced booking and load balancing minimize idle time. Together, these functionalities enhance energy usage, reduce wait times, and provide a smooth user experience.

Discussion

Performance benchmarks indicate that the EV Charging Station Management System greatly enhances efficiency in managing EV stations. The combination of real-time data, load balancing, and ChatBot support reduces operational downtime and improves response times. The ChatBot's ability to offer intuitive, personalized assistance and the optimized load management both contribute to lower energy consumption and

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operating costs. This system demonstrates how technology can improve functionality and the user experience in EV charging infrastructure.

IV. SYSTEM ARCHITECTURE

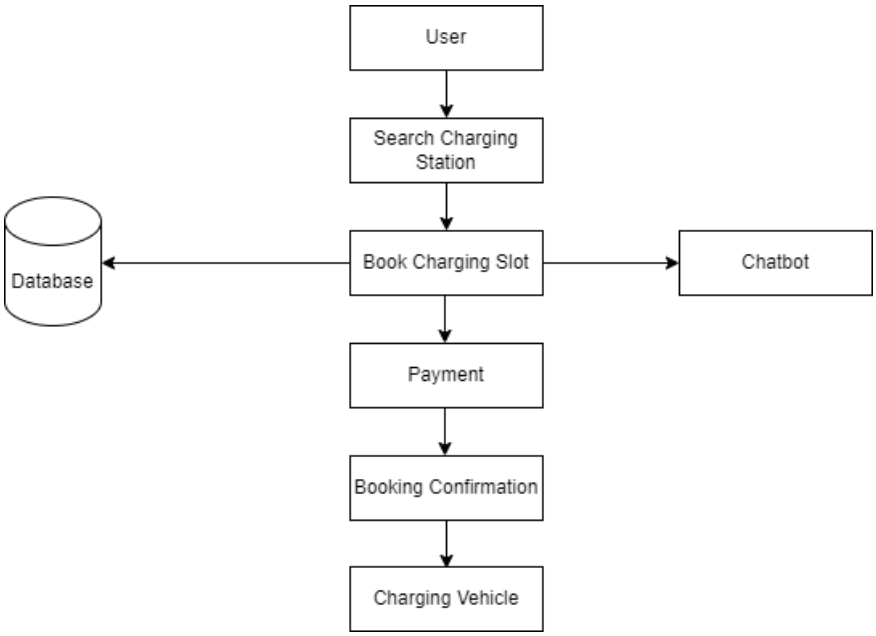

Figure 1: Block Diagram Of EV Management System

V. GAP ANALYSIS

The current EV charging station management system lacks an integrated combination of a shortest path algorithm and a chatbot, creating a notable gap in functionality. The absence of a shortest path algorithm limits the system's ability to optimize route planning for electric vehicle users seeking the nearest available charging station efficiently. Moreover, the lack of a chatbot diminishes the user experience by missing a conversational interface. By incorporating a shortest path algorithm, the system can enhance navigation, ensuring users can easily find and reach the closest charging station. Introducing a chatbot adds an interactive layer, allowing users to inquire about real-time charging station availability, receive personalized recommendations, and engage in natural language conversations for a more user-friendly experience. Integrating these technologies addresses the existing gaps, creating a more comprehensive and efficient EV charging station management system that caters to user preferences and provides a seamless interaction platform.

VI. CONCLUSION

In this study, we have introduced a web-based platform to address the challenge of long waiting times for Electric Vehicles (EVs) at charging stations through a pre-reservation system. Our approach was informed by an extensive literature review, a comparative analysis of the most widely used EV charging applications in the Indian market, and a detailed examination of customer feedback.

This research unveiled several common shortcomings in existing EV charging platforms, such as intricate and perplexing user interfaces, a lack of real-time information on charging port availability, the inability to check the operational status of charging ports, limited payment options, and a deficiency of user reviews. Our primary goal was to develop an intuitive, user-friendly website that caters to the needs of EV owners, with a focus on resolving these common reservation-related challenges. Our platform has been designed to be flexible, allowing for timely updates to ensure a smooth user experience. Drawing from user feedback, we are committed to addressing identified issues effectively.

The development of a web-based EV charging station network platform can take various directions, but it is essential to include the right features and functionalities to meet user expectations. Furthermore, we foresee improving our website by introducing new features that offer valuable recommendations to EV users, assisting them in making informed decisions when reserving slots at charging stations based on comprehensive and current information.

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