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EV Charging Stations Management System using AI Chatbot

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Abstract: *The rapid adoption of electric vehicles (EVs) has led to a growing demand for efficient EV charging station management around the world. Operated by Natural Language Processing (NLP) and Artificial Intelligence (AI), chatbots have been developed as valuable tools to improve the user experience and operational efficiency of EV charging stations. In this article, we examine existing research on chatbot integration in EV charging stations and explore the applications, benefits and challenges. Identify key areas of chatbot applications, including user support, operational monitoring, and secure payments, highlighting challenges such as integration complexity and concerns about data protection models. Future research instructions are discussed to improve these gaps and further improve EV station management.*

Along with the building of charging stations, automakers like as TATA have introduced new electric vehicles to the market. However, when the stations are fully utilized, delays may occur due to the current charging duration, which ranges from 15 to 30 minutes. To address these issues, our proposal calls for connecting all EV charging stations into a single network. Users can locate and select their preferred station with ease, which ultimately saves time and is particularly helpful when driving electric cars long distances. Users can reserve slots when they become available; if not, the system asks them to select a different time. A portion of the amount must be paid for the online booking confirmation. Additionally, our system provides charging stations with a management interface to govern reserved and open slots and displays the fastest route to the selected station. Our web-based application senses direction using the Google Maps API and time-slot allocation algorithms. An online payment gateway expedites transactions, and our chatbot technology allows voice commands to be utilized to control the program. Customers can save a great deal of time by using our technology to locate and reserve appropriate charging stations.

Keywords: Management system, Charging slot, EV Cars, GMap

I. INTRODUCTION

Both the use of fossil fuels and global warming have increased in recent years. The two pressing worldwide problems of global warming and the depletion of fossil fuels due to careless energy use. Installing fossil fuel-free renewable energy systems is necessary to address these problems. Japan's uptake of solar installations has accelerated due to the government's Feed-in Tariffs (Fit) scheme. However, the increasing output from these devices has had a detrimental effect on the system frequency and voltage distribution. As a result, the Fit system is currently being reassessed by the Japanese government. Furthermore, the cost of installing solar systems is falling yearly, pointing to a future with even reduced PV electricity costs. In order to receive power from PV systems in smart houses and transfer it to EVs and smart homes, this study suggests using EV charging stations as energy aggregators. These charging stations need fixed batteries in order to interchange electricity.

The goal of this project is to give customers a platform that allows them to plan charging times at available charging stations based on their requirements. The system has a number of features, such as an AI chatbot, digital payment alternatives, mapping capabilities for direction sensing, and alerts for every activity. A range of charging infrastructure types, each suited to certain places and needs, can be used to recharge electric vehicles. This chapter emphasizes technical details and EV charger standards to emphasize the importance of considering local design and execution for EV charging networks.

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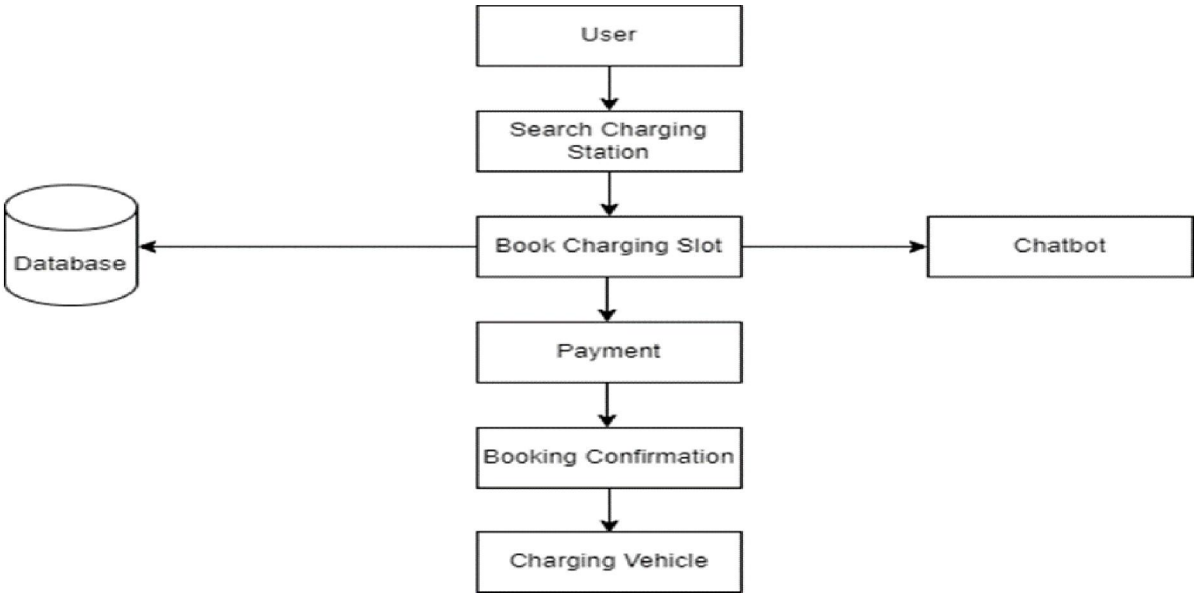
II. LITERATURE REVIEW

This paper [1] proposes the use of a coreless axial flux permanent magnet machine, which has the attributes of low stator mass, negligible core loss and virtually zero cogging torque, as the propulsion motor. As small-sized[2] superconducting magnetic energy storage (SMES) system is commercially available at present, the function and effect of a small-sized SMES in an EV charging station including photovoltaic (PV) generation system is studied in this paper, which provides a practical application of small-sized SMES. The comparison of three quick response energy storage systems including flywheel, capacitor (super-capacitor) and SMES is also presented to clarify the features of SMES. Having a network[3] of fast charging stations seems necessary in order to make EVs more attractive and to achieve larger uptake of them. Currently, 50 kW quick chargers that can charge a typical EV in about an hour are commercially available. However, a 240 kW fast charging level which can charge a typical EV in 10 minutes has been introduced in standards. Electric vehicles (EVs)[4] are being introduced by different manufacturers as an environment-friendly alternative to vehicles with internal combustion engines, with several benefits. The number of EVs is expected to grow rapidly in the coming years. However, uncoordinated charging of these vehicles can put a severe stress on the power grid. The problem of charge scheduling of EVs is an important and challenging problem and has seen significant research activity in the last few years. In order to interface one PV port[5], one bidirectional battery port and one load port of PV-Battery DC power system, a novel non-isolated three-port DC/DC converter named Boost Bidirectional Buck Converter (B3C) and its control method based on three domain control are proposed in this paper.

III. PROPOSED SYSTEM



System Architecture

1. User

The end user is usually the EV owner who wants to charge the vehicle. Interact with your system through interfaces such as mobile apps and web applications to find charging stations and book and manage payments. Filters can be used based on criteria such as location, charging speed, compatibility (such as plug-in types), and slot availability. The extension can include suggestions based on the instructions for the selected station or the user's previous selection options or settings. This module is based on data in the database to display current availability information.

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2. Search Charging Station

This module allows users to search for available charging stations nearby. Filters can be used based on criteria such as location, charging speed, compatibility (such as plug-in types), and slot availability. The extension can include suggestions based on the instructions for the selected station or the user's previous selection options or settings. This module is based on data in the database to display current availability information.

3. Database

The database is at the heart of the system and stores all the data needed for the EV charging management process. Enable real-time updates of slot availability and reservation status when users interact with the system.

4. Book charging slot

This module allows users to select and reserve a charging slot at the desired station. The reservation process checks the availability of slots in real time and reserves slots for selected times. If the slot is successfully reserved, the system is reserved to reserve the system. Reservation slot, date and time.

5. Chatbot

Chatbots act as virtual assistants that allow users to navigate the system. There are general questions and you can book slots and provide instructions to provide support when paying for payment or account-related issues. For example, users can "find the next available charging station" and chatbots can guide the search and booking process. Chatbots can handle daily inquiries. This reduces the need for human support.

6. Payment

After selecting and booking slots, the user continues to the payment level. This component manages secure transactions and integrates into payment gateways for various payment options such as credit/debit cards, mobile wallets, and UPIs. Payment systems can include security features such as encryption and multi-factor authentication to protect sensitive data. Payment data will also be stored in the database for future references and records.

7. Booking Confirmation

After a successful payment, the system will send a confirmation message or notification to the user to confirm the booking. The confirmation message typically includes essential details like the booking ID, date and time of the slot, station location, and booking code for verification at the station. This confirmation ensures that the user has proof of their reservation and can verify their slot at the charging station if needed.

8. Charging Vehicle

This is the final step, where the user physically arrives at the selected charging station and charges the vehicle during the time slot. At the station, users may need to confirm their reservations by scanning QRs or booking reservation IDs on the charging unit. Some systems may automate the charging process by allowing stations to recognize the vehicle based on booking details and providing a seamless experience for the user. After completing the store, the system can record session details (such as charging period and energy consumption) in the database for future billing or analysis.

IV. LIMITATIONS OF EXISTING SYSTEM

- **High Infrastructure Cost:** Establishing an AI control station requires investment in cloud and IoT integration.
- **Integration with Grid:** Increased EV adoption allows for extended power grids.
- **User Recruitment and Trust:** Some users may prefer human interactions to chatbots.
- **Cybersecurity Risks:** Concerns regarding payments and user data payments.

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V. FUTURE SCOPE

The proposed AI-driven EV charging station management system includes the following features:

Core Features:-

1. **AI Chatbot for User Assistance** – Provides real-time support for booking, payment, and troubleshooting.
2. **Slot Reservation System** – Users can pre-book charging slots, reducing waiting times.
3. **Smart Navigation Integration** – Uses Google Maps API to direct users to the nearest available station.
4. **Secure Payment Gateway** – Supports digital payments, including UPI, credit cards, and blockchain transactions.
5. **Real-time Station Availability** – Displays up-to-date charging slot status.

VI. CONCLUSION

Using a hybrid approach to developing web applications, we created a "smart management of EV charging stations" system. The ability to book a charging slot according to the special type of charging stake the vehicle needs is one of the system's main features. The system includes an AI chatbot that can answer questions and provide support to improve user interaction and support. This chatbot accelerates the process of accessing the charging station and ensures a perfect user experience. The system also uses the GMAPS API to enable accurate sense of direction. This feature improves efficiency and comfort by encouraging users to explore and find their next charging station. In summary, web application technology is integrated into the "Smart Management of EV Charging Stations" system. GMAPS - Uses API in an effective orientation, provides a AI chatbot to answer questions, allowing for reservation of charging space according to the load socket. The overall user experience is improved and EV charging station management is simplified with this comprehensive system.

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