



e-ISSN:2582-7219



INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

Volume 7, Issue 7, July 2024



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.521



6381 907 438



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EV Station Search and Slot Booking

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ABSTRACT: The Main strategy for developing a sustainable Transportation system which involves electric vehicles (EVs). However, there are numerous difficulties connected with adopting electric vehicles. Usually, customers face a lot of issues like extended charging times and limited information on the availability of EV supply stations while using an EV, which makes it difficult for them to accept the new technology. To tackle this kind of issue, integrating ICT-based solutions will help deal with the great consequences of EV drivers. This paper is about a web application that has been proposed for EV drivers to understand the technology and make their lives better. The web application enables EV drivers to book a charging spot based on their preference and the availability of EVSS. The test findings will support the importance of charging reservation advances to reduce EV driver's anxiety issue.

KEYWORDS: Electric vehicles (EVs), ICT-based solutions, EV charging infrastructure

I.INTRODUCTION

By adopting electric vehicles (EVs) into sustainable Transportation systems is important for reducing greenhouse gas emissions and promoting clean air in urban areas. The white-spread adoption of EVs has the potential to significantly reduce the environmental impact of transportation, which is currently one of the largest contributors to Greenhouse gas emissions globally. However, the adoption of EVs faces several challenges that makes it difficult in acceptance. One of the primary concerns of EV drivers is the available and accessibility of charging infrastructure. There is a very less number of charging station and the time it takes to fully charge and EV can lead to anxiety, making it difficult for drivers to plan their trips and ensure that they will have a sufficient charge to reach their destinations.

Another significant challenge is the information of charging station availability. EV drivers often struggle to find charging stations near their locations, which may result in anything related to frustration and inconvenience. This lack of transparency and visibility can also make it difficult for EV drivers to plan the trips and ensure they have access to charging stations when needed. Furthermore, the Limited information of charging station availability can also lead to a trust issue among EV drivers, making to adopt to EVs as their primary mode of transportation.

To solve or overcomes such challenges, the integration of ICT based solutions is essential for supporting EV drivers with information on charging station availability, insurance them to plan their trips more effectively, and reduce anxiety. Additionally, ICT base solutions can also provide EV drivers with information on the location and availability of charging stations, facilitating their ability to connect with find charging stations near their locations.

One such ICT based solution is the internet-based program developed within the EV project. This web application enables EV drivers to book charging slots based on their preference as well as the present situation of EV support station availability.

The web application is designed to support the IOE semantic architecture, which enables continuous communication between different systems and devices. This allows the application to integrate with various charging stations and provide EV drivers with a comprehensive view of charging station availability. The application also enables EV drivers to book charging slots beforehand, which might lessen tension and make it simpler for them to plan the day.

The test findings of the web application highlight the importance of changing the reservation system to reduce EV drivers anxiety issues. The test results show that the application significantly reduces anxiety among EV drivers, making it simpler for them to plan their work and ensure they have sufficient charge to reach their destination and fully film their



work. Additionally, The test findings also demonstrate that the application improves the overall user experience for EV drivers, facilitating their ability to find charging stations and book charging slots.

Once the acceptance of this technology is projected over the human environment, The enlargement of new technologies can be welcomed into our lives. The EV drivers will be allowed to book a slot by this application. Most importantly, there will be interaction between the owners of the charging stations and the EV drivers to reserve a time window. Where, the driver requests the slot and the owners confirm it by accepting the request and allotting of lot number do the driver.

There is a payment method involved in this web application which helps the charging station owners and the EV drivers to keep a track on the payments. This even helps so EV drivers to know the amount of money they are investing in charging, which may be controlled.

II. RELATED WORK

Vinod Kumar et al. [1] This Flutter-based EV charging station finder app allows users to locate nearby charging stations, view details like connector types, availability, and pricing, and filter preferences. Users may also report problems with stations. User testing confirmed the app's simplicity of use and accuracy, improving charging station accessibility and enhancing the EV ownership experience.

U.R. Patole et al. [2] Electric vehicles (EVs) are a sustainable alternative to traditional vehicles. However, the limited availability of charging stations remains a challenge. An intelligent system can automate the procedure of finding and booking charging slots, reducing wait times and improving efficiency for EV drivers.

Er. Ashwini Deokate et al. [3] The electric vehicle (EV) charging app provides a comprehensive solution for EV owners. It helps users locate charging stations, book charging slots, and manage their charging needs. The app features an AI chatbot for customer support and an SOS button for emergencies. Additionally, the app assists station administrators in managing their facilities, improving service efficiency and customer satisfaction.

Rahul George et al. [4] As fossil fuel shortages drive a shift to sustainable energy, EVs (electric vehicles) are rising in popularity. The proposed system displays the EV battery's state of charge and nearby charging stations, allowing drivers to book slots through a linked website. With increasing EV usage, an efficient slot booking system is essential to meet growing charging demands.

Dr. S. Nagarajan et al. [5] The electrification of transportation is crucial for reducing carbon emissions. As vehicles that run on electricity (EVs) become more prevalent, there is a growing need for recharging electric vehicle stations. Implementing AI-based systems can optimize charging slot allocation and improve user experience. By employing a round-robin scheduling algorithm and the KNN algorithm for locating nearby charging stations, this system aims to minimize waiting periods and enhance convenience for owners of EVs.

Syed Muhammad Danish et al. [6] Intelligent Transportation Systems (ITS) enable the integration of smart grids, electric vehicles (EVs), and vehicular communication technologies, but raise privacy and security concerns. BlockEV proposes a blockchain-based protocol for secure and private selection concerning EV charging stations using smart contracts, ensuring efficient charging without compromising user privacy.

Prerana Ravindra Chaudhari et al. [7] The Charging Station for Electric Vehicles Slot Booking System provides a centralized platform for EV drivers to find available charging stations, check slot availability, and schedule charging sessions conveniently. The system offers real-time updates on station availability, optimizing usage and reducing wait times. By enabling efficient and eco-friendly electric vehicle charging, the initiative supports sustainable urban mobility and strengthens the overall user experience.

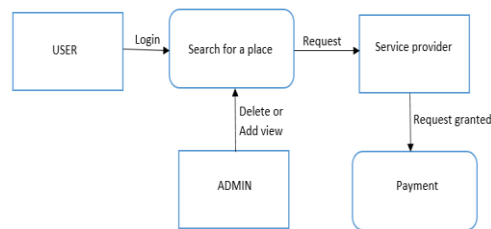
Radhika P. Deshmukh et al. [8] This Java-based EV charging station locator app uses Google Maps API to pinpoint nearby stations, providing details like connector types, availability, and pricing. Users can customize searches and report issues, ensuring accurate information to enhance EV ownership by improving charging station availability.



Joseph K. Liu et al. [9] This paper introduces a privacy-preserving Reservation system for charging facilities for electric vehicles. The platform enables users to securely reserve stations along their route while limiting reservations to prevent misuse and protect user location privacy. The authors demonstrate a practical prototype and provide security proof.

SURESH CHAVHAN et al. [10] This paper proposes an EV2X structure for charging electric vehicles that optimizes communication algorithms and prioritizes charge slot booking to enhance efficiency and reduce wait times, validated through simulations.

III.METHODOLOGY



A. User Registration and Profile

Users can register in the program by use of a straightforward form with spaces for their password, phone number, email address, and name. Also, they can register by utilizing their current social network accounts. accounts like Facebook, Google, or Apple.

During registration, users are prompted to enter details about their electric vehicle, such as make, model, battery capacity, and charging port type. This information is used to personalize their search results and provide compatibility information.

The user profile page permits them to update their contact details, vehicle information, and payment methods. Users can add multiple payment options, including credit/debit cards, digital wallets, and mobile payment apps. They can also set a default payment method for faster checkout.

B. Charging Station Search

The app's home screen features a noticeable search bar that allows users to enter their current location or destination. The app uses the device's GPS to detect the user's location if permitted. Users can also search by city, state, or zip code.

The search results page displays an inventory of nearby charging stations, with key details like address, number of charging ports, connector types, pricing, and average user ratings. Each station is color-coded based on availability - green for open slots, yellow for limited availability, and red for fully booked.

Users can filter the search results by various criteria, such as:

1. Charging speed (Level 1, Level 2, DC Fast Charging)
2. Connector types (J1772, CCS, CHAdeMO, Tesla)
3. Pricing (free, paid, subscription)
4. Amenities (covered parking, lighting, security cameras)
5. Ratings and reviews

Clicking on a station opens a detailed view with photos, hours of operation, pricing information, and real-time availability of charging slots. Users are able to view the quantity of slots are currently occupied and the number of free ones.

C. Charging Slot Booking

To book a charging slot, users select an available time slot from the detailed station view. The booking process includes:

1. Selecting the desired charging station and time slot
2. Confirming the vehicle details and charging requirements
3. Selecting a payment method from their profile
4. Reviewing and accepting the terms of service



5. Completing the transaction using the chosen payment method

Users receive a confirmation email and push notification with details like the station address, slot time, and a distinct reservation code. They can see their upcoming and past bookings in the "My Reservations" section of their profile.

The app automatically cancels a reservation if the user doesn't arrive within a 15-minute grace period. Users can also cancel or modify their bookings up to a certain time before the scheduled slot, subject to the station's cancellation policy.

D. Billing and History

The app tracks all charging sessions and displays the billing history in the user's profile. Each entry includes the date, time, location, energy consumed (in kWh), and the total cost. Users can filter their history by range of dates and export it as a CSV file for accounting purposes.

The billing page also shows the user's current balance and any outstanding payments. Users can make additional payments to their account balance using the integrated payment methods.

E. Notifications and Alerts

The app sends push notifications to users about upcoming reservations, low battery levels, and new charging stations in their area. Users can customize their notification preferences in the settings, such as:

1. Upcoming reservation reminders (1 hour, 30 minutes, 15 minutes before)
2. Low battery alerts (10%, 20%, 30% remaining)
3. New station openings within a specified radius
4. Reservation expiration warnings (5 minutes before slot ends)

The app also sends alerts if a user's reserved slot is about to expire or if there are any changes to their booking, like a station closure or pricing update.

F. Chatbot Support

An AI-powered chatbot is integrated into the app to provide real-time assistance and answer users' questions. The chatbot has a natural language interface and access to a knowledge base of FAQs and station information.

Users can ask the chatbot about topics such as:

1. How to use the app's features
2. Charging station details and amenities
3. Pricing and payment methods
4. Vehicle compatibility and charging requirements
5. Reservation policies and cancellation procedures

The chatbot uses machine learning algorithms to understand the user's intent and provide relevant responses. It can also escalate complex queries to human support staff if needed.

By incorporating these key functionalities, the EV charging station search and slot booking web application can provide a seamless and efficient experience enabling owners of electric vehicles to find, book, and pay for charging stations. The application should have an easy-to-use, clear interface that allows for simple navigation. encourage frequent usage.

IV.OUTCOME

Improved EV Driver Experience:

The proposed web application will provide EV drivers with a significantly more convenient and stress-free experience by allowing them to easily locate, reserve, and access charging stations according to their specific needs and preferences. The charging reservation feature will be a game-changer in addressing the "range anxiety" that a quantity of EV drivers experience, as it will enable them to plan their charging stops and alleviate this key barrier to EV adoption.

Furthermore the charging reservation feature, Additionally, the web application will include EV drivers with real-time information on charging station availability, charging speeds, pricing, and other relevant details. Informed decision-making and better route planning will enable drivers to create a smoother and more pleasurable driving experience, which will accelerate the adoption of EVs as they become a more appealing and practical alternative for a larger range of consumers.



Increased EV Adoption:

By tackling the main issues related to EV adoption, such as extended charging times and limited information on charging station availability, the web application will contribute significantly to increased adoption rates of electric vehicles. Increased economies of scale from higher EV adoption rates will make EVs more accessible and affordable. Expanding the market for customers, hastening the shift to electric mobility. Infrastructure for charging EVs will be needed as more people convert to these vehicles. Additionally rise, encouraging investments and the development of the charging infrastructure, so bolstering the expansion of the electric vehicle sector.

The web application's ability to offer a smooth and stress-free charging experience for EV drivers will be a crucial factor in driving increased adoption. By addressing the practical concerns and pain points that have historically hindered the widespread acceptance of EVs, the web app is going to be essential to making electric mobility a more viable and attractive option for a larger portion of the population.

Enhanced Sustainability:

The integration of electric vehicles (EVs) into the transportation system, facilitated by the web application, will have a significant and far-reaching impact on promoting a more enduring environment. The increased adoption of EVs will support a substantial reduction in emissions of greenhouse gases and air pollution, leading to improved public health and quality of life, particularly in cities where transportation-related emissions are a significant concern.

By transitioning toward a more enduring transportation system, the research will support broader environmental and climate change mitigation goals, such as reducing carbon footprints and meeting emissions reduction targets set by governments and international organizations. The benefits of EVs for the environment adoption will extend beyond the transportation sector, as the increased demand for electricity and the integration of EVs with the power grid can also drive the switch to sustainable energy sources and a more sustainable energy system. The web application's role in facilitating The use of EVs will be a key catalyst in this sustainability transformation, as it will increase the accessibility of electric mobility and practical for a larger spectrum of customers, accelerating the abandonment of conventional internal combustion engine vehicles.

Economic Benefits:

The growing adoption of electric vehicles (EVs), driven in part by the web application, will generate additional employment opportunities in the EV industry, including manufacturing, charging infrastructure development, maintenance, and related services.

The transition to EVs will also stimulate investments in research and development, leading to technological advancements that can be exported to other markets, further boosting the economic benefits. It is anticipated that as the EV industry develops, the cost of ownership will rise to a level where conventional cars with internal combustion engines, increasing EVs' accessibility to a larger customer base and accelerating their uptake.

Future Research Directions:

Integrating the web application with smart grids will be crucial for optimizing charging times, reducing grid strain, and enabling seamless EV integration with renewable energy sources. This will enhance the EV ecosystem's sustainability and create opportunities for advanced energy management systems.

Expanding the web application to other regions and countries can accelerate the global transition to sustainable transportation. This will involve adapting the app to different regulatory environments, infrastructure landscapes, and cultural preferences, ensuring widespread applicability and impact.

V.FUTURE WORK

As the use of electric vehicles continues to grow, the EV charging station search and slot booking web application can be further enhanced In order to offer an even more comprehensive and user-friendly experience.

One key area of future development is the incorporation of real-time data from charging station networks. By establishing partnerships with major charging providers, the app can retrieve live information on station availability, pricing, and charging speeds. This would allow users to decide more intelligently regarding which stations to visit and when, reducing the chances of arriving at a fully booked or out-of-service station.



Another important enhancement would be the application of advanced routing and navigation features. The app could leverage GPS and mapping technologies to provide turn-by-turn directions to the selected charging station, considering the user's current location and battery level. This would help minimize range anxiety and guarantee that EV charging is a smooth experience for drivers.

To further improve the user experience, The application is capable to incorporate using machine learning techniques to analyze user behavior and preferences. By tracking factors like charging patterns, station ratings, and payment methods, The app has the ability to offer customized suggestions and automatically suggest the most suitable charging options according to the user's needs. This level of customization would make the app an indispensable tool for EV owners.

Additionally, the app can be expanded to include features that promote sustainable mobility, such as integrating public transportation information and suggesting multimodal travel options that combine EV charging with other eco-friendly modes of transport. Providing rewards to users who choose to charge their vehicles during off-peak hours could further encourage sustainable charging practices.

Finally, the web application can be further developed to serve as an all-inclusive platform for EV owners, beyond just charging station search and booking. This could have characteristics like battery health monitoring, energy consumption tracking, and incorporation with systems for smart homes to enable seamless charging management. By expanding the app's functionality, EV drivers can have a centralized hub to manage all aspects of their electric vehicle ownership experience.

As the EV industry continues to evolve, the point of charging search and slot booking web application must also adapt and innovate to meet the changing needs of an electric vehicle owner. By incorporating these future enhancements, the app can become an essential tool in the transition towards A more enduring and efficient transportation ecosystem.

VI.CONCLUSION

The extensive use of electric vehicles (EVs) is an essential part of developing a sustainable transportation system. However, the successful integration of EVs has a number of obstacles that need to be addressed to encourage broader consumer acceptance.

Among the primary hurdles is the limited information and accessibility of the infrastructure for EV charging. Customers often struggle with extended charging times and the absence of visibility into the presence of charging stations, creating "range anxiety" and deterring EV adoption. Integrating ICT-based solutions can aid in reducing these problems and provide a more seamless experience for EV drivers.

The proposed web application offers a promising approach to address these challenges. By enabling EV drivers to conveniently book charging spots based on their preferences and real-time availability, the application helps alleviate the anxiety associated with finding and accessing charging infrastructure. This not only improves the user experience but also promotes the overall viability of EVs as a sustainable transportation option.

The test findings highlighted in the abstract further underscore the importance of such charging reservation systems. By providing EV drivers with the ability to plan and secure their charging needs, these devices have the potential to drastically reduce range anxiety and encourage greater adoption of electric vehicles.

As the world transitions towards a more enduring future, the successful integration of EVs in the transportation ecosystem is paramount. Examining the difficulties that EV drivers through innovative ICT-based solutions, such as the proposed web application, can play a vital part in accelerating this transition. By empowering EV users and enhancing the overall charging experience, these innovations have the potential to accelerate the widespread use of electric cars and advance the creation of a genuinely sustainable transportation infrastructure.

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