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EV Charging Stations Management System using AI Chatbot

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Abstract: *To mitigate global warming and energy shortages, the integration of renewable energy sources, energy storage systems, and plug-in electric vehicles (PEVs) has been introduced. Electric vehicles (EVs), as part of the smart grid, offer a viable option to reduce carbon emissions. The pressing need to address environmental concerns and lessen our reliance on fossil fuels is driving the transition to Electric Vehicles (EVs). Our project, a comprehensive Electric Vehicle Station Management System (EVSMS), aims to help with this transition. This survey delves into the design and execution of our EVSMS, emphasizing its importance in encouraging the adoption of EVs over traditional fuel-powered vehicles. Our EVSMS includes user registration, owner dashboards, and an admin panel, making it convenient for both EV owners and station operators. Users can quickly identify local charging stations thanks to connection with the Google Maps API, but what sets our system apart is real-time station occupancy data. This functionality not only helps customers identify available charging spots, but it also encourages them to investigate alternate stations when their favored ones are full. In addition to increasing ease, our technology allows for slot booking with an initial payment, which streamlines the charging procedure. Furthermore, it keeps users updated about station availability and promotions, emphasizing the benefits of EV use. Our research underlines the importance of electric vehicles (EVs) as a sustainable alternative to traditional fuel-powered cars. By providing a user-friendly, technologically advanced EVSMS, we contribute to the larger goal of lowering carbon emissions and minimizing environmental impact, making EVs a more appealing option. This poll gives information about our system's design and alignment with the global shift to sustainable, environmentally friendly mobility.*

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

I. INTRODUCTION

We are developing a system in which we going to connect all the electric car charging stations together. By using our system user can find the station according to their choice and it will be useful for those who want to travel for long distance with their EV cars and it will be time saving. It will be very easy to use. If the given time slot is available then your place for the given slot will be booked. Our system will also provide shortest map route to reach at given station. Our system will also provide interface for charging stations to view all available slots as well as booked slot lists and manage slot timing. We are going to develop this system for web based devices. To develop this system, we are going to use time-slot allocation techniques as well as Google maps API for direction sensing. 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.

The development of a centralized web-based system for EV charging stations bulletproofs the entire electric vehicle (EV) recharging process, making it more user friendly and time efficient. Increased adoption of EVs requires infrastructure that can accommodate long-distance travel without substantial delays as a result of charging station capacity.It will be an integrated solution across multiple stations that offers the user a hardware and digital platform to find charging options based on certain likes (from proximity, price or even specific amenities). They will also have the option to see real-time availability of charging slots and pre-book time slots. This in shortens your waiting time, and gets you to where are trying to go quicker reducing the stress on those longer distance travellers who need a little bit more foresight when planning there recharge stops.Perhaps a more important element of the system, however, is its use with Google Maps API -- not only does this allow users to receive exact directions to their destination station but also provides them with a recommended route that will take the least time and effort. Through real-time navigation on the platform, users will never take leave timely and escape traffic jam or detour to ensure a seamless travel.

II. LITERATURE SURVEY

Author name :Edward Kozłowski, Piotr Wi´ sniowski and AnnaBorucka

The study used data from mileage measurements of the electric vehicle (EV) driving on a motorway and in built-up areas. The results obtained showed a strong correlation between acceleration, vehicle speed, battery power, and energy consumption. In urban conditions, engine RPM and vehicle speed had an additional impact on energy consumption. Findings from this study can be used to optimize vehicle acceleration control modules to increase their range, develop eco-driving styles for EV drivers, and better understand the energy efficiency factors of EVs.

Author name :Hoach The Nguyen Khalifa Al Hosani Jamal YousufAlsawalhi , AmeenaSaad Al Sumaiti , Khaled Al Jaafari , Young-JiByon and Mohamed Shawky El Moursi .

The novelty originates from a simple predictive control structure in an abc-natural frame without adding any decoupled or separated current-component controllers. Comparative studies on both Matlab/Simulink plat form and OPAL-RT-based real-time system among proportional integral (PI) control, finite predictive control, and the proposed method are conducted to verify the efficacy of the proposed structure. The comparative results show that the control structure improves the control performance and significantly enhances the support for the local loads under unbalanced, harmonic distorted grid conditions.

Author name :Valeh Moghaddam1, Amirmehdi Yazdani2, Hai Wang3, David Parlevliet, Farhad Shahnia.

In the proposed solution, the utility provides incentives to the charging stations for their contributions in the EVs charging load shifting. Then, a constraint optimization problem is developed to minimize the total charging demand of the EVs during peak hours. To control the EVs charging demands in supporting utility's stability and increasing the total revenue of the charging stations, treated as a multi-agent framework, an online reinforcement learning model is developed which is based on the combination of an adaptive heuristic critic and recursive least square algorithm.

Author name :JaehyunLee, Eunjung Lee and Jinho Kim

The proposed method utilizes kernel density estimation, particularly the nonparametric density function estimation method, to model the usage pattern of a specific charger at a specific location. Subsequently, the estimated density function is used to sample variables related to charger usage pattern so that the variables can be cast in the training process of a reinforcement learning agent. This ensures that the agent optimally learns the characteristics of the target charger. We analyzed the e ectiveness of the proposed algorithm from two perspectives, i.e., charging cost and load shifting e ect. Simulation results show that the proposed method outperforms the benchmarks that simply model usage pattern through general assumptions in terms of charging cost and load shifting ect.

Author name :Shuoyao Wang , Suzhi Bi , and Yingjun Angela Zhang

This article proposes a reinforcement-learning (RL) approach for optimizing charging scheduling and pricing strategies that maximize the system objective of a public electric vehicle (EV) charging station. The proposed algorithm is "online" in the sense that the charging and pricing decisions made at each time depend only on the observation of past events, and is "model-free" in the sense that the algorithm does not rely on any assumed stochastic models of uncertain events. To cope with the challenge arising from the time-varying continuous state and action spaces in the RL problem, we first show that it suffices to optimize the total charging rates to ful f ill the charging requests before departure times. Then, we propose a feature-based linear function approximator for the state–value function to further enhance the efficiency and generalization ability of the proposed algorithm.

Gap Analysis

Although various techniques exist for managing EV charging, several key gaps are identified:

- Uncertainty Handling: Limited attention is paid to handling uncertainties in EV behavior, renewable sources, and human-driven interactions.
- Scalability: Centralized algorithms lack scalability in large-scale systems.
- Adaptability: Traditional optimization models are inflexible in dynamic environments.
- Data-Driven Coordination: Many reviews overlook learning-based coordination strategies such as RL.
- Model Reusability: ML models often lack generalizability across different geographic regions due to dataset-specific training.

III. OBJECTIVE

The main purpose of the EV charging station management system is to create a user-friendly platform optimized for electric vehicle (EV) owners (EV vehicles). The system aims to provide a slot reservation function that allows users to reserve charging slits for convenience. It provides a simple, adaptive surface that can be accessed to any type of user, regardless of technical expertise. Additionally, the system connects several charging stations and consolidates them into a single platform, simplifying management and access. Users can view the next available station and make real-time calls via integrated cards to efficiently achieve stations. The system also includes a feedback mechanism to easily reserve and load EVs by simplifying the car owner's process, while simultaneously allowing users to evaluate and grant insights about charging experiences at various stations. These goals aim to improve the general user experience and optimize the use of charging stations.

IV. PROPOSED SYSTEMS

1 Dijkstra Shortest Path Algorithm

The Dijkstra algorithm is a wide range of graph traversal and path search algorithms, finding the shortest path between the two nodes in the diagram. Designed in 1956 by computer scientist Edsgar W. Dijkstra, it is used in a variety of applications, including computer networks, robotics, and geographical information systems.

Objective: The main goal of Dijkstra's algorithm is to find the shortest path from the source node to all the other nodes in the diagram.

Data Structures: The algorithm contains two main data structures. Priority queue (or min -HEAP) for tracking nodes with the priority distance estimate and array (or another data structure) to store the calculated distances.

Time Complexity: The time complexity of Dijkstra's algorithm is generally $O(V^2)$ using an adjacency matrix and $O((V + E) * \log V)$ using an adjacency list, where V is the number of nodes and E is the number of edges.

Actual Working in Project:

Input:

A graph (G) where nodes represent charging stations and edges represent road distances or travel time.

Source (S): Current location of the EV.

Destination (D): Desired destination (optional, if the goal is to find a charging station en route).

Output:

The shortest path from the source to the most optimal charging station.

Steps:

Initialize:

Set the distance of all nodes to infinity (∞), except the source node (S), which is set to 0.

Create a priority queue (PQ) to store nodes based on their shortest known distance.

Insert (S, 0) into the priority queue.

Process Nodes:

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While PQ is not empty:Extract the node (U) with the smallest distance from PQ.
If U is a charging station, store the path and break (if finding the nearest station).
For each neighbor (V) of U:Compute new_distance = distance(U) + edge_weight(U, V).
If new_distance < distance(V), update distance(V).
Push (V, new_distance) into PQ.
Result Generation:
If a charging station is found, return the shortest path and estimated charging wait time (if applicable).
If no station is reachable, suggest alternatives (e.g., reroute to another area).

V. SYSTEM REQUIREMENTS

Database Requirements
MySQL Database
Software Requirements
Operating System - Windows
Application Server - Apache Tomcat
Front End - HTML, Bootstarp,CSS
Language - Java
Database - My SQL
IDE - Eclipse
Hardware Requirements
Processor - Intel i3/i5/i7
Speed - 3.1 GHz
RAM - 4 GB(min)
Hard Disk - 20 GB

VI. RESULTS/OUTPUT/SCREENSHOTS

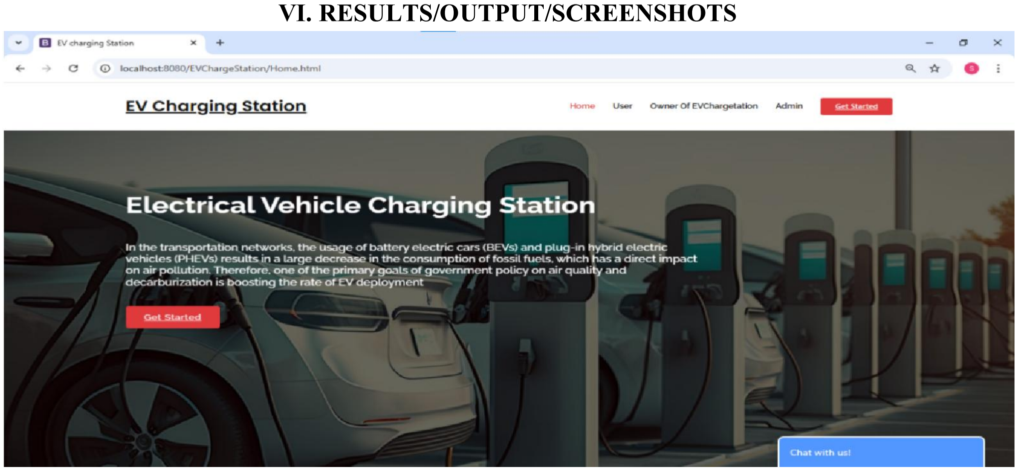

Fig.1. The Front (Starting) Page

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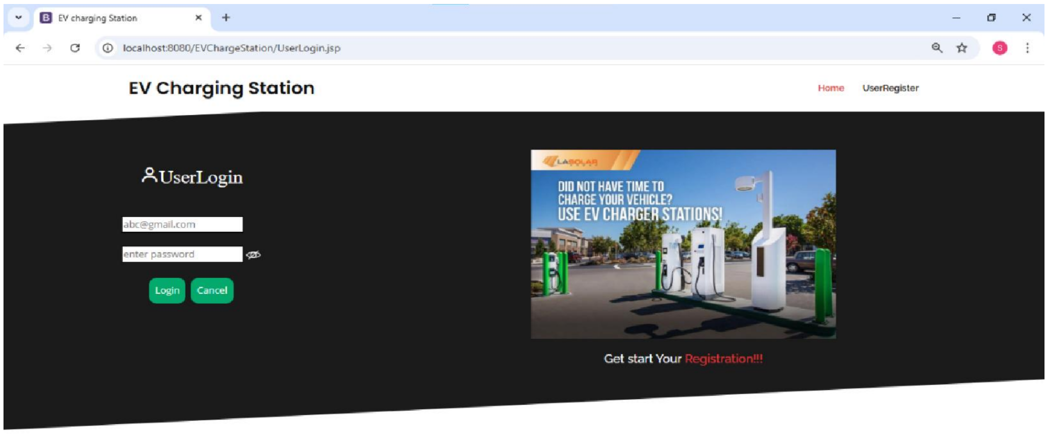

Fig.2 . User Login Page

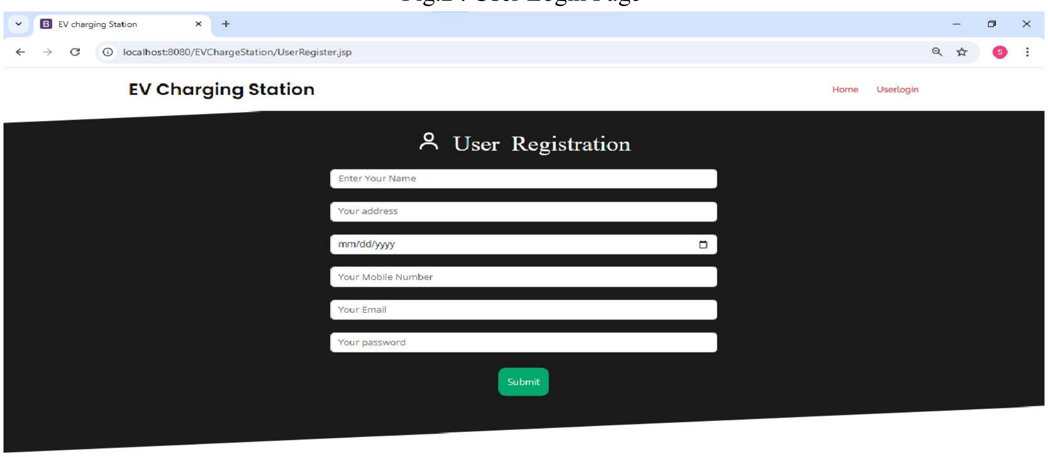

Fig.3. New Registration Form.

Fig.4.The EV Station Owner Login Page

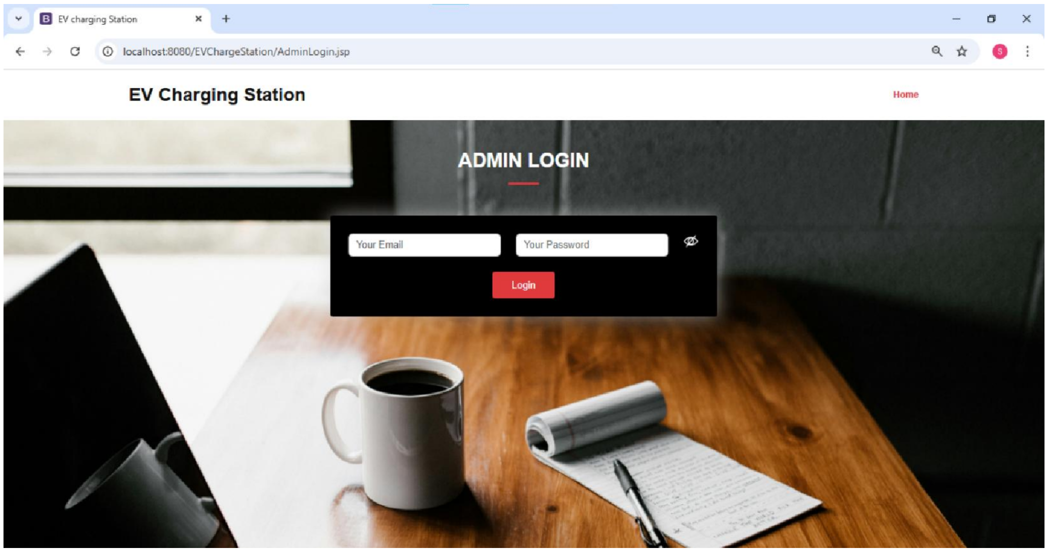

Fig.5.Admin Login Page

VII. CONCLUSION

This study presented a web-based platform to address the long latency challenges of electric vehicles (EVs) at charging stations via pre-saving systems. Our approach was influenced by a comprehensive literature overview, a comparative analysis of the most frequently used EV charging applications in the Indian market, and a detailed investigation of customer feedback. Our main goal was to develop an intuitive and user-friendly website that met the requirements of EV owners. Our platform is designed to allow timely updates to ensure a flexible and smooth user experience. Calls from user feedback are obligated to effectively resolve identified issues.

The development of a web-based EV charging station network platform can be applied in a variety of directions. However, it is important to include the correct features and features to meet user expectations. Additionally, we anticipate improvements to our website by introducing new features that provide valuable recommendations for EV users and making decisions that have been well discovered when booking slots at charging stations based on comprehensive and current information.

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