

Flutter Based Solution for Efficient Electrical Vehical Charging Slot Booking System

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ABSTRACT

Electric vehicles (EVs) are gaining traction as a sustainable means of transportation, reflecting a growing awareness of environmental concerns. However, EV owners encounter a significant challenge in accessing and locating charging stations. This study presents a novel solution: the development and deployment of a dedicated EV charging station locator application built using the Flutter framework. Leveraging the capabilities of the Google Maps API, the application offers users an intuitive interface to pinpoint nearby charging stations and access crucial details such as connector types, availability status, and pricing. Additionally, users can customize their search preferences and report any inaccuracies or inactive stations, contributing to the app's accuracy and reliability. Rigorous user testing was conducted to assess the app's usability and effectiveness, revealing its simplicity and provision of real-time, precise information on charging stations. The introduction of this application addresses the pressing issue of charging station accessibility, ultimately enhancing the overall EV ownership experience for users.

Keywords: Electric vehicles (EVs), Charging stations, Flutter framework, Google Maps API, Real-time information

INTRODUCTION

In the ever-evolving landscape of modern transportation, the last decade has witnessed a remarkable surge in electric vehicle (EV) technology, coupled with significant advancements in charging infrastructure. Beyond their role in mitigating emissions, electric vehicles offer superior power delivery and efficiency, leveraging innovations like regenerative braking to recharge batteries while in motion. Nevertheless, a pressing challenge persists—the accessibility of charging stations.

Unlike traditional vehicles that can refuel at any gas station, EV owners must carefully plan their journeys to ensure adequate charging. Recognizing the imperative need for robust charging infrastructure, we introduce an innovative solution: the EV Charging Station app. Developed utilizing the versatile Flutter framework, this application is crafted to empower EV drivers by seamlessly connecting them with available charging stations in their vicinity.

This paper delves into the essential features and functionalities of the EV Charging Station app, emphasizing its role in not only pinpointing charging points but also enhancing the user experience through slot booking capabilities. Furthermore, the app transcends conventional charging station locators by providing a comprehensive trip planning feature. By inputting their starting point and destination, users receive a personalized roadmap, highlighting all relevant charging stations along the route.

In this era of sustainable transportation, the EV Charging Station app emerges as a pivotal tool, addressing the evolving needs of the burgeoning electric vehicle community. This introduction lays the groundwork for a thorough exploration of the app's development, functionalities, and its potential impact on enhancing the convenience and efficiency of electric vehicle ownership. By streamlining the charging process and providing essential features, this application aims to save time for users and facilitate long-distance travel planning. Ultimately, it seeks to enhance the overall electric vehicle experience, enabling riders to fully enjoy the benefits of electric transportation.

LITERATURE SURVEY

1. The Study and Implementation of mobile GPS Navigation System based on Google Maps by H. Li, L. Zhijian Google Maps API is a set of application Programming Interfaces that let us talk to its Services. It will allow us to build Simple Apps to Very Sophisticated Location-Based Apps for Web, IOS and Android.[1]
2. GPS- Based Mobile Cross platform Cargo Tracking System with Web-Based Application by using Global Positioning System (GPS). GPS is a System of 30+ Navigating Satellites circling Earth. We know where they are because they constantly send out Signals. Once the Receiver Calculates its distance from four or more GPS satellites, it can figure out where you are.[2]
3. API Recommendation System for software development by F. Thung APIs Simply how developers integrate new Application components into an Existing Architecture, they help business and IT teams to Collaborate. Business needs often change quickly in response to ever shifting digital Markets, where new Competitors can Change a Whole Industry with a new App. [3]
4. Smart Electric Vehicle Charging System João C. Ferreira, Vítor Monteiro, João L. Afonso, Alberto Silva Member, IEEE In this work is proposed the design of a system to create and handle Electric Vehicles (EV) charging procedures, based on intelligent process. Due to the electrical power distribution network limitation and absence of smart meter devices, Electric Vehicles charging should be performed in a balanced way, taking into account past experience, weather information based on data mining, and simulation approaches.[4]
5. In this article, we introduce an EV charging station finder app developed for Android devices using Java and Kotlin. The app aims to address the challenge of locating charging stations for EV owners. With features like station location and journey planning, it offers convenience to users navigating the limited charging infrastructure.[5]
6. This paper explores the critical aspects of planning electric vehicle (EV) charging infrastructure amid the global shift towards zero-emission vehicles. It discusses the need for charging stations and emphasizes the importance of integrating information technology, distributed energy generation units, and supportive government policies. The paper reviews current EV trends, grid integration challenges, and optimal charging station placement.[6]
7. The paper presents an innovative Android application aimed at improving navigation by empowering users to customize map locations. Unlike conventional navigation apps, this solution allows users to add or remove specific places like hospitals, schools, and restaurants directly on the map. It leverages Google Maps APIs, Google Direction APIs, PHP, JSON, and MySQL to deliver essential navigation features such as displaying optimal routes, calculating distances, and estimating travel times. Operating on a client/server architecture, the Android app serves as the client while a backend system powered by PHP and MySQL database functions as the server, ensuring seamless functionality and user interaction.[7]
8. A new framework, EV2X communication and Charge Slot booking, integrates electric vehicles into daily life, addressing grid-run charging challenges. It combines LTE technology with conventional OCPP for efficient communication and user control. Prioritizing slot booking and utilizing intelligent power management units optimize charging cycles. Evaluation in a large-scale network shows reduced waiting times and cost savings.[8]
9. This article explores the challenges of EV charging station placement and EV adoption, addressing factors like battery degradation, infrastructure, and smart grid integration. It compares Level 1, Level 2, and DC charging stations, various battery types, and EV models to determine optimal choices. Using Agartala, India as a case study, it identifies strategic locations for charging stations.[9]

SYSTEM ARCHITECTURE

. The online EV charging slot booking system consists of an Android application, Electric Vehicles (EVs), Roadside Units (RSUs), Firebase, and charging stations.

The Android app allows EV owners to browse, book, and pay for charging slots, while EVs interact with the app to initiate bookings and receive updates. RSUs provide real-time information to EVs and facilitate communication with the central system. Firebase manages the backend infrastructure, storing data and handling user authentication. Charging stations offer

physical charging facilities and communicate with the system to confirm bookings and process payments. Together, these components enable efficient booking and utilization of charging slots for electric vehicles

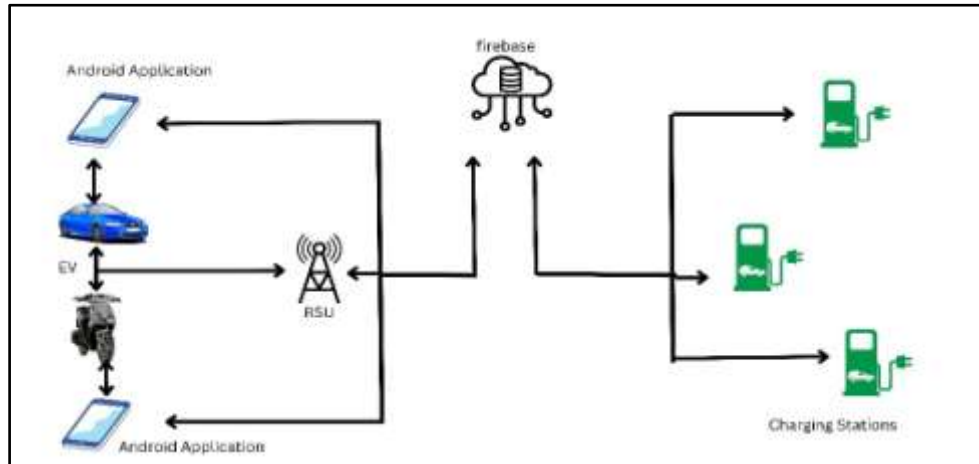


Fig 3: System Architecture

METHODOLOGY

Over the past decade, significant advancements have been made in electric vehicles (EVs) and charging technology, leading to reduced emissions and improved power delivery efficiency. Despite these benefits, challenges remain, particularly in locating charging stations. To address this, we propose the development of an Electric Vehicle Charging Station Finder app, offering a user-friendly experience with unique features. This system allows users to manage their EVs within the app and search for or book charging slots in advance at charging stations. Developed using the Flutter framework, the EV Charging Station App aims to assist EV drivers in locating nearby charging stations and booking slots for charging their vehicles.

4.1 Modules and Their Description:

The system consists of two major modules, each with its own sub-modules:

1. Admin:

Login: Allows administrators to securely access the admin dashboard.

Manage stations: Enables administrators to oversee and maintain information about charging stations, including adding, updating, or removing stations as needed.

View bookings: Provides administrators with a comprehensive view of all bookings made by users at charging stations.

2. User:

Register: Allows users to create an account by providing necessary information.

Login: Enables users to securely log in to their accounts.

Manage EV vehicles: Allows users to add, edit, or remove information about their EVs, including make, model, and registration details.

Find stations: Provides users with the ability to search for nearby charging stations based on their current location or specified criteria.

View bookings: Allows users to view their booking history and status of current bookings at charging stations.

By implementing these modules, the EV Charging Station Finder app aims to streamline the process of locating and booking charging stations, thereby enhancing the overall experience for EV owners.

4.2 Use case Diagrams:

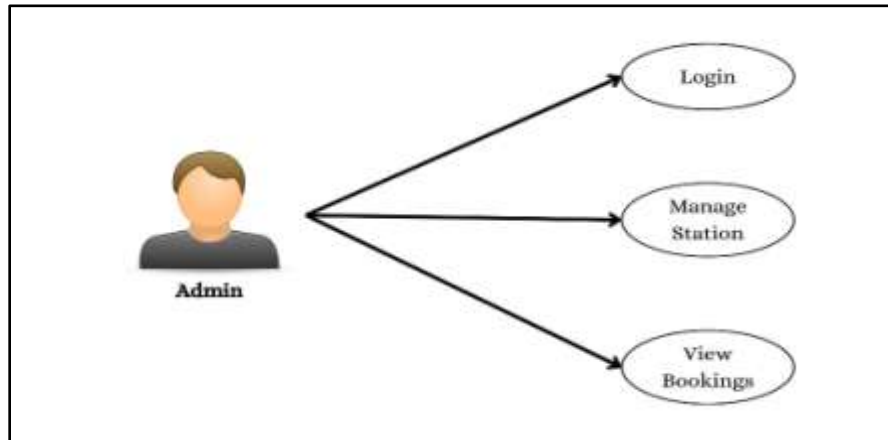


Fig5.2.1:- Use case diagram for admin

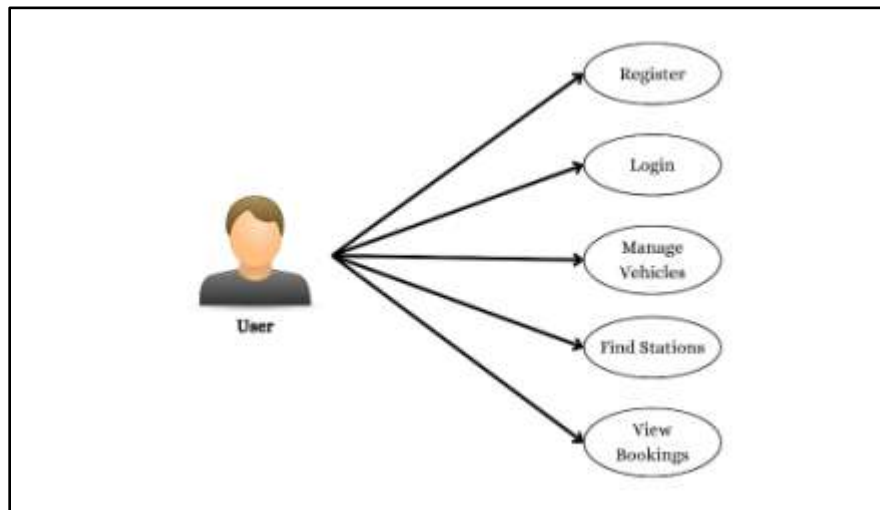


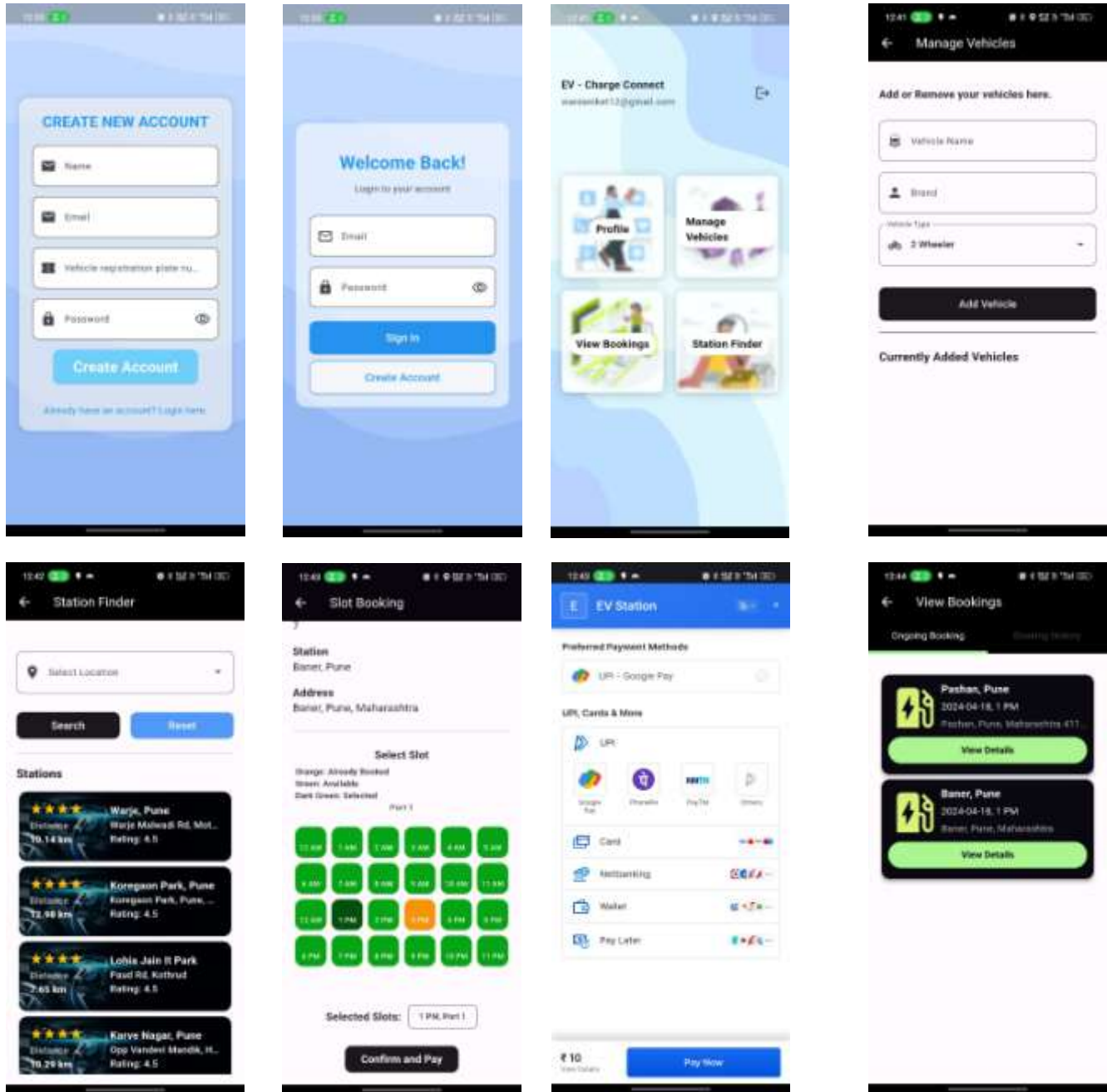
Fig5.2.2:- Use case diagram for admin

TECHNOLOGY STACK

1. Flutter: Flutter is a versatile mobile application development framework developed by Google, utilizing the Dart programming language. It enables developers to create high-performance apps for iOS, Android, web, and desktop platforms from a single codebase, simplifying the development process and ensuring consistent user experiences across different devices.
2. Android Studio: Android Studio is Google's official IDE for Android app development, built on the IntelliJ IDEA platform. It offers a range of tools, including a visual layout editor, code editor, emulator, and debugging utilities, to streamline the development process for Android applications.
3. Firebase: Firebase, developed by Google, is a versatile platform for iOS, Android, and web application development. It offers a comprehensive suite of services, tools, and support aimed at enhancing the development process. Firebase facilitates real-time tracking, crash fixing, product experiments, and app crash reporting, providing developers with robust capabilities to build and maintain high-quality applications.
4. Firebase Authentication: Firebase Authentication provides backend services for user authentication in apps. It supports password authentication, phone number authentication with OTP, and integration with identity providers like Facebook and Google. Firebase Authentication offers easy-to-use SDKs and UI libraries for developers.

5. Google Maps API: The Google Maps API is a collection of application programming interfaces (APIs) that facilitate communication with Google's diverse range of services. It enables the development of applications ranging from simple to highly complex ones, leveraging real-time location data for Android, web, and iOS platforms.
6. Google Directions API: The Google Directions API is a collection of application programming interfaces (APIs) that facilitate communication with Google's services. It enables navigation from a source to a destination, supporting the development of applications across Android, iOS, and web platforms that utilize real-time location data.

RESULT



FUTURE SCOPE

In the future, the EV Charging Station Finder and Slot Booking App can be enriched with additional features like seamless payment options, predictive analytics, social engagement tools, and loyalty programs. Enhanced user interaction through

AR navigation and voice assistants, along with personalized recommendations and gamification, will improve user experience. Compatibility can be extended to wearable devices, smart TVs, and IoT platforms, with in-car integration with vehicle manufacturers. Global expansion and localization efforts, coupled with continuous updates and exploration of emerging technologies, will ensure the app remains competitive and relevant in the market.

CONCLUSION

In summary, the EV Charging Station Finder and Slot Booking App represents a significant advancement in catering to the needs of both EV users and charging station providers. This innovative application not only streamlines the process of locating and reserving charging slots for users but also offers charging station vendors a platform to efficiently manage their facilities and cultivate customer relationships. As we look ahead, potential enhancements such as subscription models and value-added services like "charge and chill" hold promise for expanding the app's commercial viability and revenue streams. Ultimately, this project serves as a pivotal step towards fostering a more accessible and user-friendly environment for electric vehicle adoption, benefiting both individuals and the broader sustainable transportation ecosystem.

REFERENCES

- [1] H. Li and L. Zhijian , "The study and implementation of mobile GPS navigation system based on Google Maps," in International Conference on Computer and Information Application, Tianjin, China, 2010.
- [2] GPS-based mobile app tracking system with Web- based Application. An M Qadir, P.Coope of author to create the GPS tracker
- [3] API Recommendation System for Software Development F.Thung. Trip collecting Route Optimization with Operating time and Duration of Constraints.
- [4] Smart Electric Vehicle Charging System João C. Ferreira, Vítor Monteiro, João L. Afonso, Alberto Silva Member, IEEE.
- [5] Nishant S. Chaturkar , Rahul B. Lanjewar , Shreyash B. Wadaskar and Khushal D. Ingole , "Electric Vehicle Charging Station Finding App," International Journal of Advanced Research in Science, Communication and Technology (IJARSCT, vol. 2, no. 2, pp. 50-60, 2022.
- [6] Muhammad Shahid Mastoi, Shenxian Zhuang, Hafiz Mudassir Munir, Malik Haris, Mannan Hassan, Muhammad Usman, Syed Sabir Hussain Bukhari, Jong-Suk Ro, An in-depth analysis of electric vehicle charging station infrastructure, policy implications, and future trends,Energy Reports,Volume 8,2022,Pages 11504-11529,ISSN 2352-4847,https://doi.org/10.1016/j.egyr.2022.09.011.
- [7] Design and Implementation of an Online Location-Based Service Using Google Maps for Android Mobile Dr. Omar A. Ibrahim 1, Khalid J. Mohsen2.
- [8] Chavhan, S., Dubey, N., Lal, A., Khetan, D., Gupta, D., Khanna, A., ... Pinheiro, P. R. (2020). Next-Generation Smart Electric Vehicles Cyber Physical System for Charging Slots Booking in Charging Stations. IEEE Access, 1–1. doi:10.1109/access.2020.3020115
- [9] Somudeep Bhattacharjee et all,. “Investigating Electric Vehicle (EV) Charging Station Locations for Agartala, India.” 2nd International Conference of Multidisciplinary Approaches on UN Sustainable Development Goals. December 2017.