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CHARGING STATION LOCATOR AND SOLUTION FOR EV AND CNG VEHICLE

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ABSTRACT

This paper presents the development and evaluation of a mobile application designed to address the challenge of finding available charging stations for Electric Vehicles (EVs) and Compressed Natural Gas (CNG) vehicles. The application, built using the Flutter framework, leverages Google Maps API to display nearby stations and provide details like connector type, availability, and pricing. Users can filter stations based on preferences and report inaccurate information. The system also offers functionalities for managing EVs within the app (under development) and trip planning with route suggestions that include charging stations along the way. User testing confirms the application's ease of use and the accuracy of its information on payment facilities. This application promotes the wider adoption of EVs and CNG vehicles by addressing range anxiety and simplifying trip planning for drivers.

INTRODUCTION

CNG refueling and EV charging have become increasingly time-consuming processes. Upon arrival at an EV charging or CNG station, one is often met with long queues of vehicles, necessitating a wait. This situation is both tedious and time-consuming, leading to significant time wastage. While we cannot reduce the actual time required for CNG refilling or EV charging, we can address the issue of time wastage by introducing an innovative solution for managing these processes.

This project presents a concept for optimizing EV charging and CNG refilling using an online user application connected to both the station admin and the charging/CNG station. This web-based application requires login credentials for both stations and users, allowing users to track the queue at their desired station. Users can get an estimate of the total time required until their turn arrives and book their slots online. The application checks the database for pending vehicles in the queue and displays this information on the user's screen.

The project also includes a station admin login, enabling the station admin to monitor the total number of bookings at the station. After refueling each vehicle, the admin updates the vehicle's status to "completed," which is then automatically reflected on the user's screen. This shows how many vehicles have been refueled and how many remain, making the system efficient and straightforward for users to book slots and save time.

In the past decade, there have been significant advancements in electric vehicles and charging technology. Electric vehicles not only help reduce emissions but also offer better power delivery and efficiency, thanks to regenerative braking that recharges batteries while driving.

Despite their many advantages, electric vehicles still face challenges, such as locating charging stations.

Unlike conventional vehicles that can refuel at any fuel station, EV owners must ensure their vehicles are charged well in advance. This system addresses these challenges by allowing users to book slots at charging stations, thereby planning their trips more efficiently. By specifying their source and destination, users can use this system to generate a roadmap with all available charging stations along their journey, enhancing the convenience and efficiency of EV ownership.

LITERATURE SURVEY

The authors presented a charging management method for heterogeneous EVs that minimizes the charging waiting duration through a preemption charging service. This method leverages information on EVs parked locally at charging stations and those with reservations for distant charging, enabling efficient planning of charging schedules to reduce waiting times. The approach incorporates flexibility in vehicle-to-vehicle (V2V) coordination using a Delay Tolerant Network (DTN) to facilitate EV charging reservations. This study addresses long-term scheduling challenges and utilizes low-cost V2V communication to meet the traffic demands of dense networks, which can limit the range and service capabilities of Roadside Units (RSUs).

The authors also proposed a model to evaluate the throughput performance of multiple vehicles sharing the wireless resources of an 802.11-based Access Point (AP) in a given mobility scenario. This model captures the impact of road capacity, vehicle density, and relative speed differences on vehicle-to-infrastructure (V2I) communication throughput performance. The scenario envisions a fully grid-integrated EV network, and the model incorporates a design strategy to manage vehicle density. The study expands on V2I communication to collectively analyze optimal EV speeds and other necessary steps to minimize delays and mitigate risks to power grid components caused by changes in spatiotemporal EV demand patterns.

Furthermore, the authors proposed a theoretical approach to reduce charging wait times by intelligently grouping charging operations based on geographic and temporal factors. This theoretical study articulates the problem of reducing waiting time in charge scheduling and derives an upper bound on efficiency. Their approach focuses on slot booking scheduling to simplify the process, reduce charge times, and avoid scheduling collisions. In the context of modern application development, where cross-platform mobile applications are in demand, engineers often need to create systems compatible with multiple operating systems. Google provides a solution with Flutter, a framework for building cross-platform applications efficiently.

SCOPE OF PROJECT

The aim of this project is to develop an EV Charging Station app designed to assist EV drivers in locating available charging stations nearby. After locating a charging station, users can book a slot to charge their vehicle.

In the past decade, significant advancements have been made in electric vehicles and charging technology. Along with reducing emissions, electric vehicles offer superior power delivery and efficiency, as they can use regenerative braking to recharge their batteries while on the move.

Despite these advantages, electric vehicles face challenges such as finding charging stations. Unlike conventional car drivers, EV owners cannot refuel at any fuel station. They must ensure their vehicle is charged well in advance before setting out on a journey. The development of infrastructure, such as charging stations, is essential to support the growing number of electric vehicles.

This EV Charging Station app, developed using Flutter, addresses this need. It helps EV drivers locate available charging stations nearby and allows them to book a slot at the station. This system also enables EV owners to plan their trips more efficiently. By specifying the source and destination, the app generates a roadmap with all available charging stations along the route, ensuring a smooth and convenient travel experience.

METHODOLOGY

This project aims to develop an EV Charging Station app designed to streamline the management of electric vehicles (EVs) and enhance the convenience of finding and booking charging stations. Within this system, users can manage all of their EVs, search for and book charging station spaces in advance, and locate EV and CNG charging stations by location, city, or distance. By specifying a source and destination, the system can generate a roadmap with charging stations along the route based on the entered kilometers. All stations and slots are managed by an administrator to ensure efficient operation.

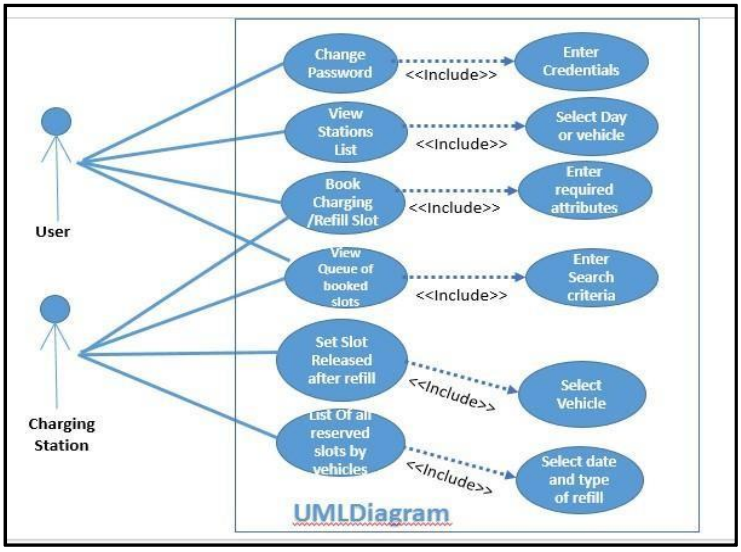
Over the past decade, there have been tremendous advancements in electric vehicles and charging technologies. Alongside reducing pollution, electric vehicles offer superior power delivery and greater efficiency through regenerative braking, which allows them to recharge their batteries while driving.

Despite their numerous advantages, electric vehicles face challenges, particularly in the availability of charging stations. Unlike traditional automobile owners who can refuel at any petrol station, EV owners must plan their charging needs in advance. This highlights the critical need for infrastructure development, including the establishment of more charging stations.

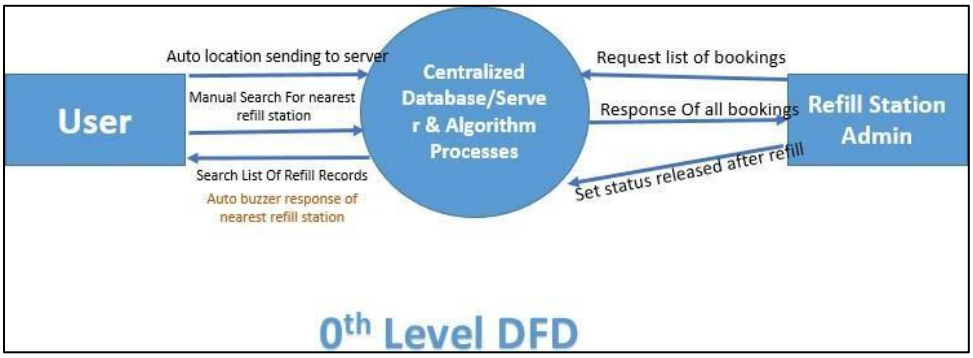
Developed using Flutter, this EV and CNG Charging Station app assists EV drivers in locating available charging stations nearby. Once a charging station is identified, users can reserve a charging slot at the station. This system also aids EV owners in planning their travels more effectively. By providing the source and destination, the technology generates a roadmap with all available charging stations along the route.

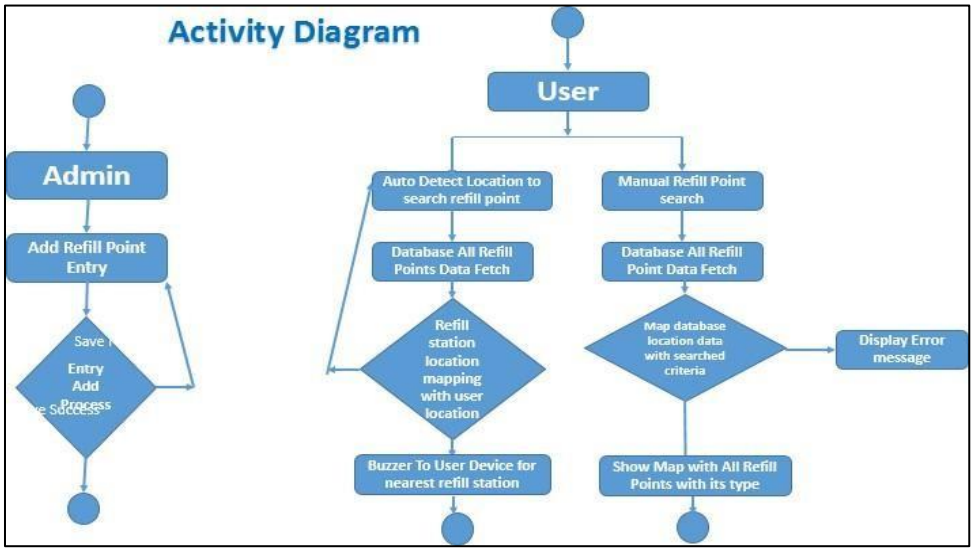
The deployment of this system is suitable for various settings, including commercial and residential buildings, industrial facilities, and public areas. The approach involves a combination of computer vision, machine learning, and wireless communication technologies to develop a reliable and effective automated fire detection and localization system. Leveraging these technologies, the system ensures early fire detection, enabling prompt responses, saving lives, and minimizing property damage.

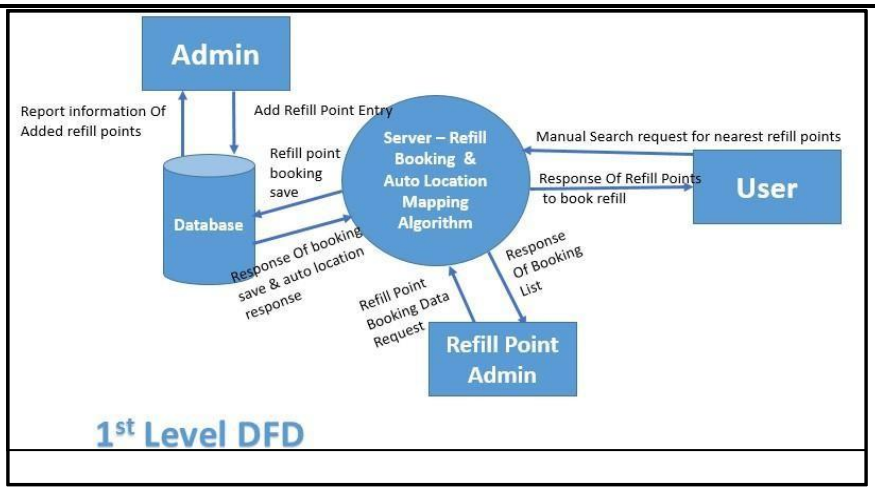
System Design – Use Case Diagram:

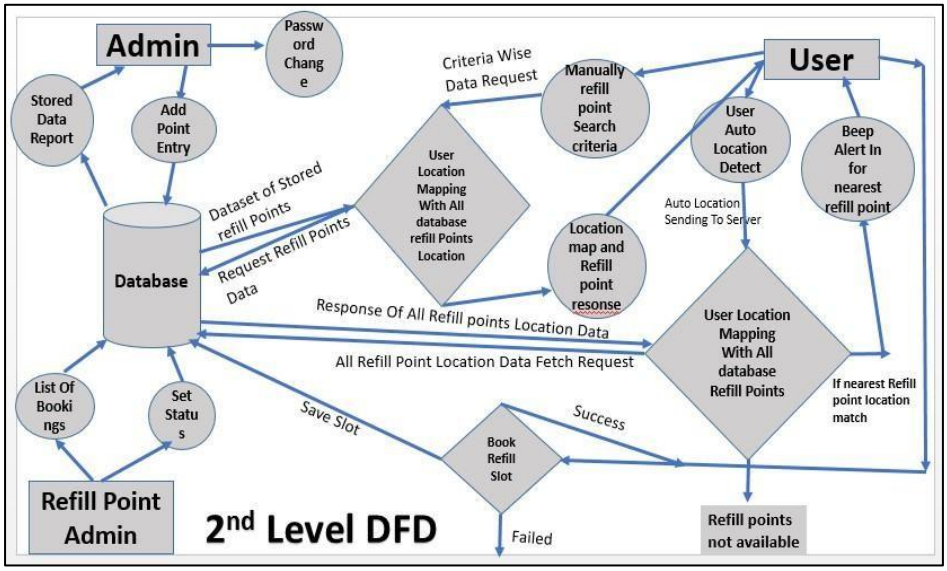


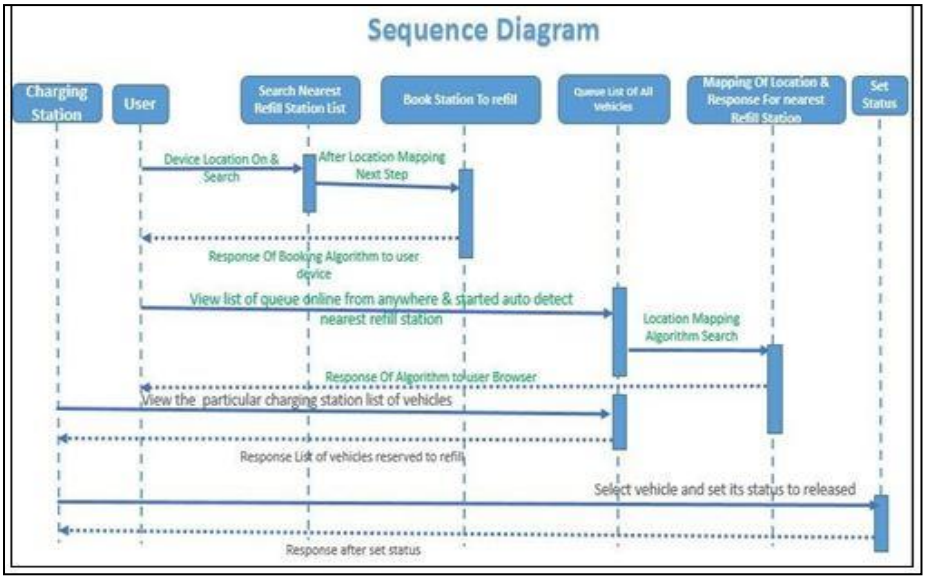
Data Flow Diagram



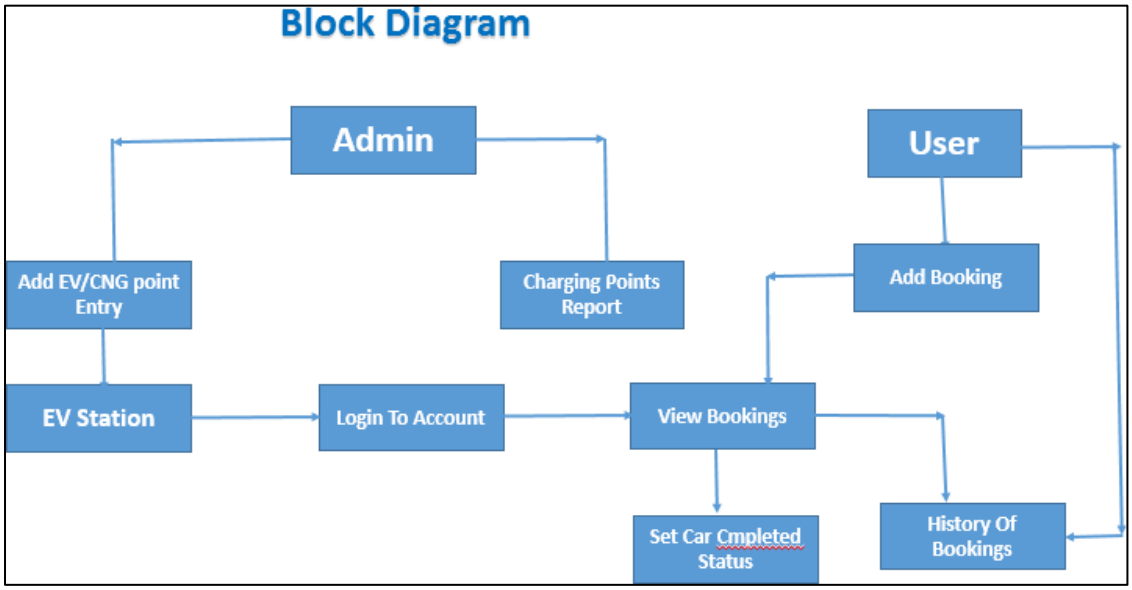



Admin
Report information Of Added refill points
Add Refill Point Entry
Refill point booking save
Server – Refill Booking & Auto Location Mapping Algorithm
Manual Search request for nearest refill points
Response Of Refill Points to book refill
User
Database
Response Of booking save & auto location response
Response Of Booking List
Refill Point Booking Data Request
Refill Point Admin
1st Level DFD

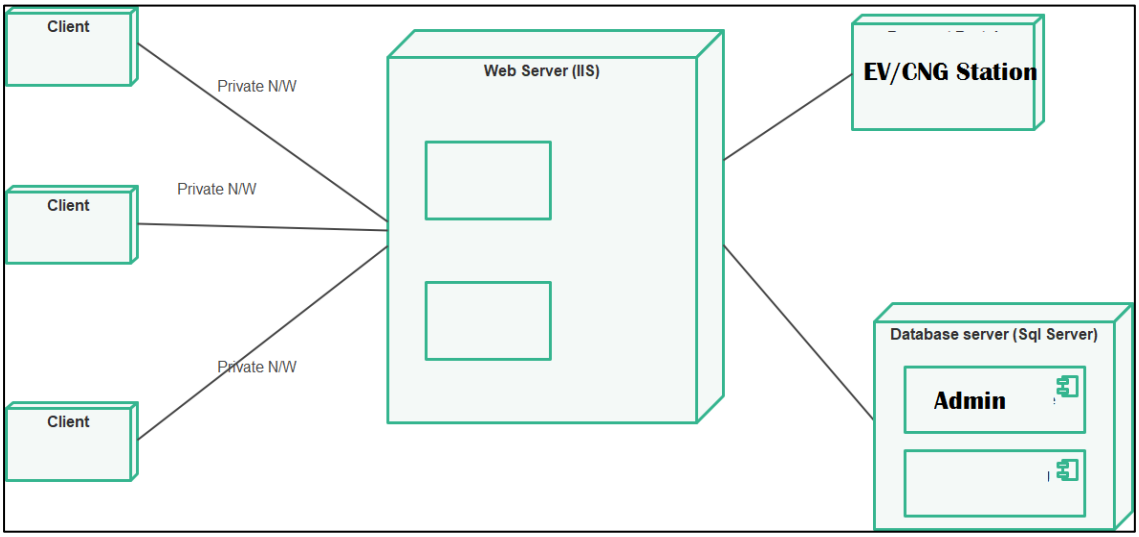

Admin
Password Change
Stored Data Report
Add Point Entry
Criteria Wise Data Request
Manually refill point Search criteria
User
User Auto Location Detect
Beep Alert In for nearest refill point
Auto Location Sending To Server
Dataset of Stored refill Points
Request Refill Points Data
User Location Mapping With All database refill Points Location
Location map and Refill point resonse
Database
Response Of All Refill points Location Data
All Refill Point Location Data Fetch Request
User Location Mapping With All database Refill Points
If nearest Refill point location match
List Of Bookings
Set Status
Save Slot
Success
Book Refill Slot
Refill Point Admin
2nd Level DFD
Failed
Refill points not available


Sequence Diagram
Charging Station
User
Search Nearest Refill Station List
Book Station To refill
Queue List Of All Vehicles
Mapping Of Location & Response For nearest Refill Station
Set Status
Device Location On & Search
After Location Mapping Next Step
Response Of Booking Algorithm to user device
View list of queue online from anywhere & started auto detect nearest refill station
Location Mapping Algorithm Search
Response Of Algorithm to user Browser
View the particular charging station list of vehicles
Response List of vehicles reserved to refill
Select vehicle and set its status to released
Response after set status

BEHAVIORAL MODELING



DEPLOYMENT DIAGRAM



Project Requirements

Resources and Consumables required

A. Hardware components:

- Keyboard, Mouse, Desktop Screen
- Ram – 8 GB Or Higher
- HDD – 500GB Or Higher
- Processor – I5 Or Higher

B. Software apps:

- Visual Studio Code Editor / Notepad++
- Wamp Server – For PHP / My SQL database
- Browser – Any latest Updated Browser – Google Chrome/Mozilla/Opera etc.
- Picpick Editor

DETAILS OF DESIGNS, WORKING AND PROCESSES

Primarily this project have following different modules

1. **Master Admin Panel**
2. *CNG / EV Charging point Panel*
3. **User Panel**

1. *Master Admin Panel Admin Panel Login*

- ID
- Password

Change Password

- Current Password
- New Password
- Confirm Password

Logout

Add EV Charging Points/CNG Point

- Charging Station name
- Contact Person Name
- Contact Person Mob No
- Email Id
- City
- State
- Country
- Pin Code

► *Report Of Added EV Charging Point/CNG points*

- Here admin can see the complete report of all added Ev Charging and stationpoints
- Search system for searching records from all cases

▶ *Booking Report OF Charging Station/CNG Pumps*

- Here admin can see the complete booking report by date wise

2. *CNG / EV Charging point Panel Panel*

Login

- ID
- Password

Change Password

Logout

- Current Password
- New Password
- Confirm Password

Point Booking Report

- This report will show the bookings of vehicles for each day by date wise.
- After each booked vehicles charged panel admin will set the status to completed, so next vehicle can see the booking number

History Reports

- History of charges vehicles/Filled CNG History

Set Status Done

- After every charging done/cng done of vehicle point admin will set status ofthat booking number to done, so other user can check queue.

3.**User Panel**

User Registration

- Name-
- Mobile Number-
- Email Id-
- Password

Login

Logout

- Mobile Number-
- Password

Search EV Station/CNG Pump

- User can search and can find the nearest EV stations/CNG Pumps

Book My Slot

- From this menu user can book charging pass at EV station /CNG Pump
- User will get unique number of booking

Booking Queue

- User can check the status of booking queue and booking numbers which areremain before his token

Booking Report

- User can check self booking report of cng/ev

CONCLUSION & FUTURE SCOPE

CONCLUSION

The primary goal of this project is to create a valuable tool for EV and CNG customers, providing an app that significantly enhances their experience. This app will not only benefit users but also serve as an interactive system for administrators. It can generate extensive data on EV and CNG vehicle owners and charging station operators, facilitating better management and planning.

Key functionalities include locating and navigating to charging stations, managing bookings, and monitoring station availability. The app's utility extends beyond immediate user convenience; it also offers potential for future enhancements as a commercial product. Planned features include subscription packs and additional functions like "charge and cool," which can generate additional revenue.

Overall, this project aims to provide a comprehensive solution for the evolving needs of EV and CNG users, making the charging process more efficient and user-friendly.

FUTURE SCOPE

The project for a Charging Station Locator and Booking Solution for EV and CNG Vehicles using Flutter holds substantial potential for future development. As the world shifts toward cleaner and more sustainable transportation options, the demand for electric and CNG vehicles is anticipated to rise. Here are some ideas for expanding this project:

- Integration with More Charging Networks
- Expand the platform's coverage by integrating with a wider range of charging networks, both regionally and internationally. This will make it more useful for users traveling across different areas.
- Real-time Data and Predictive Analysis
- Implement real-time data collection and analytics to provide users with information on charging station availability, wait times, and predictive suggestions on the best times to charge.
- EV and CNG Vehicle Compatibility Information
- Include detailed information about different EV and CNG vehicle models and their compatibility with various charging stations. This will help users select the most suitable stations for their specific vehicles.
- Payment Integration
- Enable secure and convenient payment options within the app, allowing users to pay for charging services directly. Integration with digital wallets and payment gateways will be crucial.
- User Reviews and Ratings

- Allow users to leave reviews and ratings for charging stations, creating a community-driven platform that helps others make informed decisions.
- Reservation and Booking Enhancements
- Improve the booking system by enabling users to reserve charging stations in advance. Integrate features like queuing, notifications, and the ability to cancel or reschedule reservations.
- Green Energy Sources
- Provide information about the source of electricity or natural gas used at each station, highlighting those powered by renewable energy sources, aligning with the sustainability goals of many users.
- EV and CNG Fleet Management
- Develop a separate module for businesses and organizations to manage their fleets of electric and CNG vehicles, including scheduling and monitoring charging activities.
- Navigation and Routing Integration
- Integrate with navigation apps to provide seamless directions to the chosen charging station, including real-time traffic updates and alternative route suggestions.
- Environmental Impact Tracking
- Develop features that allow users to track their environmental impact by using EVs and CNG vehicles, including metrics on carbon emissions reduced and energy savings.
- AI-Powered Recommendations
- Implement AI algorithms to provide personalized recommendations for charging stations based on user preferences, travel history, and vehicle type.
- Offline Mode
- Ensure the app can be used in areas with poor network connectivity by providing offline maps and station data.
- Internationalization
- Expand the app's reach by offering multiple languages and regional customization options.
- Public Transportation Integration
- Collaborate with public transportation agencies to integrate information on charging stations at or near public transit hubs.
- Government Incentives and Policy Updates
- Keep users informed about government incentives, subsidies, and policy changes related to electric and CNG vehicles. This information can encourage more users to adopt eco-friendly transportation.
- Ecosystem Collaboration
- Collaborate with other stakeholders in the electric and CNG vehicle ecosystem, such as vehicle manufacturers, charging station providers, and energy companies, to create a comprehensive platform.
- By incorporating these features and improvements, the Charging Station Locator and Booking Solution can significantly enhance its functionality and user experience, contributing to the broader

adoption of electric and CNG vehicles and the development of sustainable transportation infrastructure.

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