M.KUMARASAMY
COLLEGE OF ENGINEERING
NAAC Accredited Autonomous Institution
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ISO 9001:2015 Certified Institution
Thalavapalayam, Karur – 639 113.

A Minor Project Report

On

SMART EV CHARGING STATION FINDER WITH REAL TIME AVAILABILITY

Submitted by

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M.KUMARASAMY COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to Anna University, Chennai)

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MAY 2025

M.KUMARASAMY COLLEGE Of ENGINEERING

(Autonomous Institution, Affiliated to Anna University, Chennai)

BONAFIDE CERTIFICATE

Certified that this Report titled **"SMART EV CHARGING STATION FINDER WITH REAL TIME AVAILABILITY "** is the bonafide work of **ELAKKIYADASAN T(927622BEE029), KARTHICK RAJA K(927622BEE052), KARTHIKEYAN K(927622BEE053)** who carried out the work during the academic year (2024-2025) under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other project report.

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Submitted for Minor Project IV (18EEP302L) viva-voce Examination held at M.Kumarasamy College of Engineering,Karur-639113 on ……………….

DECLARATION

We affirm that the Minor Project IV report titled "SMART EV CHARGING STATION FINDER WITH REAL TIME AVAILABILITY" being submitted in partial fulfillment for the award of Bachelor of Engineering in Electrical and Electronics Engineering is the original work carried out by us.

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VISION AND MISSION OF THE INSTITUTION

VISION

- ✓ To emerge as a leader among the top institutions in the field of technical education

MISSION

- ✓ Produce smart technocrats with empirical knowledge who can surmount the global Challenges.
- ✓ Create a diverse, fully-engaged, learner - centric campus environment to provide Quality education to the students.
- ✓ Maintain mutually beneficial partnerships with our alumni, industry, and Professional associations.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To produce smart and dynamic professionals with profound theoretical and practical knowledge comparable with the best in the field.

MISSION

- ✓ Produce hi-tech professionals in the field of Electrical and Electronics Engineering by inculcating core knowledge.
- ✓ Produce highly competent professionals with thrust on research.
- ✓ Provide personalized training to the students for enriching their skills.

PROGRAMME EDUCATIONAL OBJECTIVES(PEOs)

- ✓ **PEO1:** Graduates will have flourishing career in the core areas of Electrical Engineering and also allied disciplines.
- ✓ **PEO2:** Graduates will pursue higher studies and succeed in academic/research careers
- ✓ **PEO3:** Graduates will be a successful entrepreneur in creating jobs related to Electrical and Electronics Engineering /allied disciplines.
- ✓ **PEO4:** Graduates will practice ethics and have habit of continuous learning for their success in the chosen career.

PROGRAMME OUTCOMES(POs)

After the successful completion of the B.E. Electrical and Electronics Engineering degree program, the students will be able to:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/Development of solutions:

Design solutions for Complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety,and the cultural, societal and environmental considerations.

PO4: Conduct Investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning in formed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES(PSOs)

The following are the Program Specific Outcomes of Engineering Students:

- **PSO1:** Apply the basic concepts of mathematics and science to analyse and design circuits, controls, Electrical machines and drives to solve complex problems.
- **PSO2:** Apply relevant models, resources and emerging tools and techniques to provide solutions to power and energy related issues & challenges.
- **PSO3:** Design, Develop and implement methods and concepts to facilitate solutions for electrical and electronics engineering related real-world problems.

Abstract (Key Words)	Mapping of POs and PSOs
Electric Vehicles (EVs) ,Charging Stations, Real-Time Information,Maplibre,Open Street Map,Geolocation Traction.	PO1, PO2, PO3, PO4, POS, PO6, PO7, PO8, PO9, PO10, PO11, PO12, PSO1, PSO2, PSO3

ACKNOWLEDGEMENT

Our sincere thanks to **Thiru.M.Kumarasamy, Founder and Dr.K.Ramakrishnan B.E, Chairman** of **M.Kumarasamy College of Engineering** for providing extra ordinary infrastructure, which helped us to complete the Minor project in time.

It is a great privilege for us to express our gratitude to our esteemed **Principal Dr.B.S.Murugan M.Tech., Ph.D.,** for providing us right ambiance for carrying out the project work.

We would like to thank our **Head of the Department Dr.J.Uma M.E., Ph.D., Department of Electrical and Electronics Engineering,** for her unwavering moral support throughout the evolution of the project.

We would like to express my deep gratitude to our Minor Project Guide **Mr.AL.Chockalingam M.E, Assistant Professor, Department of Electrical and Electronics Engineering,** for his constant encouragement, kind co-operation, valuable suggestions and support rendered in making our project a success.

We offer our wholehearted thanks to our Minor project coordinator **Mrs.R.Indhumathi M.E., Assistant Professor, Department of Electrical and Electronics Engineering,** for his constant encouragement, kind co-operation and valuable suggestions for making our project a success.

We are glad to thank all the **Faculty Members** of **Department of Electrical and Electronics Engineering** for extending a warm helping hand and valuable suggestions throughout the project.

Words are boundless to thank **Our Parents and Friends** for their constant encouragement to complete this Minor project successfully.

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ABSTRACT

The increasing adoption of electric vehicles (EVs) has created a growing demand for accessible, reliable, and real-time information on EV charging stations. This project presents a web-based EV Charging Station Locator system designed to assist EV users in locating nearby charging points, checking slot availability, and planning optimal travel routes with charging support. The website integrates interactive map functionality using MapLibre and OpenStreetMap for open-source, customizable mapping, while Firebase Firestore is used as the cloud database to store and retrieve real-time station data. The core objective of the project is to bridge the gap between EV drivers and charging infrastructure by providing a platform that simplifies trip planning and reduces range anxiety. Key features include user geolocation tracking, a "Find Nearby Stations" button, and a routing system that allows users to search for directions between two points while displaying all available EV charging stations along the route. The platform is built using HTML, CSS, and JavaScript to ensure performance and accessibility across devices. The system aims to eliminate the uncertainty EV users often face regarding charger locations and availability. By accessing live data from Firebase, users can make informed decisions before starting a journey. The interactive map interface also promotes user engagement by visually representing the most efficient routes and charging points. Furthermore, the solution is lightweight and responsive, allowing seamless integration into future mobile app versions. To support future scalability, the system architecture allows for the integration of additional modules such as user authentication, station ratings, charging time predictions, and dynamic pricing. It can also be extended to support third-party EV charging providers, allowing centralized access to distributed networks. Through this project, we demonstrate the potential of web technologies and open mapping tools to build a smart, real-time service that supports the rapid growth of electric mobility. This initiative contributes to sustainable transportation goals and offers a practical, user-centered solution to everyday EV challenges.

PROBLEM IDENTIFICATION

With the increasing global shift toward sustainable and eco-friendly transportation, electric vehicles (EVs) have gained significant popularity. However, despite the rise in EV usage, a major hurdle that persists is the lack of accessible and real-time information about available EV charging infrastructure. Many EV users face difficulties locating nearby charging stations, especially in unfamiliar areas or during long-distance travel. This leads to range anxiety—a fear of running out of battery without knowing where the next available charging point is located. In most cases, available information about charging stations is either outdated, scattered across multiple platforms, or lacks important real-time details such as charger availability, slot status, or estimated wait times. Existing solutions may rely heavily on proprietary APIs, which are often costly and not easily customizable for developers or startups looking to build local or region-specific solutions. Moreover, users lack tools that allow route planning with charging stations in mind. When traveling from point A to point B, users need to know not only the directions but also where charging stations are located along that route. Without such integration, EV owners are forced to manually search for stations, which is time-consuming and inefficient. Another challenge lies in the absence of unified platforms that are both user-friendly and developer-friendly. Many EV station maps or apps lack responsive design, real-time updates, or advanced features like geolocation tracking, distance filtering, and route-based search. This limits their usability and effectiveness in real-world scenarios. Therefore, there is a need for a cost-effective, responsive, and scalable web application that can help EV users easily locate nearby charging stations, view live availability, and plan routes with charging support using open-source mapping tools and real-time cloud databases. Addressing this gap is essential to support the continued adoption of electric vehicles and to reduce dependence on fossil fuels in modern transportation.

CHAPTER 1

LITERATURE REVIEW

Paper 1 Title: Real-Time EV Charging Station Locator Using Google Maps and Firebase Inference:

This paper proposes a web-based system that enables EV users to locate nearby charging stations using Google Maps API and Firebase Realtime Database. The system uses geolocation to track the user's current position and displays the nearest available stations on the map interface. By integrating cloud storage with real-time updates, the application allows users to view charger availability and estimated wait times. The system is optimized for both desktop and mobile interfaces, ensuring accessibility and ease of use. This approach improves trip planning and reduces range anxiety.

Paper 2 Title: OpenStreetMap-Based Electric Vehicle Route Planning and Station Discovery Inference:

This research explores the use of open-source mapping tools like OpenStreetMap and MapLibre for EV navigation applications. Unlike paid APIs, these tools provide customizable, cost-effective alternatives ideal for scalable development. The study shows how EV users can input start and destination points to receive optimized routes that include charging station suggestions along the way. The system prioritizes flexibility, allowing developers to adjust the UI and data layers to match local or custom datasets. This supports the development of community-driven EV infrastructure solutions.

Paper 3 Title: Firebase-Powered IoT Application for Real-Time EV Charger Monitoring Inference:

This paper highlights the use of Firebase Firestore in managing EV charging data such as station status, availability, and user interactions. The study demonstrates how Firestore's real-time capabilities allow developers to build fast, reactive interfaces that automatically update as data changes. The paper also presents a case study where users receive live notifications about charger availability and estimated wait times.

Paper 4 Title: A User-Centered Design for EV Charging Station Web Portals Inference:

Focusing on UI/UX, this research identifies the essential features that improve user experience in EV charging websites. It emphasizes clear station indicators, booking features, and responsive design as critical factors. The study incorporates surveys and A/B testing to evaluate user satisfaction across multiple interface designs. The findings suggest that web portals that offer intuitive navigation, real-time updates, and smart filtering (such as distance, station type, and availability) can greatly enhance the daily usability and adoption of EV platforms.

Paper 5 Title: Smart EV Infrastructure Using Location-Based Services and Cloud Integration Inference:

This paper discusses the integration of cloud services and LBS (Location-Based Services) for building intelligent EV support systems. The proposed architecture includes components for live tracking, cloud database management, user authentication, and scalable APIs. The study demonstrates the effectiveness of combining real-time user location with station metadata to offer personalized EV routing suggestions. This model serves as the foundation for future smart mobility applications that emphasize efficiency, environmental sustainability, and user convenience.

CHAPTER 2

PROPOSED METHODOLOGY

2.1 BLOCK DIAGRAM

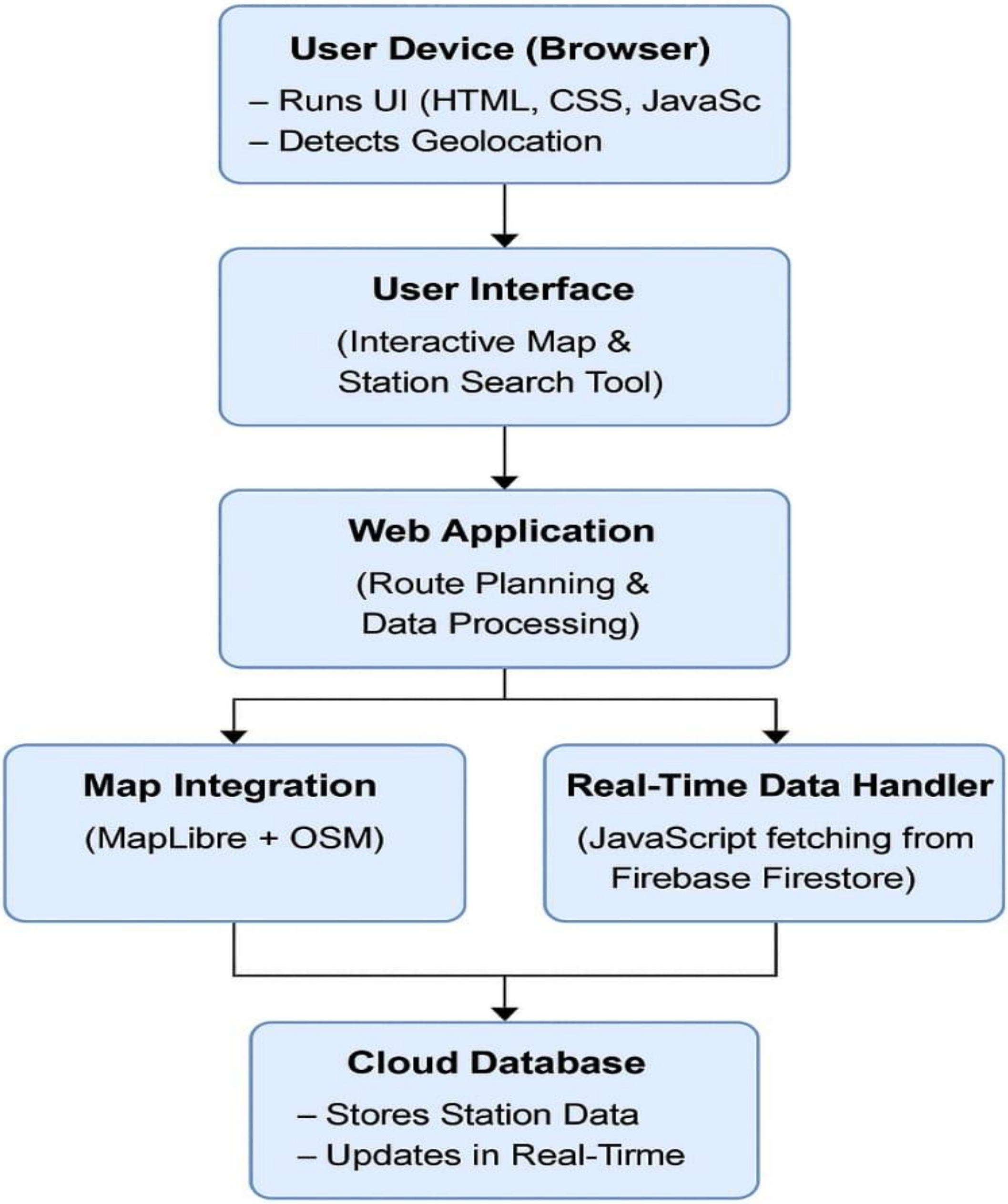


Figure 2.1:block diagram

2.2 DESCRIPTION

VS Code

Visual Studio Code (VS Code) is a free, open-source code editor developed by Microsoft. It is one of the most popular Integrated Development Environments (IDEs) used by developers due to its flexibility, extensive plugin support, and efficient debugging capabilities. In this project, VS Code serves as the primary development environment for coding in HTML, CSS, JavaScript, and working with Firebase Firestore. It provides features like intelligent code completion, syntax highlighting, Git integration, and extensions for real-time collaboration, which streamline the development process.

HTML

HTML (HyperText Markup Language) is the standard markup language used for creating web pages. In this project, HTML is used to structure the content of the website. It provides the foundation for displaying the webpage layout, including headers, footers, navigation menus, maps, and other interactive components. HTML elements such as <div>, <section>, <header>, and <footer> are used to organize and display the content for the user, ensuring an accessible and responsive layout.

CSS

CSS (Cascading Style Sheets) is used for styling the visual presentation of HTML elements. In this project, CSS is applied to the various components of the website, such as buttons, maps, and station listings. It controls the design, including aspects like colors, typography, margins, padding, and the responsiveness of the website. CSS ensures that the website adapts well across different screen sizes, creating a user-friendly experience on desktops, tablets, and mobile devices. Technologies like Flexbox and CSS Grid are employed for layout, and Media Queries are used to make the site responsive.

JavaScript (JS)

JavaScript is a programming language used to add interactivity and dynamic behavior to web pages. In this project, JavaScript is used to handle user interactions, such as clicking the "Find Nearby Stations" button or searching for routes between two points. JavaScript is also responsible for fetching real-time station data from the Firebase Firestore database and updating the map and station information dynamically. It powers the logic for geolocation, searching routes, filtering stations, and managing the overall user experience in real-time.

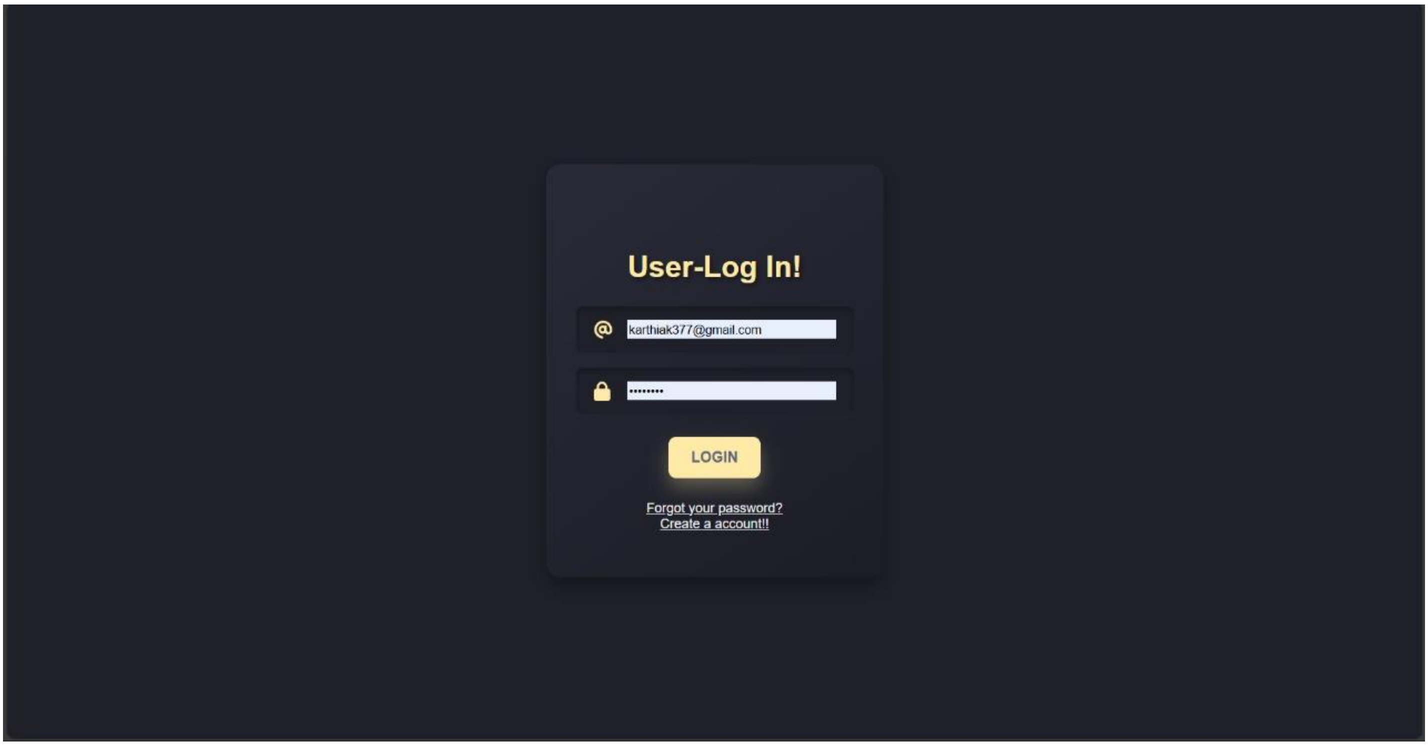
MapLibre + OpenFreemap

MapLibre is an open-source mapping platform that allows developers to build customized, interactive maps using OpenStreetMap (OSM) data. In this project, MapLibre is used to display charging station locations on the map, allowing users to interact with the map by zooming in and out, and clicking on stations for more details. OpenFreemap, a community-driven mapping tool based on OSM data, is utilized to gather and display accurate charging station data in real-time. These tools together offer a seamless and scalable mapping solution for visualizing EV charging stations across different regions.

Firebase Firestore

Firebase Firestore is a flexible, scalable NoSQL cloud database offered by Google. It allows real-time data synchronization between the client (browser) and the database. In this project, Firestore is used to store and retrieve data related to EV charging stations, including location details, station names, slot availability, and real-time updates. With its real-time synchronization, Firestore ensures that any changes to the database (like a charging slot becoming available or full) are instantly reflected in the user interface without needing to refresh the page.

2.3 SOFTWARE KIT



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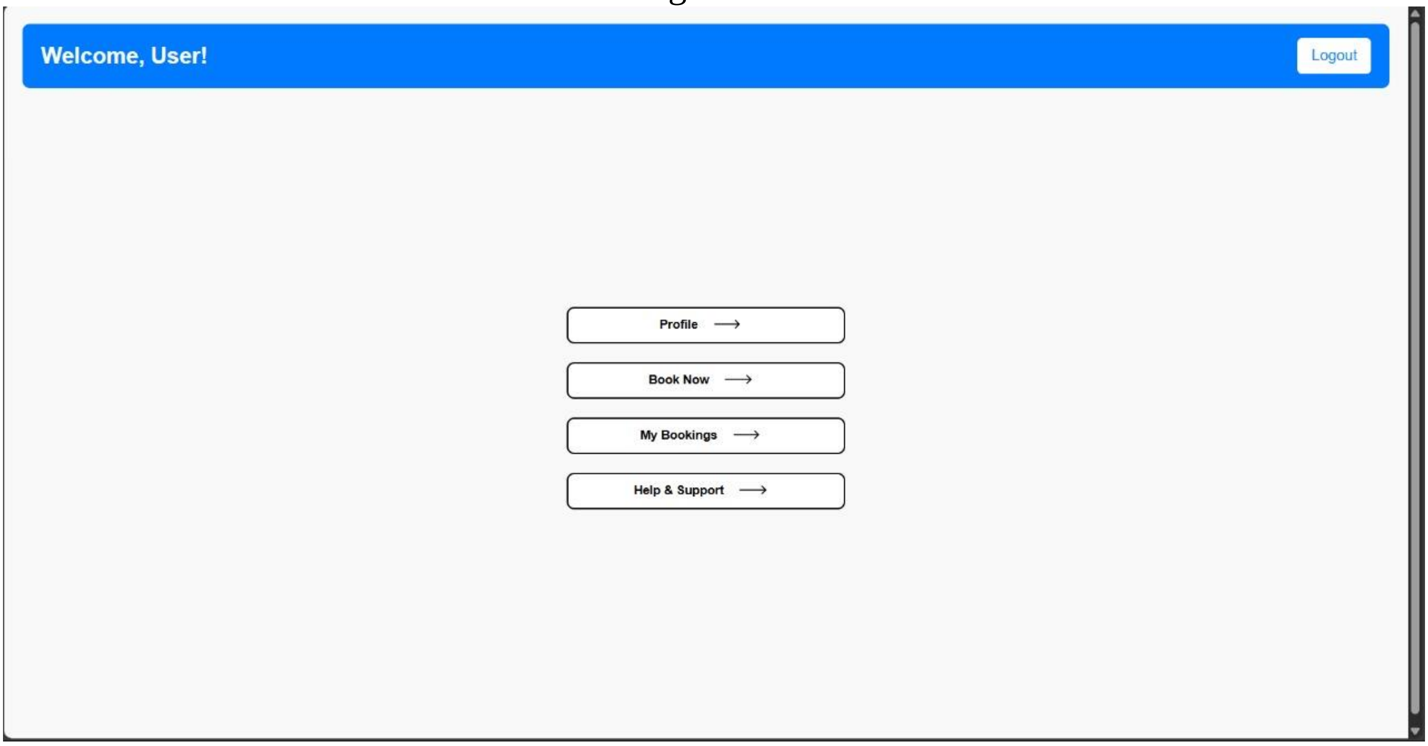

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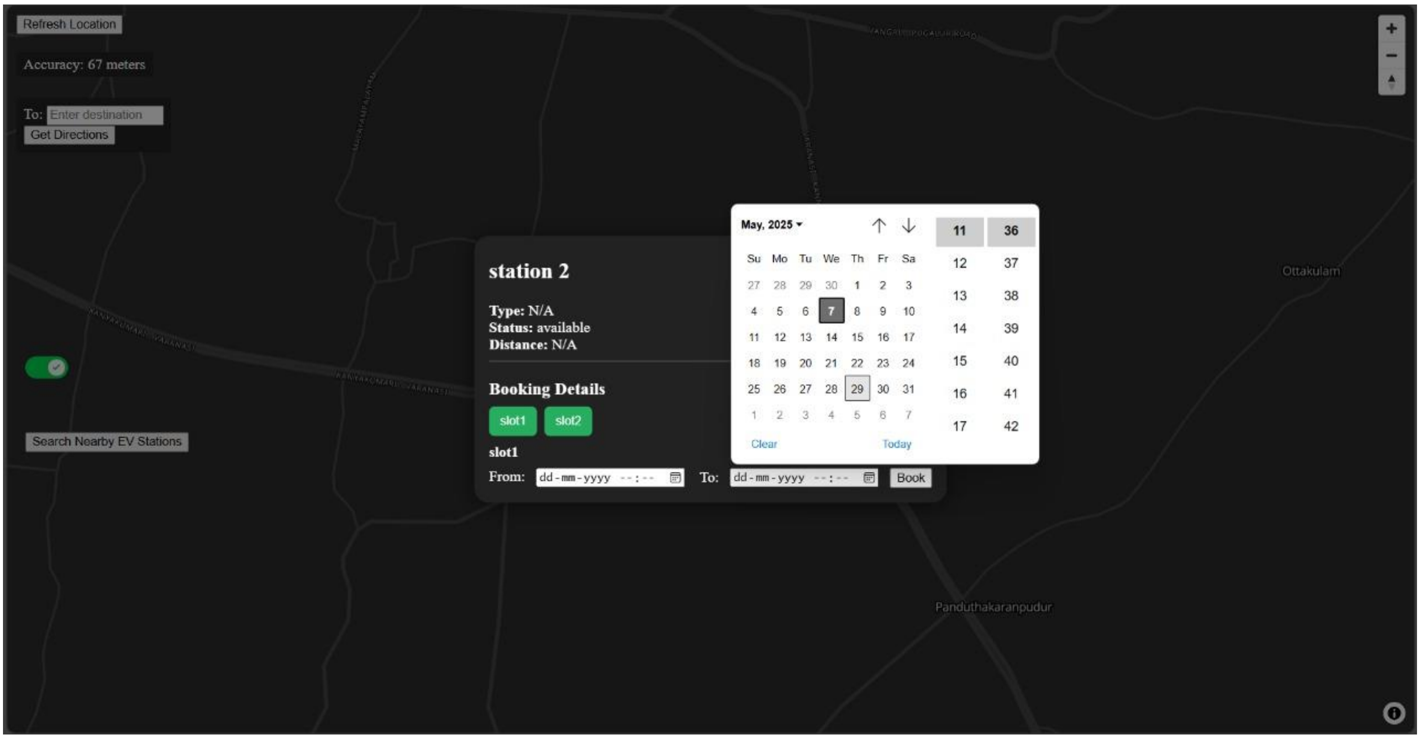

Figure:2.4

2.4 WORKING PRINCIPLE

The EV Charging Station Locator Website operates by providing users with real-time information about available electric vehicle (EV) charging stations and route planning. When users visit the website, their location is detected using the browser's geolocation API, allowing the system to display nearby charging stations on an interactive map powered by MapLibre and OpenStreetMap. Users can search for stations, check availability, and plan routes by entering their destination. The system uses JavaScript to calculate optimal routes and display charging stations along the way, ensuring users can easily plan long-distance trips without range anxiety. Real-time data is fetched from Firebase Firestore, which stores station information like location and slot availability. This allows the website to present accurate, up-to-date details and dynamically update the station data as users interact with the platform. The system ensures a seamless user experience by providing up-to-date information on charging station availability and enabling easy route planning for EV drivers.

CHAPTER-3

RESULT

The EV Charging Station Locator website was successfully developed and deployed with core features functioning as intended. It allows users to search for nearby EV charging stations using live geolocation and displays the results on an interactive map interface powered by MapLibre and OpenStreetMap. The data about each station—including its location, name, and availability—is dynamically fetched from Firebase Firestore, ensuring that updates are reflected in real time.

The system's "Find Nearby Stations" button accurately calculates proximity using geolocation coordinates and displays only relevant stations within a given radius. Additionally, the route-finding feature works effectively by allowing users to input starting and destination points, showing directions along with station markers on the way. The map interaction is smooth and responsive across devices, and station data is consistently retrieved from the cloud database without errors.

Overall, the website meets its objectives by offering a responsive, user-friendly interface that simplifies the process of locating charging infrastructure. It successfully bridges the gap between EV users and charging stations, making trip planning more efficient and convenient.

CHAPTER 4

CONCLUSION

The EV Charging Station Locator Website is a timely and innovative solution designed to meet the increasing demands of electric vehicle (EV) users for accessible, real-time charging infrastructure. As the global transition from fossil fuel-powered vehicles to electric mobility gains momentum, the need for reliable and user-friendly platforms to support EV drivers becomes more critical. This project successfully bridges the gap between EV drivers and the charging network by providing essential features such as live station tracking, geolocation-based nearby station discovery, and route-based station suggestions. Built using front-end technologies like HTML, CSS, and JavaScript, the platform ensures responsiveness and compatibility across multiple devices and screen sizes. The integration of MapLibre and OpenStreetMap allows for an open-source, customizable, and interactive map interface that visualizes charging stations with precision and clarity. Through this map, users can easily view station details such as name, location, and slot availability. In addition, the Firebase Firestore backend enables real-time database access, ensuring users are always presented with the most up-to-date station information, such as changes in availability or new station additions. A major advantage of the system is its ability to provide users with optimized travel planning by suggesting EV stations along the route entered by the user. This helps reduce range anxiety, one of the primary concerns for EV owners, especially during long-distance travel. Moreover, the "Find Nearby Stations" feature uses the user's current location to show charging stations within a certain radius, making the system highly convenient and travel-friendly.Beyond just displaying station locations, the website is designed with future scalability in mind. Features such as booking charging slots, integrating payment systems, user reviews, and notification alerts can be easily added. This positions the platform as a strong foundation for a more comprehensive EV infrastructure management system.

CHAPTER 5

FUTURE SCOPE AND IMPLEMENTATION

The EV Charging Station Locator Website has significant potential for future enhancements in line with the rapid growth of electric vehicles (EVs) worldwide. As EV usage increases, the demand for efficient charging infrastructure and intelligent software solutions will rise. One major future improvement is the integration of a slot booking system, enabling users to reserve charging stations in advance, thereby reducing waiting times. Additionally, digital payment integration through UPI, wallets, or card systems can streamline the charging experience by making it cashless and hassle-free. The platform can also be enhanced with user authentication features, allowing users to log in, view past charging history, save favorite stations, and provide reviews or ratings. Further, incorporating IoT-based real-time status updates would allow users to view live availability, charger health, and station status using sensors at each station. A mobile application version of the platform can also be developed to increase accessibility and provide push notifications for station updates or booking confirmations. Advanced features such as AI-based route optimization, which recommends travel paths based on station locations, traffic, and battery levels, can improve long-distance EV travel. With growing partnerships between software platforms and charging infrastructure providers, the system can also scale nationally or globally, integrating thousands of public and private charging stations into a unified platform. The future scope of this project extends toward creating a complete, smart mobility solution for sustainable transportation. Implementation The implementation of the EV Charging Station Locator Website uses a combination of web development tools and cloud technologies. Development was carried out in Visual Studio Code (VS Code) using HTML, CSS, and JavaScript for front-end design and functionality. HTML structures the content, CSS handles styling and layout, and JavaScript adds interactivity such as map control, data fetching, and user inputs. These components ensure responsiveness and usability across devices. The platform integrates MapLibre with OpenStreetMap (OSM) for the map interface, allowing open-source rendering of maps and placement of EV charging station markers.

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