A

Mini Project Report

on

EV Charging Station Availability Using Flask
Submitted in partial fulfillment of the requirements for the degree

Second Year Engineering – Computer Science and Engineering Data Science

by

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CERTIFICATE

This to certify that the Mini Project report On EV Charging Station Availability Using Flak has been submitted by Sneha Gupta (22107042), Priyal Madvi (22107020), Ayush Gupta (23207007) and Rushikesh Palekar (23207004) who are bonafide students of A. P. Shah Institute of Technology, Thane as a partial fulfillment of the requirement for the degree in **Computer Science and Engineering Data Science**, during the academic year **2023-2024** in the satisfactory manner as per the curriculum laid down by University of Mumbai.

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Abstract

This project introduces a web application developed using Flask framework to address the need for real-time access to charging station availability for electric vehicles (EVs). The application utilizes APIs from charging station networks to provide users with up-to-date information on the availability of charging stations in their vicinity.

Key feature of the application is its ability to provide users with personalized recommendations and notifications based on their charging preferences and usage patterns. Users can access this information through a user-friendly web interface, allowing them to plan their EV charging activities efficiently.

The project emphasizes a modular architecture design, facilitating easy integration of additional data sources and scalability as the EV infrastructure expands. Security measures are implemented to protect user data and ensure the application's integrity.

Challenges such as data accuracy and reliability are addressed, with strategies proposed to give solution effectively. Future enhancements may include predictive analytics for charging station availability and personalized recommendations based on user preferences.

Overall, this project aims to provide a valuable resource for EV owners, supporting the adoption of sustainable transportation solutions by enabling convenient access to charging infrastructure.

Chapter 1

Introduction

An introduction serves as the opening section of a document, paper, presentation, or project, providing essential background information, context, and an overview of what the audience can expect to learn or explore further. In the case of the EV Charging Station Availability Project, the introduction would typically outline the purpose of the project, its significance in the context of electric vehicle adoption and sustainability efforts, any relevant background information, the objectives or goals of the project, and an overview of the methodology or approach that will be used.

Ev charging station availability using flask is a simple MySQL, Bootstrap and flask base project designed to help Ev user to choose a location of station and help them explore more about various station. In this project we will explore the concept of Ev charging and how it can be used to optimize EV charging station availability and accessibility. In the dynamic landscape of electric vehicle (EV) infrastructure, ensuring efficient access to charging stations is crucial for promoting widespread adoption and sustainability. This project proposes the development of an intelligent planning system using Flask, aimed at optimizing EV charging station availability and accessibility.

This report delves into the comprehensive project aimed at exploring and implementing EV charging station solutions in the searching for proper location of the station and exploring more about the station. It recommends optimal charging station locations based on real-time availability data and geographical factors, offering convenient access to electric vehicle users. We aim to provide a holistic overview of the project's objectives, methodologies, and expected outcomes.

Through this project, we aim to improve the accessibility of electric vehicle charging infrastructure and ultimately enhance the user experience for EV drivers. This report will provide an overview of the project's objectives, scope, and methodologies employed to optimize charging station availability using Flask, making it more adaptable and efficient in meeting the evolving needs of electric vehicle users.

The application will utilize various parameters such as real-time availability data, geographic location, and user preferences to suggest the most suitable charging station for electric vehicle drivers. This way, drivers will have a tool that helps them locate charging stations effortlessly, ensuring a stress-free experience throughout their journey. This application can

also be used by the station operator and EV user, since there is a separate page for exploration, and it has information regarding the different station till date.

1.1 Purpose

The purpose of "Ev charging station availability using flask" is to assist drivers in creating a well-informed and strategic approach to their charging needs. This planning involves recommending the most suitable charging stations based on real-time availability, geographic location, and user preferences. "Ev charging station availability using flask" serves the critical purpose of aiding drivers in making informed decisions about their charging routes. It also provides sufficient information regarding available charging options, which ultimately guides them in their EV ownership experience. Overall, the purpose of "Ev charging station availability using flask" is to empower drivers to make wise choices that lead to seamless and efficient charging experiences.

1.2 Problem Statement

It's not uncommon for drivers to face challenges in determining where to find available EV charging stations or how to effectively plan their charging stops. This decision can have a significant impact on their ability to travel efficiently and meet their transportation needs.

Selecting a charging station for electric vehicles is a crucial decision for drivers, influencing their ability to efficiently travel and meet their transportation needs. It's a multifaceted process involving factors such as location convenience, charging speed, energy costs, and environmental considerations. Drivers must assess their requirements, evaluate available options, and consider long-term implications. Balancing convenience with efficiency is challenging, as is forecasting future charging demands, infrastructure expansions, and concerns about compatibility. Access to accurate information and guidance is essential for informed decisions in this pivotal moment.

To simplify the process of finding and utilizing charging stations:
After purchasing an electric vehicle, drivers often encounter numerous charging stations to choose from, each offering a unique set of features and convenience levels. They may find themselves in a state of confusion, unsure of which charging station aligns best with their driving habits, preferences, and long-term travel plans. It's essential to recognize that each charging station presents a different array of amenities and charging speeds, each with its own set of accessibility and compatibility factors.

Lack of information:
Even if the driver knows they need to charge their electric vehicle, they may not be aware of the available charging stations and the opportunities each station offers. When drivers have a vague notion of their preferred charging station, a lack of comprehensive information can hinder their awareness of the diverse charging options available. This incomplete knowledge may cause them to overlook factors such as charging speeds, availability of fast-charging options, payment methods, and the influence of renewable energy sources.

EV Charging Station Information Service:
The service provides essential details on EV charging stations including locations, real-time availability, compatibility with various EV models, pricing, and user reviews. Its aim is to streamline the charging experience, empower drivers with informed choices, and promote the adoption of electric vehicles, contributing to sustainable transportation initiatives.

1.3 Objectives

To optimize EV Infrastructure Utilization: To improve the use of Electric Vehicle (EV) infrastructure, we need to make charging and support systems more efficient, convenient, and effective.

To enable users to plan their routes based on station availability, minimizing downtime: Provide users with up-to-date and accurate information about the availability of charging stations in real time.

To improve the overall experience of EV users by offering a reliable tool: Improving the user experience for electric vehicle owners requires a dependable resource. This resource, whether an app, website, or vehicle feature, should seamlessly provide essential details about charging stations, including their locations, availability, and payment.

To reduce the inconvenience caused by unavailable charging stations: Create a system where users can share feedback about charging stations they've used. This feedback should include reports of any problems encountered. Use this information to identify and resolve issues with charging stations. Doing this will reduce the inconvenience caused by faulty charging stations, making the EV charging process more convenient and dependable for everyone.

1.4 Scope

Our project aims to provide a comprehensive understanding of its objectives, methodologies, and anticipated outcomes. By focusing on improving access to EV charging stations and simplifying the reservation process, we aspire to significantly impact drivers' convenience and overall satisfaction. This report serves as a roadmap, elucidating the project's purpose, scope, and the innovative strategies employed to enhance EV charging station availability, making it more adaptable and efficient in meeting the needs of electric vehicle users. With the increasing demand for electric vehicles, our project aims to address the common challenge drivers face in finding available charging stations, guiding them towards informed decisions about their charging routes.

There are many drivers who are uncertain about where to find available EV charging stations, and there are also individuals and families who may not be well-versed in the technology and don't know how to navigate the process. Hence, this application assists them in locating nearby charging stations and helps them plan their routes accordingly.

It provides information to the drivers who know they need to charge their EVs but are uncertain about where to find available charging stations or how to efficiently plan their charging stops There are also some drivers who have a specific destination in mind and are aware of the need to charge their EV along the way, but they lack sufficient knowledge on where to find available charging stations or how to effectively plan their charging route.

Chapter 2

Literature Review

A literature review is a critical evaluation and synthesis of existing research and literature on a particular topic or subject. It involves examining a wide range of sources such as academic papers, books, articles, and other scholarly materials that are relevant to the topic of interest. The purpose of a literature review is to provide a comprehensive understanding of the current state of knowledge on the subject, identify gaps or areas for further research, and establish the theoretical framework or context for the research project or study.

[1] The study by ENEA C.R. Casaccia, Adrenacci, Valentini, M.P in November 2023, explores how electric vehicle (EV) owners interact with charging processes. They aim to solve common issues like long wait times and inefficient scheduling. To help readers understand better, the authors created a user-friendly graphical interface (GUI) using HTML, CSS, and Bootstrap to display station information. By considering the various battery types and charging needs of EVs, the research aims to address owner inconveniences. The authors hope to reduce wait times and improve charging schedules through their work.

[2] The research conducted by Vikas Mahala and Mansi Mutreja in June 2023 examines the impact of electric vehicles (EVs) on distribution systems, with a focus on enhancing user convenience and transparency. The study highlights the importance of providing EV owners with access to their charging port usage history and implementing a secure payment system or slot booking mechanism. To achieve these objectives, the authors utilized HTML, CSS, and Bootstrap to create a graphical user interface (GUI) for displaying station information, along with SQL for storing user details.

One of the key outcomes of this research is the improved user experience, as EV owners can now conveniently access the history of their booked slots, allowing them to review the usage history of their charging ports. Moreover, the implementation of a proper payment system ensures that users can seamlessly pay for booking their slots, enhancing the overall efficiency and reliability of the charging process. By addressing these aspects, the study contributes to fostering greater trust and usability within the EV ecosystem, thereby facilitating the transition towards a more sustainable transportation infrastructure.

[3] In 2023, Dr. Omar A. Ibrahim and Khalid J. Mohsen introduced the Electric Vehicle Charging Station Finder App, designed to enhance user experience and interaction within the electric vehicle (EV) community. One significant outcome of this app is the provision for users

to express their views on station services through feedback. Leveraging the Flask framework and SQL database, the methodology enables the retrieval and storage of user feedback, ensuring a seamless and efficient process.

A notable feature of the app is the incorporation of a user feedback system, allowing individuals to provide reviews for charging stations. This not only empowers users by giving them a platform to share their experiences but also facilitates informed decision-making for other EV owners seeking reliable charging options. Additionally, the app offers valuable information on optimized charging schedules, further enhancing user convenience and efficiency in managing their EV charging needs.

Chapter 3

Proposed System

A proposed system refers to a plan or concept for a new system or solution to address a specific problem or need. In the context of your EV Charging Station Availability Project, the proposed system would likely entail the design and implementation of a solution or framework aimed at optimizing the accessibility and distribution of EV charging infrastructure. The proposed system would be based on the findings and insights gained from the research and analysis conducted as part of the project.

3.1 Features and Functionality

Booking: The EV charging station booking system enables users to secure charging slots in advance, ensuring they have access to available charging facilities at their desired times. This feature enhances convenience by allowing drivers to plan their charging sessions ahead of time, minimizing wait times and uncertainties associated with finding an available charging station.

Availability of Station: The availability feature in the EV charging station booking system offers real-time updates on station occupancy, allowing users to check the status of each station before arrival. This ensures efficient route planning, minimizes waiting times, and enhances the overall charging experience for electric vehicle drivers.

Invoice generator: The invoice generator in the EV charging station booking system automatically creates detailed invoices after users complete their payments. These invoices summarize the transaction, including the amount paid, charging duration, and essential details, providing users with clear records for their transactions.

Sending email for changing the Password: The email password reset feature in the EV charging station booking system provides a secure and user-friendly method for users to reset their passwords. Upon request, users receive an email with a unique link or code, allowing them to verify their identity and create a new password through a secure password reset page. This ensures account security while simplifying the password recovery process for users.

Chapter 4

Requirements Analysis

Requirement analysis is a crucial phase in the development of a system, software, or project. It involves gathering, documenting, and analyzing the needs and expectations of stakeholders to define the scope, functionalities, and constraints of the system to be developed.

Real-time Data Integration: The system should integrate with EV charging station databases or APIs to retrieve real-time information about station availability, including the number of charging spots available, current usage, and any ongoing maintenance or outages.

User Interface: A user-friendly interface accessible via web or mobile app should display the availability of nearby charging stations. It should allow users to easily search for stations based on location, filter results based on factors like charging speed or station type, and view detailed information about each station.

Location Services: The system should utilize location services to provide users with accurate information about nearby charging stations.

Reservation and Booking: To improve user experience, the system could allow users to reserve a charging spot in advance, either through the app or website. This feature would require integration with payment processing systems and the ability to manage reservations in real-time.

Scalability and Performance: The system should be designed to handle a large volume of users and data, ensuring scalability and optimal performance even during peak usage times.

Feedback Mechanism: Incorporating a feedback mechanism allows users to report issues with charging stations, provide ratings and reviews, and suggest improvements to the service.
By meeting these requirements, the EV charging station availability project can provide a valuable service to electric vehicle owners, helping them locate and access charging infrastructure more efficiently.

Chapter 5

Project Design

Project design refers to the process of conceptualizing and planning the structure, components, and functionalities of a project to achieve specific objectives. It involves translating the requirements and goals identified during the initial phases (such as requirement analysis) into a detailed blueprint or roadmap for implementation.

5.1   System Architecture

Database Architecture: Plan the database architecture to store essential information such as charging station locations, availability status, pricing details, user reviews, and EV model compatibility.

User Authentication and Security: Design a secure authentication system to ensure user privacy and prevent unauthorized access.

Reservation System Design: Design a robust reservation system that allows users to book charging slots efficiently. Consider features such as booking and cancellation.
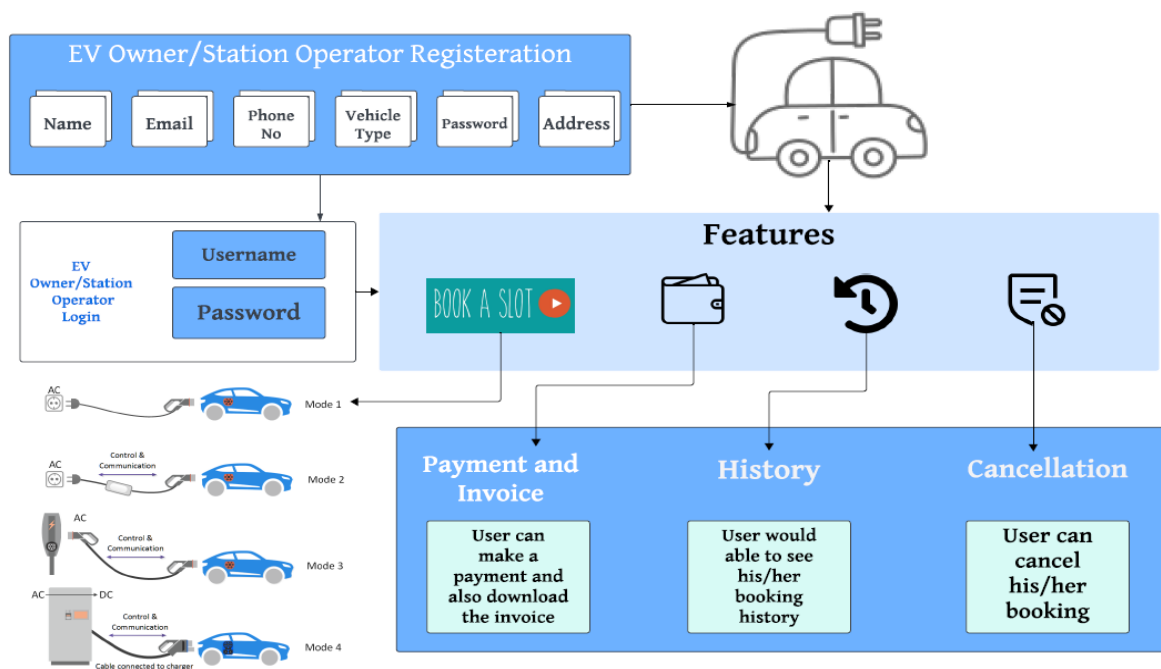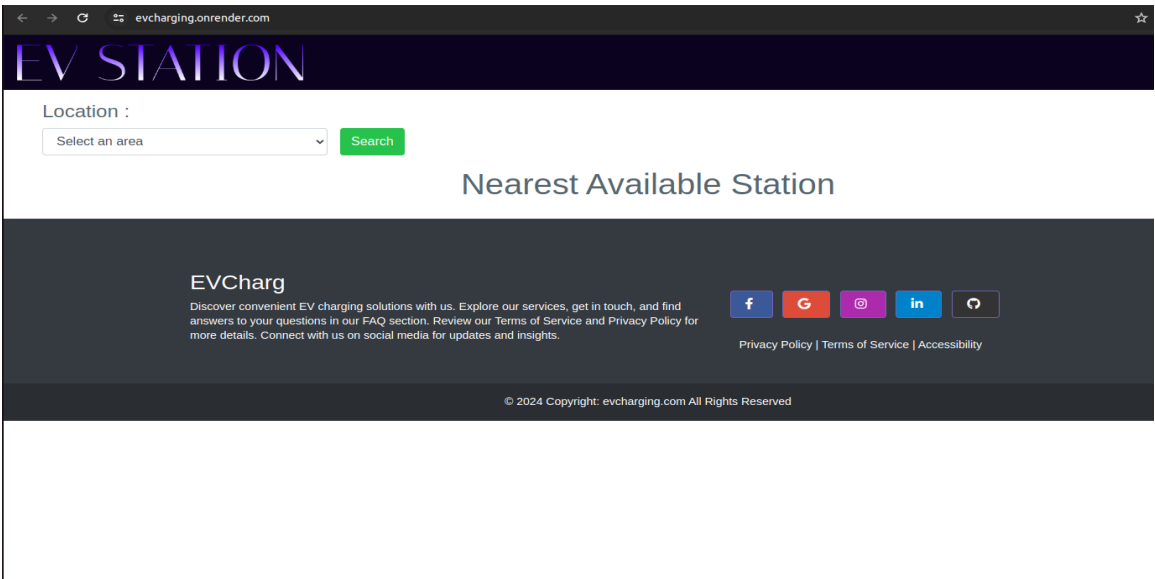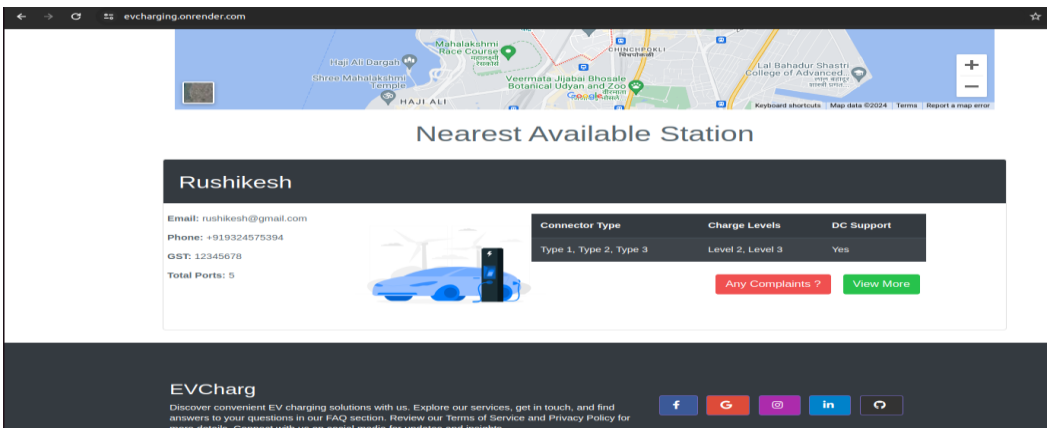

Fig 5.1: Block Diagram
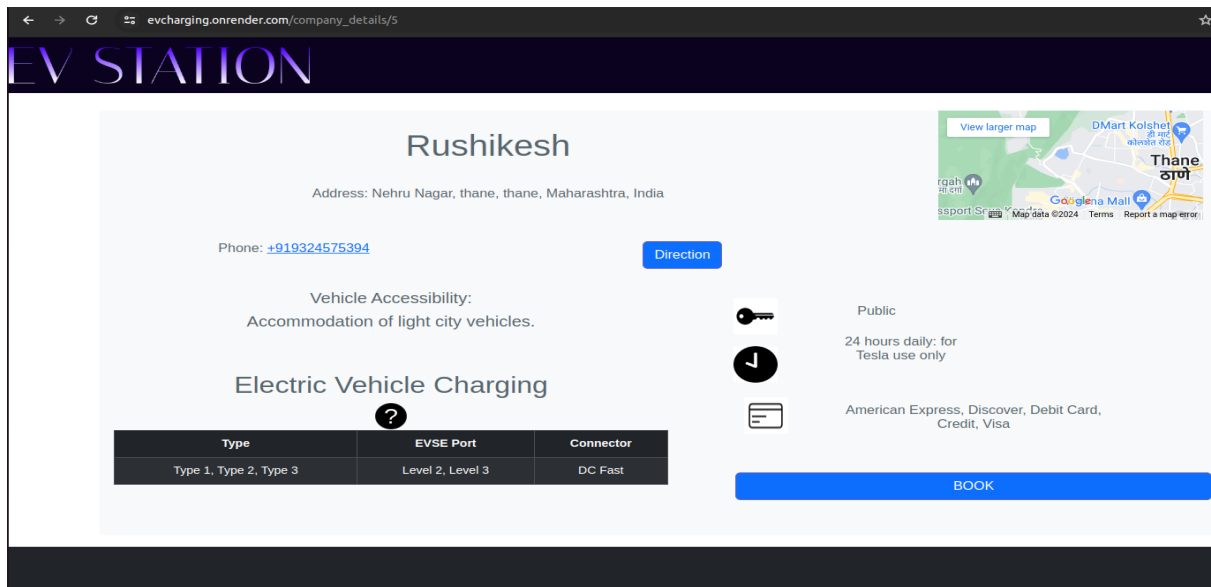
5.2 Implementation

Fig 5.2: Search nearest available station.

Here, user will able to search the nearest available station and select the station according to his/her convenience.
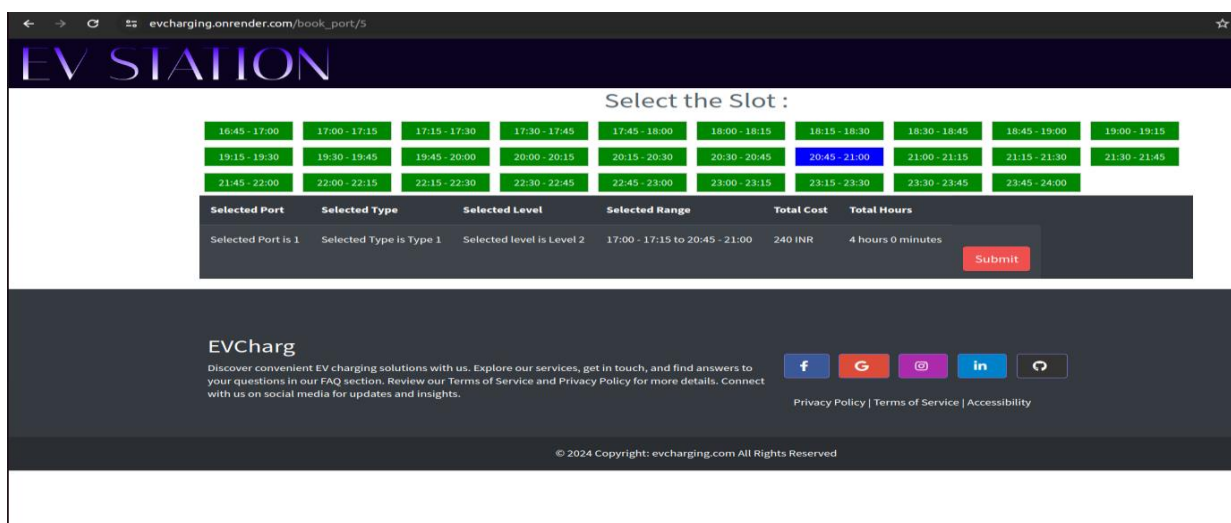

Fig 5.3: Display available station.

Here, user will able to see available station and the station information.
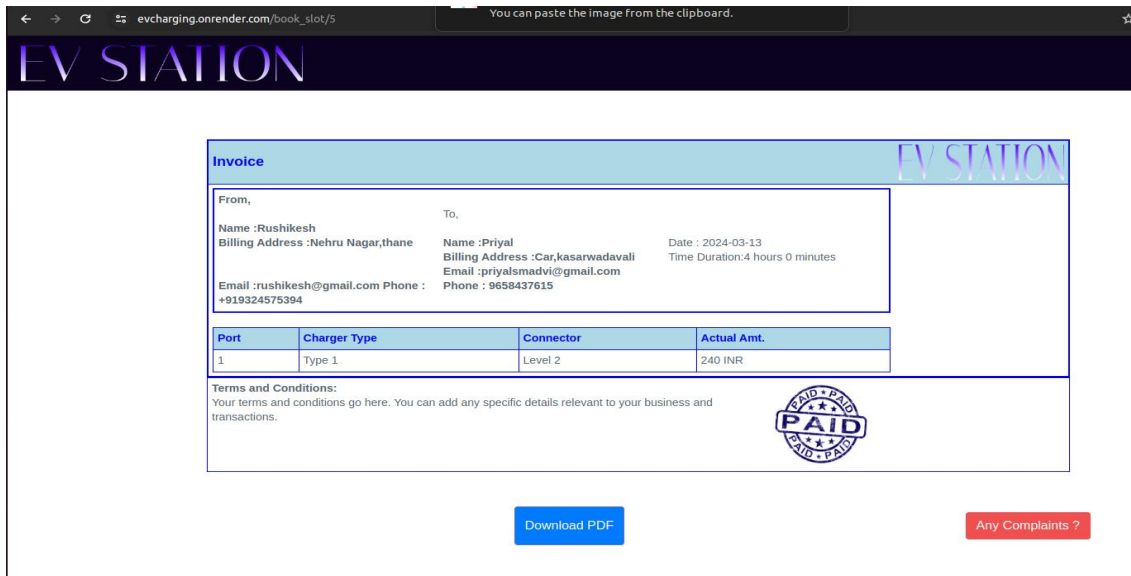
Fig 5.4: Station information.

Here, option such as book and station information will be available. Details of station will able to see by user.

Fig 5.5: User select time slot to book charging station.

Here, user can select the time slot according his/her convenience and then this booking and total price will be displayed.

Fig 5.6: Invoice generated after booking a slot

Here, invoice will be generated and will able to download the invoice.

Chapter 6

Technical Specification

The technical specifications provide a detailed outline of the necessary tools, technologies, and infrastructure needed to execute the project effectively. In our project, these specifications encompass the selection of programming languages to ensure that the project is equipped with the appropriate resources for compatibility, scalability, and efficiency throughout its development and deployment phases.

Technology Stack

Backend: Python

Web Framework: Flask

Data Retrieval: Requests library for making API calls

Data Processing: JSON library for parsing API responses

Database: MySql for storing historical data

To integrate payment functionality into your Flask application, you can use various payment gateway APIs. Here we used one popular one:

Razor pay API

Razor pay provides an API for processing online payments, allowing you to accept payments from razor pay accounts, credit/debit cards, and other sources. Integration with Flask is possible using the PayPal REST API and Python SDK.

Chapter 7

Project Scheduling

Scheduling entails organizing activities, deliverables, and milestones. A schedule outlining planned start and finish dates, durations, and allocated resources for each task, ensuring tasks are completed on time and within budge for effective task and time management.

Sr. No	Group Members	Duration	Task Performed
1.	Priyal Madvi, Sneha Gupta, Rushikesh Palekar, Ayush Gupta	2nd Week of January	Group formation and Topic finalization. Identifying the scope and objectives of the Mini Project. Discussing the project topic with the help of a paper prototype.
		1st Week of February	Identifying the functionalities of the Mini Project. Designing the Graphical User Interface (GUI).
2.	Priyal Madvi, Sneha Gupta	2nd Week of February	Searched literature review paper.
3.	Priyal Madvi, Sneha Gupta	3rd Week ofFebruary	Study of the literature Paper.
4.	Priyal Madvi, Sneha Gupta	2th Week of March	Presentation I
5.	Rushikesh Palekar, Ayush Gupta	3st Week ofMarch	Database Connectivity of all modules
6.	Priyal Madvi, Sneha Gupta, Rushikesh Palekar, Ayush Gupta	1st Week of April	Presentation II

Table 7.1 Project Scheduling

Gantt Chart

In our project, the Gantt chart will outline key activities where each task will be represented by a bar on the chart, indicating its start and end dates, duration, and dependencies, allowing project stakeholders to track progress, identify potential delays, and timely completion of project objectives.
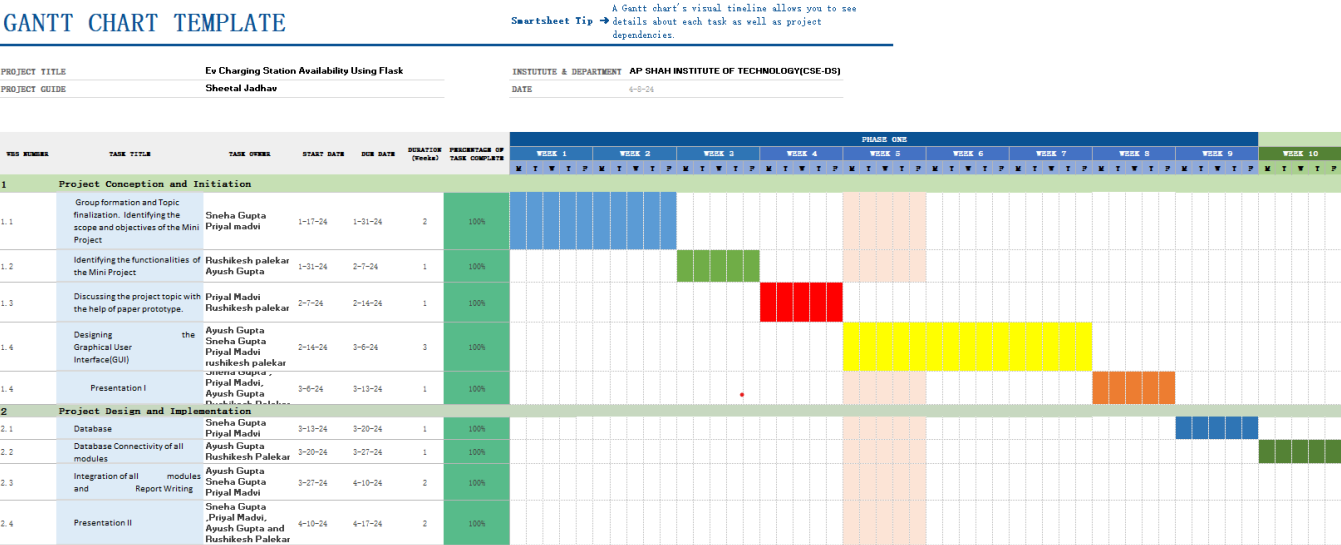

Fig 7.2 Gantt Chart

Following is the detail of the Gantt chart – In the third week of January, Sneha Gupta, Priyal Madvi, Rushikesh Palekar, Ayush Gupta formed a group for their mini project. They discussed and finalized the project's topic, scope, and objectives during this meeting. In the following weeks, Sneha Gupta, Priyal Madvi, Rushikesh Palekar used a paper prototype to explore and refine project ideas, completing this phase by the 2nd week of February.

In late February, Priyal Madvi, Rushikesh Palekar, Ayush Gupta executed the design and integration of the graphical user interface (GUI). Afterward, on 15th March, the first project review took place, and the faculty suggested some changes to the GUI, which were subsequently approved. Following this, Rushikesh Palekar, Ayush Gupta collaborated to create a structured database system, facilitating the systematic storage of information.

This, in turn, made it easier for Priyal Madvi and Sneha Gupta to connect the database to the project. This database work was completed by end of March. Finally, the team integrated all modules and completed the report writing, resulting in their final presentation on 10th April, which was approved by the faculty.

Chapter 8

Result

The project results section provides a concise overview of the outcomes achieved through the implementation of the project. Highlighting key findings, deliverables, and the final implementation of the project lifecycle. This section serves to summarize the tangible outcomes and impacts of the project, providing stakeholders with valuable insights into its overall effectiveness and contribution to the intended objectives.

System Overview: This web application, built with Flask, offers a comprehensive suite of features to support user well-being. After completing the initial implementation, our application underwent significant enhancements to offer users a more comprehensive experience. We incorporated several key features, including the ability to book and cancel charging sessions, access a detailed history of past transactions, and seamlessly process payments with the option to download invoices. These additions not only improve user convenience but also streamline the overall user journey, empowering individuals to manage their charging needs efficiently and effectively. With these enhancements, our application becomes a versatile platform that caters to the diverse requirements of electric vehicle owners, ensuring a seamless and hassle-free charging experience.

System Architecture: The application is structured with a modular architecture, where the Flask framework forms the backbone of backend development, overseeing essential functionalities and orchestrating interactions among distinct modules. Serving as the point of user engagement, the User Interface (UI) module efficiently manages user interactions and presents relevant information.

Frontend Development: The user interface (UI) is likely built using HTML, CSS, and potentially JavaScript frameworks. This ensures a user-friendly and responsive interface for interacting with the app's features. The UI is responsible for displaying information, receiving user input and presenting the processed responses

Backend Development: Flask forms the core of the backend development. It handles user login/credentials, processes user input from the UI.

Database Design: The application probably employs the latest version of MySQL as the relational database management system (RDBMS) for data storage. The core tables could include:
  Users: This table stores user login credentials (username, password) and potentially additional user information (name, email, etc.).
  Station Operator: This table stores login credentials (username, password) and potentially additional user information (name, email, etc).

Chapter 9

Conclusion

A conclusion is the final section of a document, paper, presentation, or project that summarizes key findings, highlights important insights, and provides closure to the topic or discussion. In the context of a project, the conclusion serves several purposes

As cities embrace electric vehicles (EVs), there's a big demand for charging spots, but not enough places to charge up. The challenge is figuring out how to manage EVs in busy traffic and make sure everyone gets a turn at the charging station without wasting time. Our goal is to make charging stations work better and help EV drivers save time. With the rising demand for EV charging in urban areas and limited charging facilities available, there's a challenge in effectively managing the dispatch of EVs in a constantly changing traffic environment and coordinating interactions among different user.

Chapter 10

Future Scope

The "future scope" of a project refers to potential areas of development, expansion, or further exploration beyond the current scope and objectives. It outlines opportunities for future work, research, or enhancements that can build upon the foundation laid by the existing project.

Smart Charging Recommendations

Implement algorithms to analyze historical charging data and provide smart charging recommendations to users. This could include suggestions on optimal charging times, stations with lower waiting times, or recommendations based on energy prices.

Integration with Electric Vehicle (EV) Data

Integrate with APIs or databases that provide real-time data on EV models, battery capacities, and charging compatibility. This information can be used to tailor recommendations and availability statuses based on the user's specific EV model.

Data Visualization and Analytics

Develop interactive dashboards and data visualizations to present charging station availability trends, usage patterns, and other relevant analytics. This can help stakeholders make informed decisions about infrastructure planning and resource allocation.

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