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Plug & Go: Ev Station Locator and Slot booking Android Application

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ABSTRACT :

Electric vehicles (EVs) are gaining traction as a sustainable means of transportation. However, a significant hurdle for EV owners is the accessibility of charging infrastructure. This study introduces a Java-based EV charging station locator app, leveraging Firebase Realtime Database, aimed at addressing this challenge. Integrating the Google Maps API, the app pinpoints nearby charging stations, furnishing users with vital details such as connector types, availability status, and pricing information. Additionally, users can tailor their search criteria and report inaccuracies or non-functional stations. Through user testing, the app demonstrated user-friendly navigation and provided reliable, current data on charging stations. Implementing this app holds promise in ameliorating the availability conundrum and enhancing the EV ownership experience

Keywords: Plug & Go App, Java, XML, Firebase Realtime Database.

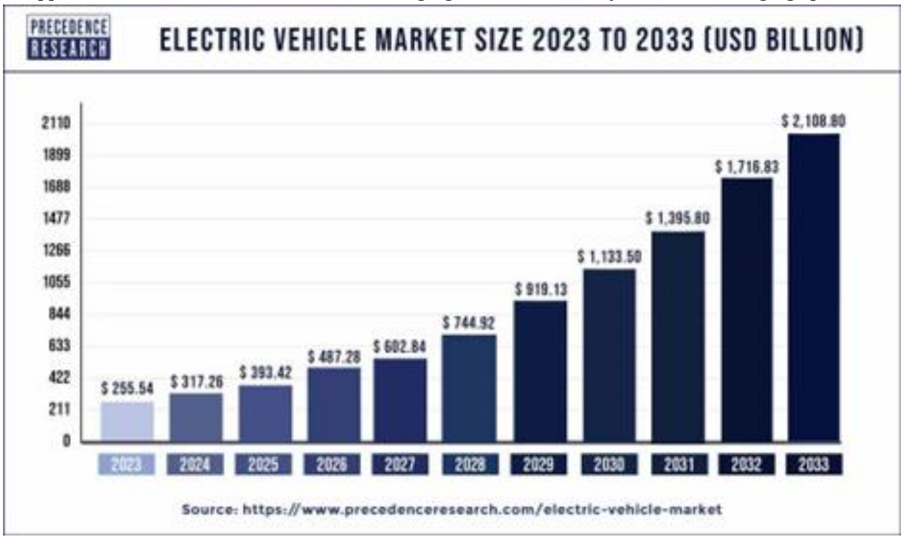
Introduction :

Emerging sectors such as Electric Vehicles (EVs) are witnessing growth, particularly in India where sales of electric vehicles are on the rise, as illustrated in the chart below.[1]

Fig-1: Electric Vehicle Market Growth

Currently, the availability of electric charging stations in India is limited, posing challenges for individuals seeking convenient and cost-effective charging solutions. The issue extends beyond locating charging stations to include the time-consuming process of charging electric vehicles (EVs) swiftly.

As the electric vehicle (EV) industry expands in India, the scarcity of charging stations persists, hindering users' ability to locate them efficiently through virtual maps. To address this issue, an EV charging station app is proposed, aimed at assisting EV owners in finding and managing charging services seamlessly. [1][2] The app offers essential information such as charging station availability, locations, charging speeds, and associated costs,



facilitating users' navigation to the nearest station. Moreover, it streamlines payment processes by enabling direct transactions through the app, eliminating the need for cash or card payments onsite. Additionally, the app can track users' charging history, enabling them to monitor usage and expenses effectively. The primary objective of the EV charging station app is to enhance the convenience and efficiency of the charging process for EV owners.

This project entails several chapters: the second chapter comprises a literature survey, gathering relevant documents and analysis papers associated with the project's objectives; the third chapter outlines the implementation methodology; the fourth chapter discusses the technology stack, detailing the technologies employed in the project; the fifth chapter delves into discussions on project execution strategies. [3] Lastly, the project's future work and plans for public deployment are addressed in the concluding section.

The core aim of this project is to design and develop an app capable of identifying nearby charging stations within the user's vicinity. The app will display all nearby EV charging stations, enabling users to navigate directly to them. Additionally, users can book charging slots tailored to their vehicle's type and charging port, optimizing convenience and saving time for EV owners.[3][4]

Literature Review

The Google Maps API offers a range of tools for integrating custom content into Google Maps, facilitating the development of various web map applications. With the rise of assisted mobile operation companies adopting A-GPS as the most accurate positioning method for location-based services, there's a growing need for mobile navigation systems with functionalities like browsing and querying Google Maps, searching for bus lines, and enabling rapid local positioning on mobile devices. This paper proposes a solution to address these needs, discussing the technical scheme and key implementation technologies of such a mobile navigation system.

Furthermore, GPS tracking systems have diverse applications in today's world, including tracking children, assets, vehicles, or equipment, and even serving as surveillance tools. [4][6] This paper outlines a GPS tracking system comprising a portable tracked device linked to an object or person and a tracking center that monitors the device's location. The system utilizes GSM modems to transmit the device's coordinates to the tracking center, which visualizes the location on Google Maps using the free version of Google Maps APIs.

Java has emerged as a popular UI framework for developing mobile applications compatible with various platforms such as iOS, Android, Linux, web, and Windows. To address state management issues encountered by Java developers, this paper proposes a Java architecture based on the Clean Architecture by Uncle Bob, packaged and released through a Java package. The architecture's efficacy is validated by developing a full application from scratch and documenting the process.

In addition, assertions, which are runtime checks incorporated into code to verify assumptions and invariants, play a crucial role in programming practice. [5] This paper presents preliminary work on translating design constraints into assertions for mobile apps. Formal specifications using Object Constraint Language (OCL) are translated into executable assertions written in Dart, the language of the Java cross-platform framework, considering language and platform-specific features.

Moreover, with the increasing demand for cross-platform mobile applications, Google introduces Java as an open-source SDK aimed at enhancing app performance and reliability across multiple operating systems. [6][7] The paper explores Java's frameworks and widgets, highlighting their ease of use and implementation.

The research and development of electric vehicles (EVs) have gained momentum globally, including in Indonesia. To support EV adoption, charging station (CS) infrastructure is crucial. The paper discusses the development of a charging station management system (CSMS) called SONIK, aiming to monitor and control CS efficiently.[7]

Furthermore, the electrification of transportation has extended beyond electric cars to include commercial vehicles like trucks. The paper provides a comprehensive review and analysis of existing literature on commercial vehicle charging, reflecting the ongoing journey towards transportation electrification.

Overall, the papers presented in this literature cover various aspects of mobile navigation, GPS tracking, Java architecture, assertion-based programming, charging station management, and commercial vehicle electrification, contributing to the advancement of these fields.

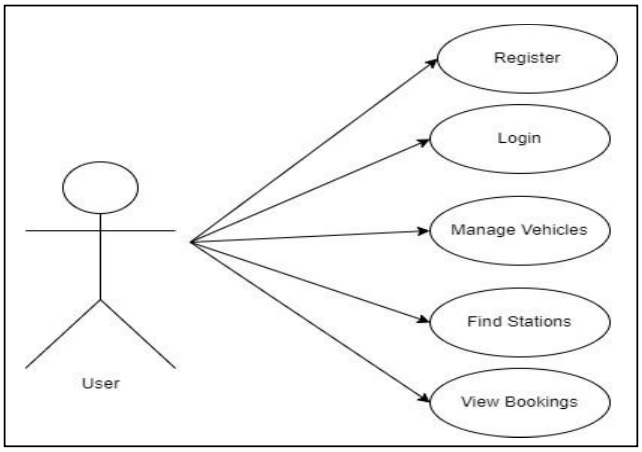
Methodology

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. [3] Developed using Java, 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.

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.

2.1. Use Case Diagram

A use case diagram is a type of behavioural UML diagram that depicts the interactions between actors and the system being developed.[9]

1] Admin:

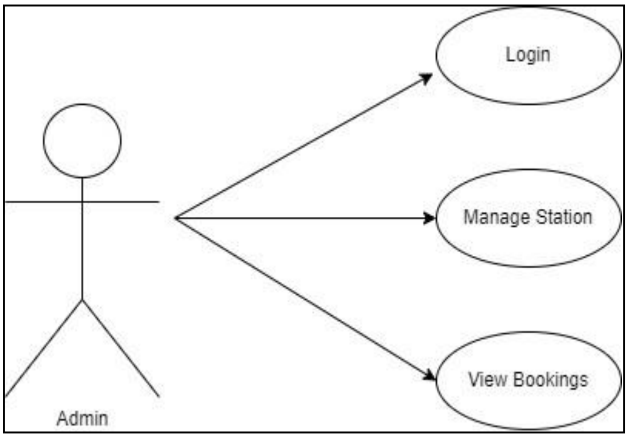
Fig-2: Use Case Diagram for Admin

2] User:

Fig-3: Use Case Diagram for User

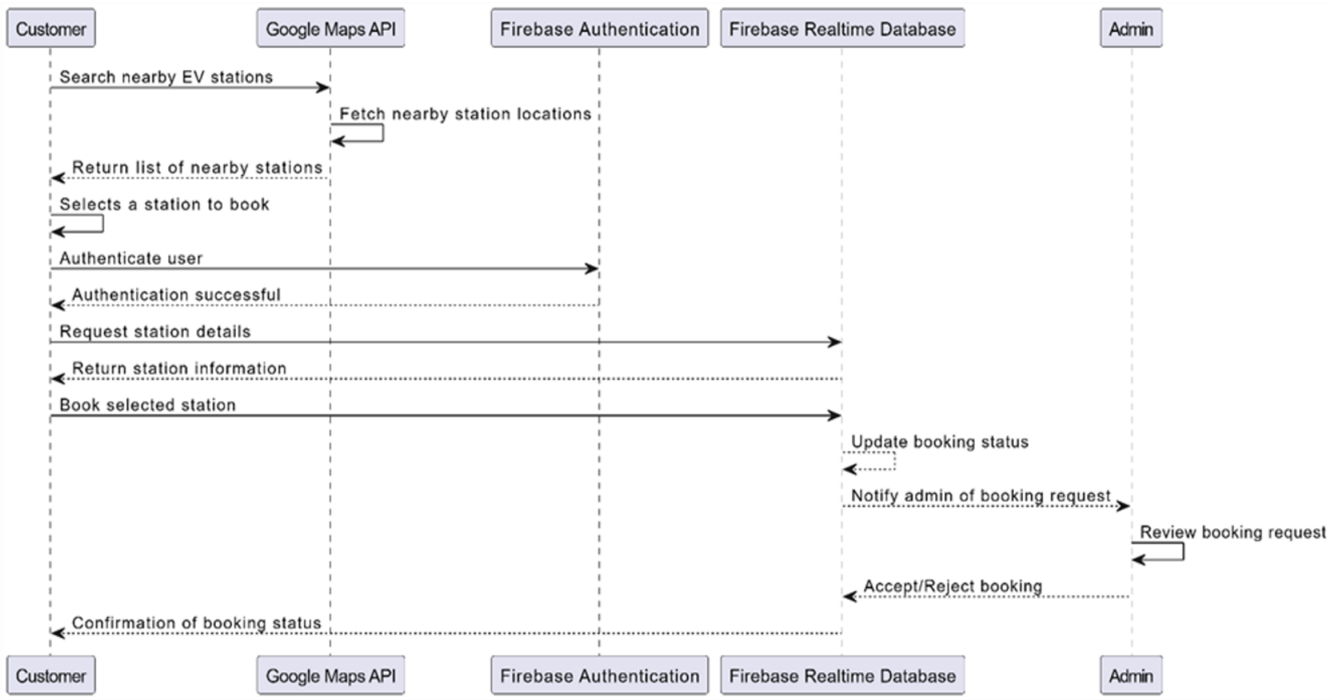
Technology Stack

- **Java:** Java 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 anddesigned specifically for Android app development.

- **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 SDKsto use and already Ui libraries also.
- **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, theclient library communicates with the packages of the SDK'simplementation and footprint in Google Play services.
- **Google Maps API:** It is a set of APIs (applicationprogramminginterfaces) that provide the communication bridge to Google's various services. It will help us to build simple android, iOS, and apps tovery 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. Prominentpoints of interest like establishments or geographiclocations are referred to as places in these APIs.[3][7][8]



System Flow Chart/Sequence Diagram:

Discussion :

The strategies and approaches we intend to employ will ensure direct interaction with the app, fostering a highly interactive, dependable, and user-friendly experience for both EV users and charging station owners. Our architecture will encompass various services including real-time location tracking, integration with Google Maps, navigation assistance, slot booking and management, and user profile management.[6][9][10].

Conclusion :

The primary objective of this project is to create a practical solution for EV users that offers utmost convenience. This app will not only serve users but also function as an interactive platform for administrators. Additionally, it will gather valuable data regarding EV owners and charging station operators. Users can utilize it for locating and navigating to charging stations seamlessly. Moreover, there are plans to expand this app into a commercial product in the future, offering enhanced features such as subscription packs and revenue-generating options like "charge and chill".

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$$\rho = \frac{\vec{E}}{J_C(T = \text{const.}) \cdot \left(P \cdot \left(\frac{\vec{E}}{E_C} \right)^m + (1 - P) \right)} \tag{1}$$

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Appendix A. An example appendix

Authors including an appendix section should do so before References section. Multiple appendices should all have headings in the style used above. They will automatically be ordered A, B, C etc.

Example of a sub-heading within an appendix

There is also the option to include a subheading within the Appendix if you wish.

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