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CHARGEMATE: Electric Vehicle Booking

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Abstract: EVs are gaining popularity as a more environmentally friendly form of transportation. However, the accessibility and availability of charging facili- ties are one of the major issues that EV users must deal with. In this paper, we designed and implemented an Android Studio framework-based app for identi- fying EV charging stations. The software makes use of the Google Maps API to provide the precise position of nearby charging stations as well as comprehen- sive details like the type of connection, availability, and cost. Users of the app may also report any errors or out-of-service charging stations and select charging stations depending on their preferences. To assess the app's usability and effi- cacy, user testing was done. The results of the paper demonstrated that the app is simple to use and gave precise, current information about charging stations. The introduction of the app may help address the problem of the accessibility of charging stations and enhance the whole experience of EV ownership. As EVs grow more popular, there will be a need to develop an effective slot booking sys- tem since charging may be time-consuming, and demand for additional stations will be high. The suggested booking system paradigm is intended to produce a cost-effective and efficient system.

Challenges:

1.Limited Charging Station Availability:

Problem: It may be difficult for EV users to locate a charging station in some areas due to a lack of charging stations.

Solution: Increase the number of charging stations installed by working with local businesses, governments, and utility companies to expand the infrastructure for charging. Prioritize station placement by using data analytics to identify high-EV usage areas.

2.Range Anxiety:

Problem: EV owners may worry that their batteries will run out of power before they get to their destination.
Solution: Incorporate cutting-edge navigation and route planning tools into the booking app to recommend the best places to stop for charging along the way. Continually update the availability of charging stations and their estimated charging times.

3.Charging Station Compatibility:

Problem: It can be difficult to accommodate all users when different EV models call for different kinds of charging connectors.
Solution: Provide universal charging stations that accommodate various connector types, and make sure that details regarding each charging station's compatibility with different connector types are provided by the booking system.

4.Peak-Time Congestion:

Problem: There may be a backlog at charging stations during busy times, which could result in lengthy waits.
Solution: Use dynamic pricing models as a solution to incentivize users to charge during off peak hours. Manage station traffic, recommend other nearby stations, and provide estimated wait times with booking system data.

Key Components of the System:

1.Booking Engine: Reservation management allows users to make reservations choosing dates, time of pick up and drop off of a car at a certain place. Real-time availability to avoid overbooking, monitors and keeps vehicle availability data current on a real-time basis.

2.User Authentication and Authorization: User accounts managing user information such as secure login and registration to authenticate customers and manage account details. Authorization levels the different user roles, like customers, administrators, and fleet managers, having their own level of access and permissions.

3.Payment Gateway: Secure transactions secure payment link that allows users to pay their reservations through an integrated payment gateway. Payment history tracking and tracking of user payment histories.

4.Vehicle Management System: Fleet monitoring the whole fleet of all electric vehicles in real time. Maintenance Schedule carrying out monitoring and scheduling of preventive service to keep the cars well maintained.

5.Notification System: Booking confirmation user's automated confirmation notifications and subsequent information. Reminders Alerts concerning forward reservation recalls, and deadline returns.

6.GPS and Navigation Integration: Location services interfacing with GPS for real-time mapping of the vehicle and directing users on where to find picking up and dropping points.

Key Features and Benefits:

Key Features:

1.User-Friendly Interface: They focus on the simplicity of usability through an easily registerable interface as well as a convenient method of choosing a car rental. The design has an intuitive design that is easy to use since it is highly user-friendly and provides good screen aesthetic.

2.Real-Time Availability: Such up-to-date information helps user to select an electric vehicle at the same time when he/she needs it. The booking systemenables one to plan for their trip, make better choices, as well as enhancing user satisfaction by simplifying the booking process.
3.Secure Payment Integration: Also, it utilizes strong security for easy and safe deals. It is important on this context because users' confidence depends entirely on a transaction being flexible and trustworthy. This may include use of credit card or even a digital wallet that supports varied payment options.
4.Charging Station Assistance: The platform provides a complete information on nearby charging points for use in electric vehicle use. This would provide users with information about charging times, station location, and availability therefore making travel easy for them.
5.Notification System: The notification system based on communication allows timeliness communication. It sends messages to users for confirmation of reservations, the status of charge, as well as future bookings. This increases their active involvement in user's community.
6.Fleet Management Tools: The powerful admin dashboard provides administrators an in-depth view of the entire electric fleet. On this note, it integrates various functionalities, including maintenance tracking and analytics. This allows for informed decision making aimed at improving uptime and enhancing reliability.

Benefits:

1.Optimized Charging Efficiency: This improves efficiency by enabling individuals to book for charging sessions hence minimizes the waiting period while maximizing utilization of charging infrastructure. This increases utilization by both users and charging station operators thus reducing their periods of downtime.
2.User Convenience and Planning: This allows users to book charging sessions well in advance, therefore, making it more convenient to them. Electric car owners can easily schedule charging in their time and this feature make process of recharging the car more reliable and comfortable for people who use cars.
3.Reduced Energy Grid Strain: Staggered and planned charging of the system contributes in grid management as it reduces the peak demand for electricity during certain parts of the day. It also helps in off-peak charging, which reduces strain on the energy grids and supports the integration of renewable energies as well.
4.Environmental Impact: Indirectly, this system helps promote a sustainable environment by encouraging an efficient use of charging infrastructure. Optimized scheduling will help reduce energy consumption as well as the impact on the environment since electric vehicles consume electricity.
5.Enhanced Fleet Management: The charging booking system acts as a single means of monitoring and managing electric vehicle fleets for businesses. This involves carrying out normal maintenance, planning for optimal recharging schedules as well as guaranteeing a reliable and efficient fleet.
6.Data-Driven Insights: It provides useful information on the ways in which people charge vehicles at stations as well as station usage for instance. With this information it is possible to develop efficient infrastructure planning and growthdecisions, targeted at meeting everchanging user expectations of mobile chargers.

Keywords: Flutter Framework, Google Maps API, EV Charging Station App.

1.Introduction:

Electric vehicles (EVs) are one of the newest sectors to emerge. Electric car sales are rising in India. As shown in the figure below:

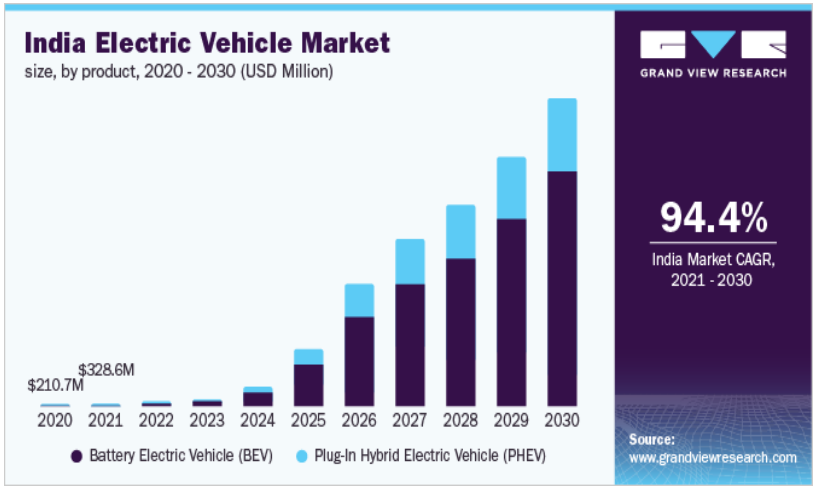

Figure 1:EV' Sales

Electric cars and charging technologies have made enormous strides in the last ten years. Electric vehicles not only reduce pollutants but also offer superior power deliv- ery and are much more economical since they can use regenerative braking to replenish their batteries while driving [1]. Even with its benefits, electric vehicles still need help finding charging outlets. Therefore, we came up with the idea of creating an app for discovering electric car charging stations that enables a pleasant user experience with unique features. In this system, the user may search for or reserve a charging station space in advance as well as manage all of their electric vehicles within the application.

The Basic Idea of our title, "Electric vehicle advance booking System for the Charg- ing Station," is to design a system to help people locate the correct charging station. This will save them time and money because few electric charging stations are now available in India. Because EVs take longer to charge than traditional cars, finding and using a charging station are the concerns. Due to the inconvenience this causes EV customers, EV charging slots must be reserved in advance. The trend towards electric vehicles (EVs) has been steadily increasing in recent years. This is due to a number of factors, including advancements in technology that have made EVs more efficient and affordable, as well as increasing concerns about the environmental impact of traditional gasoline-powered vehicles. There is no availability of this expanding charging station on virtual maps while the electric car sector is expanding in India, fewer charging sta- tions are accessible there, and the number of new registrations of charging stations is increasing. This makes it difficult for the user to locate a charging station virtually. A smartphone app for finding and managing charging station services is called an electric vehicle (EV) charging station app. The software aids users in finding the closest charg- ing station by providing information about the charging station's availability, location, charging prices, and expenses. Additionally, it dispenses with the necessity for cash or credit card payments at the station by enabling customers to pay for charging services directly through the app. The software may also track the user's vehicle's charging history, enabling them to monitor their expenditure and use. Making the charging pro- cedure for EV owners as convenient and effective as feasible is the major

objective of an EV charging station app. In this paper, we present an innovative idea to reduce the bottleneck for EV owners to stand in queue for more time by providing a journey booking facility for charging the Electric vehicle.

The rest of the paper is organised as follows:
Section II (Literature survey) – This includes several documents, manuals, and anal- ysis papers related to our proposed system plan.
Section III (Proposed System) – Gives an Idea of our proposed system.
Section IV (Results) – This includes the results and working of our proposed system. Section V (Conclusion) – This Section concludes the paper with a conclusion.
Finally, we must consider our efforts in the future and conclude how we will make our product suitable for usage by the general public. In this proposed system, we'll design and create an Android application that helps users in their area locate charging outlets nearby. The app displays all nearby electric car charging outlets. To get to these charging stations, the user only needs to browse. Based on the kind and charging port of the user's car, this app will offer the ability to reserve slots for charging the user's electric vehicle at convenient times. This software will help owners of electric vehicles save a ton of time.

2.Literature Review:

[1] D. Gong, M. Tang, B.Buchmeister and H. Zhang. Solving location problem for electric vehicle charging stations a sharing charging model. This study reports a new emobility platform to construct effective usage of charging points by electric vehicle users to eliminate long charge durations. It's platform includes such subsystems as smartphones, databases, and IoT.

[2] Dost, P.Spichartz, P. and Sourkounis, C. (2015). Charging behaviour of users utilising battery electric vehicles and extended range electric vehicles within the scope of a field test. The number of electric vehicles (EVs) on the road is increasing, charging stations is becoming increasingly crucial. An increased number of Electric Vehicles (EVs) on the roads. Charging infrastructure is gaining an ever-more key role in addressing the needs of both the local distribution grid and EV consumers at the same time.

[3] Yongmin Zhang, Lin Cai. Dynamic Charging Scheduling for EV Parking Lots With Photovoltaic Power System. The spread of these vehicles is still low due to the lack of charging stations as well as their high prices. This paper reviews important research about charging stations with IoT and the charging type used in these stations. Saves the time spent by the user looking for the stations, knowing the location of charging stations by using a mobile application.

[4] S. Akshya, Anjali Ravindran, A. Sakthi Srinidhi, Subham Panda, Anu G. Kumar. Grid Integration for Electric Vehicle and Photovoltaic Panel for a Smart Home. The growing number of electric vehicles on the roads makes it increasingly necessary tohave a public charging infrastructure. On the other hand, the limited range of their batteries and charging times. At the goal of optimizing trip time, drivers need to automate their travel plans based on a smart charging solution, which will require the development of new Vehicle-to-Grid applications that will allow at the charging stations to dynamically interact with the vehicles.

[5] Florea, B.C. and Taralunga, D.D. (2020). Blockchain IoT for Smart Electric Vehicles Battery Management. Electric Vehicles (EVs) have generated a lot of interest in recent years, due to the advances in battery life and low pollution. Similarly, the expansion of the Internet of Things (IoT) allowed more and more devices to be interconnected. One major problem EVs face today is the limited range of the battery and the limited number of charging or battery swapping stations.

[6] Subudhi, P.S. and Krithiga, S. (2020). Wireless Power Transfer Topologies used for Static and Dynamic Charging of EV Battery. Electric vehicles (EV) are found to be a good alternative for the conventional internal combustion (IC) engine vehicles in transportation sector due to its various advantages. Now-a-days, wireless charging of EV battery is preferred among the various methods used for charging EV battery. Static wireless EV battery charging technique adopts inductive and capacitive method for transferring power whereas, dynamic wireless EV battery charging technique adopts only inductive method for transferring power.

3.Proposed System:

This paper proposes to simplify the procedure for booking an electric car charging station. The system enables electric car owners to reserve a charging station in advance, lowering wait times and improving the entire charging experience. It is intended to deliver an effective and user-friendly experience for electric vehicle owners. The user interface, the booking engine, the charging station management system, and the payment gateway make up the architecture of the suggested system.

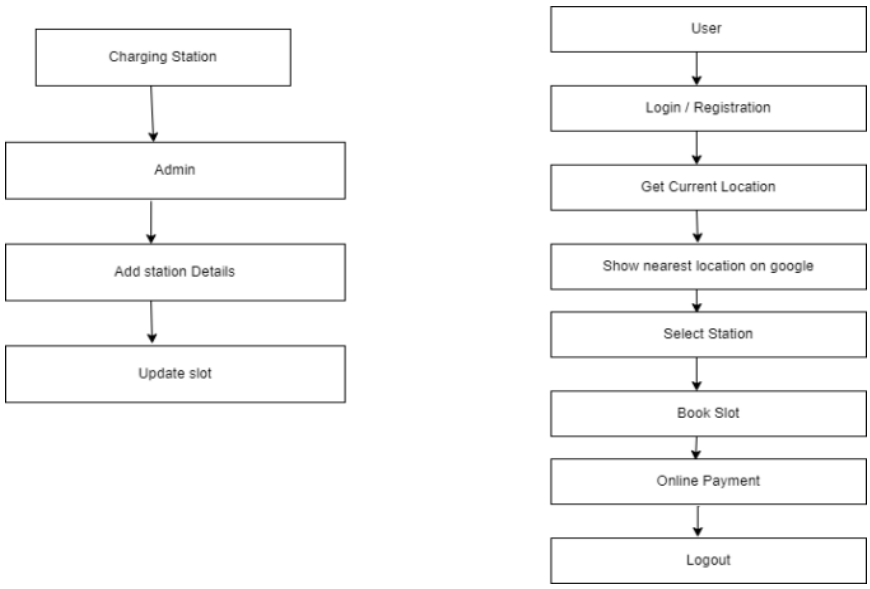

Figure 2:Architecture Diagram

The above figure shows the proposed architecture of our system. It is consisted of two modules:
1. Admin
2. User

3.1 System Architecture:

The system comprises of 2 major modules with their sub-modules as follows:

Admin:

- Login:
  - Admin can login using id and password.
- Manage Stations:
  - Add/update/delete/view Stations
  - Enable/Disable
  - Manage Slots - Add/Update/Delete/View
  - Slot price
- View Bookings:
  - View registered users booking history
  - Cancel booking if station is broken etc.

User:

- Register:
  - User can register using personal details.
- Login:
  - User can login in his personal account using id and password.
- Profile:
  - View and update.
- Change Password:
  - Can change the password by using the app.
- Manage EV Vehicles:
  - Add/Delete/View/Update
- Find Stations:
  - Filter by nearby/city/kms
  - Choose station
  - Choose slot
  - Select date/time
  - Payment (Dummy)

- View Bookings:
  - Road Map
  - The system will create a route for you with charging stations along the way once you enter your source/destination and travel distance.

- View Bookings:
  - Filter by date
  - Cancel within a certain time frame.

4.Results:

The ideas and techniques we put into practice will allow us to engage directly with the app, making it incredibly engaging, dependable, and simple for both users and the owner of an electric charging station to use. Many services, including a real-time position finder, a Google map, navigation, slot booking and administration, and profile management, will be developed and deployed using this architecture.

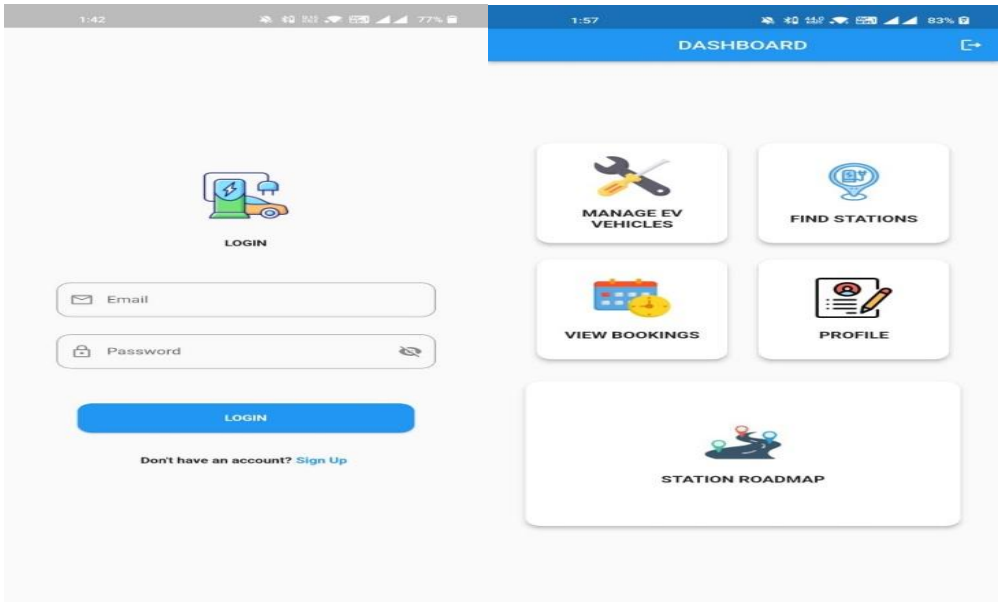

Figure: 3(a) *Figure: 3(b)*

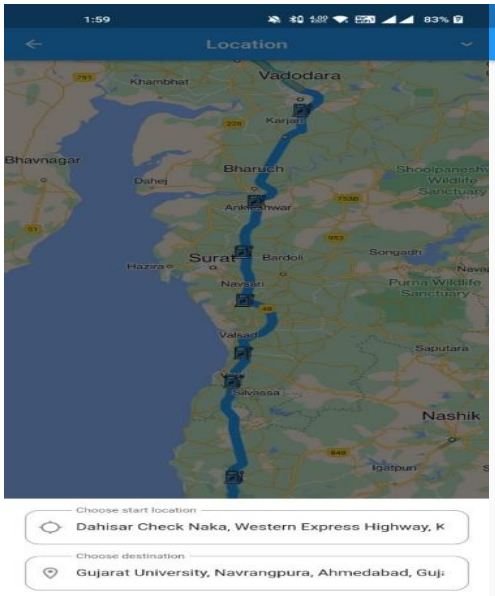

Figure: 3(c)

Figure: 3(d)

Here, Figure: 3(a), (b), (c) & (d) represent the User module present in the application.
Figure: 3(a) Shows the login form of the application where the user will be entering his/her Email and Password to login to the application. If the user is new to the application, he/she can register himself/herself using the sign-up button by providing their details like Name, Email, Phone number, and Password.

Figure: 3(b) Shows the Dashboard of the application where the user will be directed after the successful login. The Dashboard comprises six sub-modules like Manage EV Vehicles, find stations, View bookings, Profile, Station Roadmap, and Log out button.

Figure: 3(c) Depicts the station roadmap i.e., the Charging stations present in the journey of the user. Here the user needs to choose the start location and destination location. Then it shows the EV charging Stations in the roadmap over the maps.
Figure: 3(d) Displays the booking details of the user. Which portrays the details like the Station name, Vehicle name, Status, Amount, and many more.

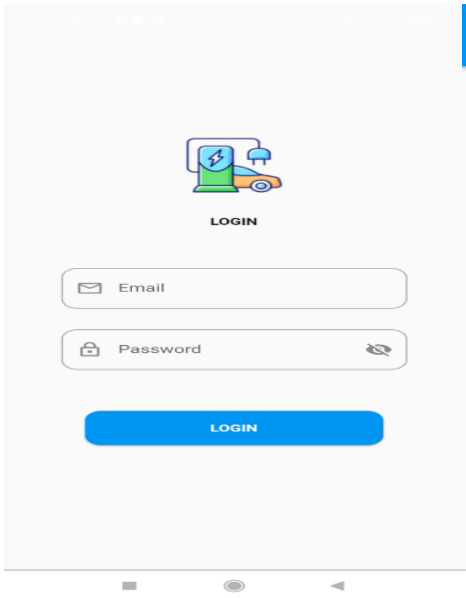

Figure: 4(a)

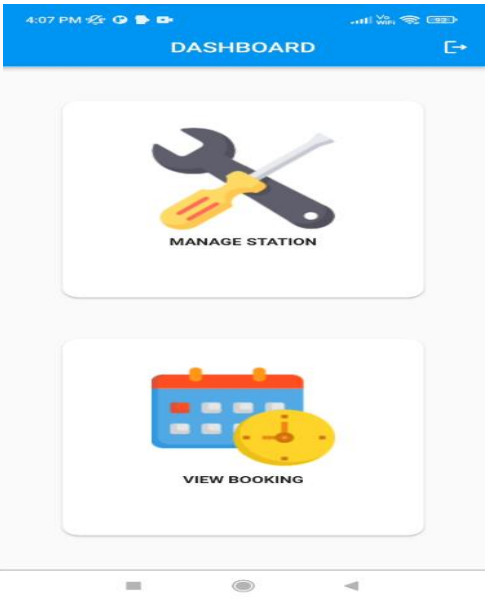

Figure: 4(b)

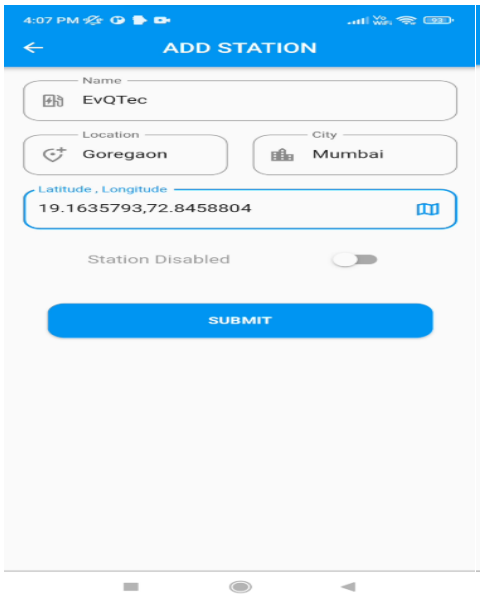

Figure:4(c)

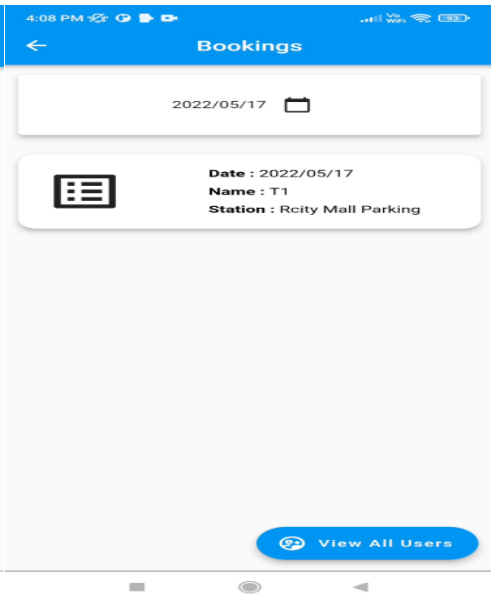

Figure: 4(d)

Here, Figure: 4(a), (b), (c) & (d) represent the Admin module present in the application.

Figure: 4(a) Shows the login form of the admin where the admin will be entering his/her Email and Password to login to the admin side of the application.

Figure: 4(b) Shows the dashboard of the admin side application, where the admin will be directed after the successful login. The Dashboard comprises three sub-modules like Manage Station, View Booking, and Log out button.

Figure: 4(c) Depicts the Add station, Here the admin add, update, delete or view the Charging station details like price amount of charge by Giving the Name, Location, City, and the latitude and longitude of the charging station. Admin can set enabled and disabled status the charging station.

Figure: 4(d) Displays the Bookings of all the users on the given dates. Here the admin can see the requests made by the users and their booking history.

5.Conclusion:

The primary goal of our proposed system is to provide a helpful product that will be highly practical for EV consumers. In addition to offering services to the user, the administrator will utilise this app as a live system. It may be used to navigate to stations as well as locate them. Many investigations also emphasise the economic benefits for charging providers, EV owners, and power grid firms. The collaboration of EVs may decrease carbon emissions, which benefits the environment. The EV driver may quickly decide and reserve a place if charging is necessary. Additionally, charging times may be significantly shortened to guarantee system effectiveness. In the future, this app will also be developed as a paid product with additional capabilities that will also make use of subscription packs, as well as features like blockchain integration, IoT devices to track real-time charging status, and notifications about when charging sessions are finished.

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