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ChargePlug- A Comprehensive Cross-Platform Application for Locating Electric Charging Stations

Pratham Nitin Dhanesha
Dept. of Information Technology
A. P. Shah Institute of Technology
Thane, India
19104021@apsit.edu.in

Pavan Chopra
Dept. of Information Technology
A. P. Shah Institute of Technology
Thane, India
19104069@apsit.edu.in

Shreya Desai
Dept. of Information Technology
A. P. Shah Institute of Technology
Thane, India
16104018@apsit.edu.in

Prof. Manasi Choche
Dept. of Information Technology
A. P. Shah Institute of Technology
Thane, India
mdchoche@apsit.edu.in

Dr. Kiran Deshpande
Dept. of Information Technology
A. P. Shah Institute of Technology
Thane, India
kbdeshpande@apsit.edu.in

***Abstract*—Living in the 21st century, people are well acquainted with the technology. Technology has proved its importance by showing its benefits to the human race. The use of technology has become an integrated part of life. Technology has lent a helping hand to automobile developers to develop cars that can run on batteries and be charged using electricity. In the market, the scale of sales of such electric vehicles is booming. The latest strong performance of EV sales is due to the consumers' concerns regarding the hike in prices of petrol and gases. These EV cars thus require charging in locations along the road so that people can charge their cars as they use to fuel them. Being the initial stage of the rise of electric vehicles people are not aware of the locations of charging stations. Hence, During this article, we tend to plan the planning and implementation of an electrical vehicle (EV) charging station finder application developed in Android Studio using Dart Programming Language. The mobile application will have maps that will help the users quickly contact the charging location. The app being in a form of a mobile application will provide a lot of conveniences, and reliability and will allow them to easily communicate with the user. As per the constraint of the electric power distribution network, electric vehicle charging stations are restricted and it is difficult for new heat unit owners to discover the stations. So as to produce information to users concerning the charging stations and to help them navigate, it developed a need for mobile applications to assist electric vehicle owners in these processes. This proposed Electric Vehicle finder Application that helps heat unit house owners find a charging station close to them and set up a journey with several options.**

***Index Terms*—Flutter, Google Maps API, Electric Vehicle Charging Station Locator.**

I. Introduction

In recent years, automobile makers have developed and produced a brand-new generation of an alternatively fuelled vehicle, advantageous compared to traditional cars in several aspects: lower dependence on oil, reduced gas emissions (GHG), and usually a vital reduction in pollution. Among the foremost promising technologies are those that totally trust electricity. Currently, more than thirty models of electric vehicles are factory-made while the quantity of cash invested for the support of design, construction, and promotion of electrical vehicles (EVs) is endlessly increasing. The existence of Electric vehicle charging stations is increasing due to the rapid increase in the sales of electric vehicles in urban areas. Compared to 2021, the sales of electric cars will have risen by 141 percent by 2022. The year 2022 has set the record for the EV industry, considering the total sale of 995319 EVs.

As electrical vehicles (EVs) enter the market, demand for public charging stations is increasing. Reciprocally, the demand for EVs is influenced by the supply of recharging infrastructure. Promoting electrical vehicles (EVs) on different fuel vehicles have gained interest among governing body and policy manufacturers in recent years because of the advantages of those vehicles over the standard burning engine vehicles. The goal of this report is to develop a model to optimally find charging facilities for electric vehicles.

Concerning electrical charging stations in a square measure are quite a few in India because of which individuals can't notice the proper charging station that will save their time and cash. EV unit charging stations need areas like parks, malls, and societies. For personal and semi-public charging stations, this area is out there within the parking areas of the societies, lodging buildings, or of economic or public, or institutional areas. Because of this, there's an additional issue for EV unit owners to search out charging stations close to them.

The matter isn't solely to search out the charging station but conjointly to charge it quickly owing to the time needed to charge the EVs. This ends up in inconvenience the EV unit users as it needs tons of their time therefore there is a need for slot-booking for recharging. An electric vehicle charging station locator helps in many ways like provides convenience, real-time information, charge type compatibility, cost and payment option, and trip planning. The app will help in finding the closest electric charging station from the current location which will help the driver to plan the trip accordingly. Many locator apps provide information about the

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type of charger available, so the driver can see whether the charging station is occupied or not for use. An EV charging station locator can also help you plan long-distance trips by showing you the location of charging stations along your route, so you can plan when and where to stop for a recharge. As the EV industry is growing in India and there is less availability of charging stations this ends up in inconvenience users in locating charging stations just about. Also, new registrations are complete for charging stations and there is less representation of these on virtual maps which also leads to disruption to EV owners.

II. Related Work

1) As per the study made by Monika Sharma [1], the tracking of the location of the user is useful in most applications. There won't be a need for any purchase of a GPS device if the Geo-location API is used. The tracking of location is done on the basis of the hosting device. Also without the GPS device, the location is obtained by Google's Online Service.

2) According to Efthymiou, D., Chrysostomou K. [2],The Electric Charging Station infrastructure locator is a project that develops a tool based on a genetic algorithm, which is open source and freely available to interested users. This approach is used to assign charging stations at a higher level and also the authors encourage its use by local authorities of other cities too.

3) In accordance with Sumit S. Muddalkar [3] Nishant S. Chaturkar, Khushal D. Ingole, Shreyah B. Wadaskar, the concept and the methodologies that will be implemented in a way that they will interact with the app directly and it will be reliable, interactive, and easy to use by the users and the vendors of the electric charging station. The architecture will be adopted to develop and enjoy many services.

4) As per the study made by Qdir, A. M., and Cooper [4], the system uses Flutter and Backend Firebase database which works on multiple platforms like Android and iOS. It can also work on Windows, Linux, and Mac OS as it uses Node.js as a back-end server and has a Web-based application. The Cargo can be transported to any country as multiple branches can be handled using GPS which helps in taking the current locations of cargo to provide it to the clients.

5) As per the study of J. C. Ferreira, V. Monteiro, J. L. Afonso and A. Silva [5], Vehicle-to-Grid (V2G) technology is used for Electric Vehicles and renewable energy sources to Smart Grids (SG). Exploration of Electrical Markets (EM) with deregulation of electricity production and use is also done to optimize the price of buying and selling the energy system. User interaction is facilitated through mobile applications. The EV charging is programmed and assisted by the Central Information Repository with Data Mining Approaches.

6) As reported by R. George, S. Vaidyanathan and K. Deepa [6], this paper focuses on defining the State of Charge and using the website created to locate a charging station to book a slot at the available time slot using the database management system.When a slot is selected and booked, the navigation is displayed and the user proceeds to the station to charge the EV.

III. Methodology

The great boom of the electric vehicle industry led a lot of people to switch from petrol and gas vehicles to electric vehicles. So the users need to know the location of charging stations where they can pay and charge their vehicles. High usage of electric vehicles and limited known locations of charging stations can be a problem for drivers which causes difficulty. So, this study aims to build an application using Dart programming language that will minimize the car moving distances to reach the nearest charging station. The Google Maps API provided by Google will be used for getting the map interface where all the charging stations for EV will be marked initially. These marked stations will also be having information on the type of charger available for charging such as CCS1 DC connector, CCS2 DC connectors, AC type-2 connector. With the help of this available information, the driver can book a slot for charging his vehicle at a location where he has the required charger type. The app will be using Google Geolocation API that will be providing the current location of the driver when the user of the app gives permission to access location services. An account is created on the application while setting up a password RegEx Expression, which means the password must be 8 letters long with 1 uppercase letter,1 lowercase letter, 1 digit and 1 special character. This service allows the user to get to the nearest charging station in his neighbouring. Limited by mileage, EVs must visit charging stations before the battery runs out. The app will be having a payment portal where they can pre-book the slot by paying the charge to the supplier to charge their vehicle prior to reaching the location. This allows the driver to save time.

Fig. 1. CCS1 and CCS2 charger connector

IV. Proposed System

Sharing charging stations with other users to charge their vehicles can be a good solution for routine usage of electric vehicles charging, In spite of there being a high demand for charging stations in cities they are not mostly vacant, while in the nearby rural areas, the stations are idle. Thus there was an urge to create an interface that can combine all this information and bring up a better solution. Hence, we came up with the idea of making a proper application. To create an application for finding EV charging stations on Google Maps the developer first need to integrate the app with Google Maps API into the application that will allow displaying maps and location information within the app. Gather data on EV charging stations, including their locations, availability, type of charger, and other relevant information. This data can be sourced from existing charging station networks or obtained through scraping websites and databases. Store the data collected in a database that can be easily queried and updated. Design a user-friendly interface for your application

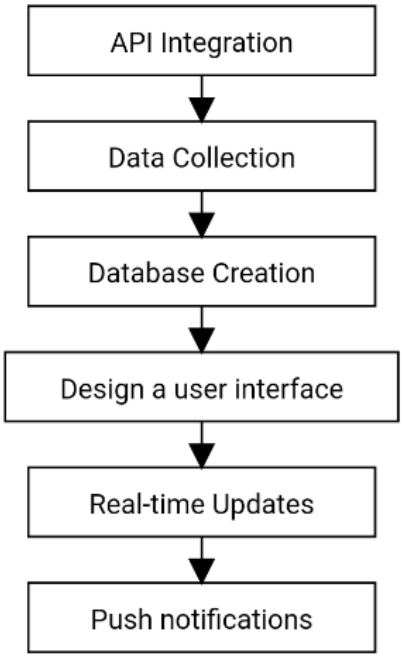

Fig. 2. Processing steps from the beginning of the application

that allows users to search for charging stations by location, view their availability and type of charger, and get directions to the station. Implement a search functionality that allows users to search for charging stations by location and filter their results by availability, type of charger, and other criteria. Incorporate real-time updates into the application, so that users can see if a charging station is occupied or not. This can be achieved by integrating with existing charging station networks or by using real-time data from users. The application when created will have a specific login page for ensuring the identity of the user where the user can register himself with a unique username and password. After creating an ID user can log in to the application by putting the credentials. If the credentials are proper the user access is approved, if not then the login request is denied. For finding nearby e-charging stations Geolocation API provided by Google comes into the picture. The user needs to enter his current location or give access to the location information to the app which will gather the current location and will be run by the dataset to find the nearby electric charging station. Following that, a booking section will have in booking the slot prior to reaching there. The directions are later provided to navigate.

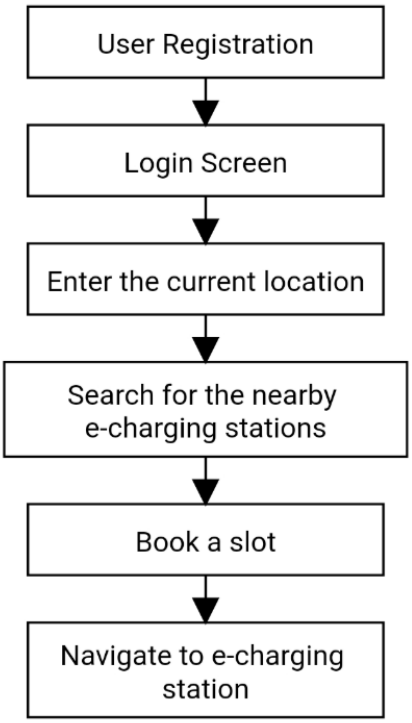

Fig. 3. Steps while using the application

V. Implementation

The task of the electric vehicle charging station locator is to find nearby charging stations with ease using one application that will navigate the driver to that location. The app is developed on Android Studio Projects using Dart programming language and Flutter framework. Flutter framework is easy to use and easy to understand. The rich features of Flutter framework allow app development simple for developers. Flutter provides the user with the platform to easily develop and distribute natively, aesthetically pleasing applications for different platforms. This application's main bid is on the maps that provide the locations of the charging stations on maps with markers. Integration is done with different APIs like Google Geolocation API, Google Maps API, MapMyIndia API, etc.

that will allow you to view maps, get current live locations and also provide navigation from Point A to B. The app interface will be basic and simple with aesthetic looks. On starting the app it will be having a login screen first where the user will have to log in with the unique identity that he might have created earlier. Or if the user is new then he will have to create

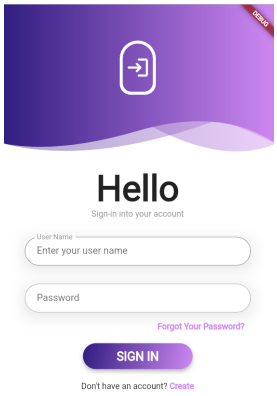

Fig. 4. Log in Screen of the application

a new account. The creation of an account is necessary for accessing this application, as it requires access to the location. While registering the user it will ask for basic details like the name of the user, phone number, address, etc. After creating the account and logging on to the application it will direct the user to the home page where he will be having access to features like booking slots for charging stations, markers on the map showing nearby charging stations, and a navigation feature to reach that location.

On the login page, there is also a widget for "Forget Password", where the user can gain access by sending a verification mail to the registered email. The home screen allows the user

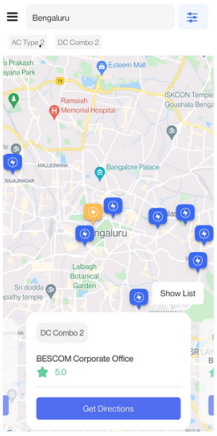

Fig. 5. Marker for nearby charging stations on the application

to find the nearby charging stations in two ways: firstly by entering the start location manually and another one is by giving the application access to the location which will be used because of the Google Geolocation API. This will give the shortest route to the user to reach the destination

by minimizing the time taken to reach the destination and also the distance. The user can also book a slot before going to the station based on the availability of the charging station with the required charger type. The booking can be done once the payment is done to the supplier.

The app will be having two modes of access. One will be user access, where the user can find charging stations, book slots for charging, etc ., Another mode of access is by being a supplier. Suppose you live in an area where you have a charging point all by yourself. It is not in much use and remains idle most of the time. So the owners of such kind of charging points can take access to suppliers where they can put their charging points as available for charging to others. Take into note that the charging station provided by that supplier will be private so, in that case, the security in residence comes into the picture.

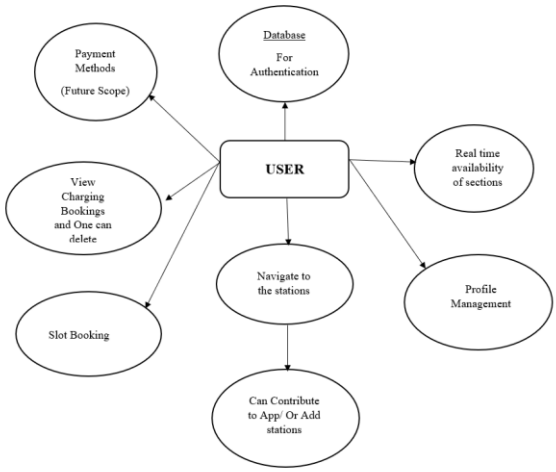

Fig. 6. Features of the application

VI. Future Scope

The future scope for locating nearby electric vehicle (EV) charging stations by applications is promising as the adoption of EVs continues to grow globally. As the number of EVs on the road increases, more people will require easy access to EV charging stations. Applications that help users locate and navigate to nearby charging stations are likely to see an increase in user adoption. Also, Artificial intelligence (AI) can be used to predict charging station usage patterns, helping to optimize charging station placement and improve user convenience. Future applications could use AI to provide real-time data on charging station availability and predict future demand. As the number of charging stations grows, payment systems for EV charging will become more important. Applications that can integrate with payment systems and provide real-time data on payment options could become essential for EV drivers. Overall, the future of applications that locates

nearby EV charging stations is bright, with opportunities for integration with other technologies and expansion into new markets. As more people adopt EVs, the demand for such applications is likely to increase, making them a valuable tool for drivers.

VII. Conclusion

In conclusion, making an application for locating electric charging stations for vehicles is a beneficial and necessary project in today's world. With the increasing number of electric vehicles on the road, having an application that can easily and accurately locate charging stations is crucial for the adoption of electric vehicles. The application should have a user-friendly interface, reliable and accurate charging station data, and real-time updates. Additionally, it should provide relevant information about the charging station, such as the types of charging ports available, charging speeds, and availability. By incorporating these features, the application will be a valuable tool for electric vehicle owners, helping them find the nearest and most convenient charging station, and ultimately supporting the growth of the e-vehicle market.

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