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ELECTRIC VEHICLE CHARGING STATION FINDER AND SLOT BOOKING MOBILE APPLICATION USING FLUTTER

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Abstract- *Electric vehicles (EVs) are becoming increasingly popular as a sustainable mode of transportation. However, one of the main challenges faced by EV owners is the availability and accessibility of charging stations. In this research, we present the development and implementation of an EV charging station finding the app using the Flutter framework. The app utilizes the Google Maps API to display the location of nearby charging stations and provides detailed information such as the type of connector, availability, and pricing. The app also allows users to filter charging stations based on their preferences and report any inaccuracies or out-of-service stations. User testing was conducted to evaluate the usability and effectiveness of the app. Results showed that the app was easy to use and provided accurate and up-to-date information on charging stations. The implementation of the app can help address the issue of charging station availability and improve the overall EV ownership experience.*

***Key Words*: Flutter Framework, Google Maps API, EV Charging Station**

1. INTRODUCTION

New industries are emerging, like Electric Vehicles (EVs). In India, Electric vehicles Sales are increasing. As mentioned in a below chart

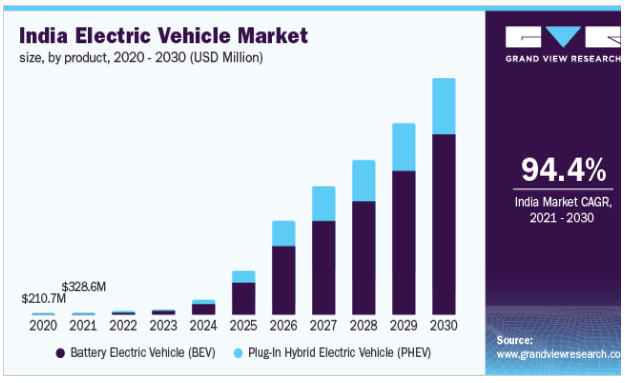

Fig -1: India Electric Vehicle Market

As of now electric charging stations are limited in India and people cannot find the right charging station which will save them time and money. The problem is not only finding the charging station but also charging it quickly because of the time required to charge the EVs. This leads to the inconvenience of EV users as requires a lot of time, so slot booking is required to charge EVs. As the electric vehicle industry is growing in India and fewer charging stations are available in India and new registrations of the charging station are growing so there is no availability of this growing charging station on virtual Maps. This leads to the inconvenience of the user in finding a charging station virtually. An electric vehicle (EV) charging station app is a mobile application designed for EV owners to locate and manage charging station services. The app provides information about the availability and location of charging stations, their charging speeds, and costs, and helps users to navigate to the nearest charging station. It also allows users to pay for charging services directly through the app, eliminating the need for cash or card payments at the station. Additionally, the app may track the charging history of the user's vehicle, allowing them to monitor their usage and spending. The main goal of an EV charging station app is to make the charging process as convenient and efficient as possible for EV owners. An electric vehicle (EV) charging station app is a mobile application designed for EV owners to locate and manage charging station services. The app provides information about the availability and location of charging stations, their charging speeds, and costs, and helps users to navigate to the nearest charging station. It also allows users to pay for charging services directly through the app, eliminating the need for cash or card payments at the station. Additionally, the app may track the charging history of the user's vehicle, allowing them to monitor their usage and spending. The main goal of an EV charging station app is to make the charging process as convenient and efficient as possible for EV owners. In this article, we will primarily focus on the basic idea of our project which we are going to develop. To give you our project's basic idea we have organized this paper into chapters; the second chapter is a literature survey which includes several documents, manuals, and analysis papers that are associated with our plan for the project, third chapter focus on the method which we will go to follow during the implementation of our project, and a fourth chapter is technology stack, which focuses on technologies we will be using during our project, fifth chapter is discussion, in which we will discussing in what manner we will be working on this project. Finally, we have to focus on future work and conclude the statement on how we are going to make this project ready for public use. In this project, we will design and develop an app that will find nearby charging stations of the user locality. The app will show all nearby electric vehicle charging stations. The user can directly navigate to these charging stations. This app will provide a facility for booking slots for charging the Electric vehicle of the users based on the type and charging

port of their vehicle in their convenient time slots. This app will save a lot of time for Electric vehicle owners.

2. LITERATURE REVIEW

Google Maps API provides several utilities for adding individual content to the Google map and various web map applications can be explored based on Google Maps API. Assisted mobile operation companies adopt global positioning systems (A-GPS) as the highest accurate positioning way in mobile location-based services. This paper proposes a solution for a mobile navigation system that realizes such functions as Google map browse and query, bus lines search, rapid local positioning on your mobile phone, etc. In this paper, we discuss the system's technical scheme and the key realization technologies. [1] GPS tracking has many uses in today's world; the system can be used for children tracking, asset, car, or any equipment tracking and as spy equipment. The system permits the localization of a portable tracked unit and transmitting the position to the tracking center. [2] The GPS tracking system consists of a portable tracked device attached to a person, vehicle, or any asset and the tracking center where the portable device's location should be monitored. The mobile tracked device receives its coordinates from the GPS and sends these coordinates as SMS via GSM modem to the tracking center, which is simply a personal computer with many interface programs to display the location on Google maps using a free version of Google Maps APIs (application programming interfaces). Flutter is a popular UI framework for developing mobile applications for Google. It has caught traction in recent years. However, Flutter developers have to deal with a state management issue when developing their applications. [3] To solve this problem, multiple architectures have been developed. This paper proposes a new Flutter architecture based on the Clean Architecture by Uncle Bob. The Flutter Clean Architecture proposed in this paper is packaged and released through a Flutter package. The architecture is tested by developing a full application from scratch using the package and documenting the process. [4] It is a good programming practice to include runtime checks called assertions in the code to check assumptions and invariants. Assertions are said to be often most effective when they encode design decisions and constraints. In this paper, we show our preliminary work on translating design constraints to assertions for mobile apps. Design properties and constraints are specified formally in the Object Constraint Language (OCL) and translated to executable assertions written in Dart, the language of the Flutter cross-platform framework. We consider various language and platform-specific features of OCL, Dart, and Flutter. [5] The development of Cross-platform mobile applications is a goal of every client in today's world. Engineers are forced to build the same system multiple times for different OS (operating systems). Google provides a solution by introducing Flutter. It is an open-source SDK for improving high performance and the most reliable mobile apps for apps like iOS, Android, Linux, web, and windows. [6] It provides a feature of timely compiling using a computer code that includes integration during the execution of the program in working time instead of previous practice. [7] Flutter provides different frameworks and widgets that make it easy to use and implement code. In this Research paper, we are going to discuss flutter and its widgets. In recent years, research and development of electric vehicles have been promoted in Indonesia as new technologies. The provision of charging station (CS) infrastructure for electric vehicles (EV) is essential to ensure flexibility. Managing the EV Charging Station is challenging due to communicating several brands into the central system. We successfully developed the charging station management system (CSMS). Application development is used to make a tool in the form of a CSMS application to monitor and control CS with the name SONIK (electric vehicle charging operation system). [8] The general trend is for an increase in the number of electric cars, but at the same time, it is necessary to expand the charging infrastructure. With the construction of new charging stations, certain problems arise in the electrical networks, especially in urban areas. In this paper, a classification of the types of charging stations is made and a Matlab model of a charging station powered by a DC power supply is presented. [9] Sharing charging stations are an effective solution for daily usage of electric vehicles charging, however, area with high demand cannot provide enough stations while there are plenty of stations left idle in remote areas with less demand. The core of the problem is the imbalance of demand and supply. In other words, we need to allocate the charging station to the appropriate locations to balance demand and supply. This study aims to solve the problem of locating charging stations for public electric vehicles (PUEVs), to improve the sharing charging level. We take into consideration the factors affecting charging station locations including mileage, PUEV distribution, and passenger distribution. A Non-deterministic Polynomial (NP) model aiming to minimize the total vehicle service distance is developed. [10] This paper optimizes the existing location by improving the constraint for the smallest number of charging stations; the proposed model can be used for EV charging stations' location in the densely populated metropolis. The journey towards transportation electrification started with small electric vehicles (i.e., electric cars), which have enjoyed an increasing level of global interest in recent years. [11] Electrification of commercial vehicles (e.g., trucks) seems to be a natural progression of this journey, and many commercial vehicle manufacturers have shifted their focus to medium- and heavy-duty vehicle electrification over the last few years. In this paper, we present a comprehensive review and analysis of the existing works presented in the literature on commercial vehicle charging. [12]

3. METHODOLOGY

In the recent decade, we have witnessed monumental advancements in electric vehicles and charging technology. Along with helping cut down on emissions, electric vehicles also have better power delivery and prove to be far more efficient as they can employ regenerative braking to recharge their batteries while on the move. Despite their many advantages, electric vehicles still fall short when it comes to aspects such as finding charging stations. So, we come up with the idea to design an Electric vehicle charging station finding app which facilitates a pleasing experience for the user with its unique features. In this system, the user can manage all their EVs inside the app plus they can search for or book a slot in advance in the charging station. Developed using Flutter, this EV Charging Station App has been developed to help EV drivers locate available charging stations near them. After locating a charging station, users can also book a slot at the station to charge their vehicle.

3.1 Modules and Their Description

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

1) Admin:

- Login.
- Manage stations.
- View bookings.

2) User:

- Register.
- Login.
- Manage EV vehicles.
- Find stations.
- View bookings.

3.2 Use Case Diagram

A use case diagram is a type of behavioral UML diagram that depicts the interactions between actors and the system being developed.

1) Admin:

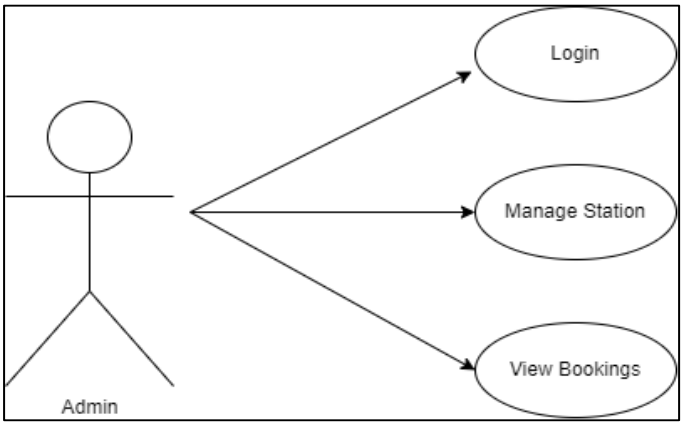

Fig -2: Use Case Diagram for Admin

2) User:

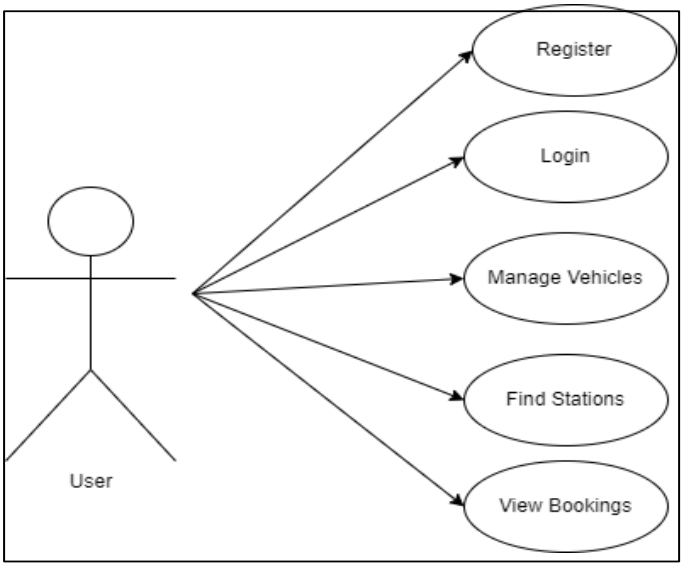

Fig -3: Use Case Diagram for user

4. TECHNOLOGY STACK

Flutter: Flutter is a free and open-source mobile application development framework created by Google. It uses the Dart programming language to build high-performance, high-fidelity, apps for iOS and Android, web, and desktop from a single codebase.

Android Studio: Android Studio is the official integrated development environment (IDE) for Google's Android operating system. It is built on the IntelliJ IDEA platform and designed specifically for Android app development. It offers a rich set of features for building, testing, and debugging Android apps, including a visual layout editor, code editor, emulator, and debugging tools.

Xcode: Xcode is an integrated development environment (IDE) created by Apple for developing software on MacOS, iOS, pads, watches, and TVs. It is the primary tool used by developers to build applications for the Apple ecosystem. Xcode provides a complete suite of tools for software development, including a source code editor, a graphical user interface builder, testing tools, and a powerful debugger. Xcode makes it easy for developers to create high-quality, native apps for Apple's platforms.

Firebase: Google Firebase is software that is used for the application development of iOS, Android, and web apps. It is a google-backed application development software. Firebase provides services tools and support for real-time tracking systems, fixing of app crashes, product experiments, and reporting of app crashes.

Firebase Authentication: Firebase Authentication provides backend services for the authentication of users of the app. It provides service authentication in different formats such as password authentication, phone number authentication using OTP, and Organization identity providers like Facebook, Twitter, Google, and more. It provides easy SDKs to use and already Ui libraries also.

Azure Data Studio: Azure Data Studio is a free, cross-platform data management tool developed by Microsoft. It is designed to work with various data platforms including SQL Server, Azure SQL Database, and Azure Synapse Analytics (formerly SQL DW). Azure Data Studio provides a rich set of features for data management, including a customizable editor, code snippets, source control integration, and a built-in terminal. It also supports multiple database engines including SQL Server, PostgreSQL, and MySQL.

Google Play Services: Google Play services provide a large set of SDKs on android to help us to build our app, increase privacy and security, engagement of the users, and grow your apps. These SDKs are unique. These libraries require a thin client library to be included in our app. At runtime, the client library communicates with the packages of the SDK's implementation and footprint in Google Play services.

Google Maps API: It is a set of APIs (application programming interfaces) that provide the communication bridge to Google's various services. It will help us to build simple android, iOS, and apps to very complex apps which are based on real-time location for Android, web, and iOS.

Google Place API: The Places API (application programming interface) is a service that provides information about places using HTTP requests. Prominent points of interest like establishments or geographic locations are referred to as places in these APIs.

Google Direction API: It is a set of APIs (application programming interfaces) that provide the communication bridge to Google's various services. It provides to navigate to the destination from the source. It will help us to build simple android, and iOS apps to very complex apps which are based on real-time location for Android, web, and iOS.

5. DISCUSSION

The concepts and methodologies that we will implement in the way, so we will interact with the app directly and it will be very interactive, reliable, and easy to use by the users as well as by the owner of an electric charging station. The architecture will be adopted to develop and deploy many services like real-time location finder, Google map, Navigation, slot booking and management, and profile management.

6. CONCLUSION

The main purpose of the project is to develop a useful product for EV users which will be very convenient for them. This app will not only provide service to the user but will also be used by the admin as an interactive system. It can also generate more data about the user who owns electric vehicles and the owners of the charging station. One can use it to find as well as navigate to stations. This app will also be expanded in the future as a commercial product with more features that will also use subscription packs, as well as features like charge and chill which will generate more revenue.

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