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Smart Management of EV Charging Station

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***Abstract*—In today's world, Electric Vehicles(EVs) are dras- tically evolving. General public transport as buses, autos, taxis, etc., are rapidly being replaced by EVs, the major cause for this is the rapidly increasing fossil fuel price and the limited resource available. We observe people switching to EVs but still facing charging issues. The proposed system will work onthis issue by displaying charging stations, providing the userwith a slot at the nearest charging station, guiding them to the destination via GMAPS API, a chatbot for queries and displaying the battery percentage so that they are always aware of the currently available battery.**

***Index Terms*—EV; Battery Percentage; GMAPS; Slots.**

I. INTRODUCTION

In recent years, there has been a significant focus on electric vehicles (EVs) as a source to reduce the use of fossil fuels and cutting the extra use of these gases, also saving the ozone layer. EVs utilize rechargeable batteries that can be recharged by plugging into charging stations or electrical outlets. The development of this technology has resulted in a range of EV models, from compact city cars to large trucks.

EVs are becoming increasingly popular worldwide, with both automakers and governments advocating for their adoption as a way to mitigate air pollution and improve public health. In addition to being environmentally friendly, there are many benefits of using EVs such as there is no engine thus the sound is effectively reduced, very light weight so effortlessly used by number of people, also cost of purchase and maintenance is a lot cheaper as compared to conventional vehicles Our proposed system gives an idea on how EVs operates, including their history, technology, benefits, and limitations. Furthermore, this article will examine the current state of the electric vehicle market and the challenges hindering the widespread adoption of electric vehicles. Finally, the document will offer recommendations to policymakers and stakeholders to expedite the transition to electric vehicles, including the launch and marketing of new EV models.

Car manufacturers such as Tesla and Tata have recently introduced new electric vehicle models to the market. To reserve one of these vehicles, users are required to pay a portion of the total cost online. Our system will employ the Google Maps slotting strategy and API to generate the quickest route to a charging station. The chatbot system software will use text commands to operate. Specific charging stations are dedicated to charging electric vehicles, although it should be noted that under current conditions, approximately 4,444 cars would require at least 15 to 30 minutes to fully charge.

II. OBJECTIVE AND SCOPE

A. Objective

The objective of this project is to provide an efficient and convenient charging slot booking system for electric vehicle (EV) car owners. The project aims to design a simple and user- friendly interface that can be easily understood by everyone. Italso aims to connect multiple charging stations together via a single system and provide users with details about the nearest stations and routes to reach them through maps. The overall objective is to simplify the process of booking and charging EVs, making it more accessible to users.

B. Scope

The scope of this project is to provide a fast and easy way for customers to book charging slots at EV charging stations. By implementing this system, users will be able to save time and easily find available charging slots at nearby stations. The project will also enable the connection of multiple charging stations through a single system, making it more efficientand cost-effective. Additionally, users will be able to access information about the nearest charging stations and navigateto them using maps.

III. REVIEW OF LITERATURE

Mohsen Ahmadi; N. Mithulananthan; Rahul Sharma "A review on topologies for fast charging stations for electric vehicles". This article [1] presents a topological inventory of charging stations available in the literature. Currently, 50 kW fast chargers capable of charging an average electric car in about an hour are already on the market. However, a fast charging level of 240 kW capable of recharging a typical electric vehicle in 10 minutes has been introduced into the standard. These high-powered fast chargers should be available soon. When several electric vehicles charge quickly simultaneously, charging stations must provide charging power in the order of several megawatts.

Akinwole, OO and Oladimeji, TT "Design and implementation of arduino microcontroller based automatic lighting control with I2c LCD display". In this paper [2] we understand how to setup basic arduino system with lcd in order to display the voltage,battery percentage, etc., and also aboutthe different components involved, the resistors used. The paper is also meant to provide socio economic benefits as well.

Ferreira, João C. and Monteiro, Vítor and Afonso, João Luiz "Smart Electric Vehicle Charging System". In this paper [3] the proposed smart electric vehicle charging system connects electric vehicles and renewables to a smart grid (SG) using vehicle-to-grid (V2G) technology. In addition, the system seeks a new paradigm in the power market (EM) through deregulation of power generation and use to obtain the best conditions for commercialization of power.

Achmad fitro Research Gate oct 2008 "Shortest Route at Dynamic Location with Node Combination-Dijkstra Algorithm". This paper [4] describes the modification in the node combination algorithm to find the shortest route. The issue of determining the shortest path from the dynamic positions collected from the fleet is resolved in this paper.

Rahul George, Srikumar Vaidyanathan, K Deepa "EV Charging Station Locator With Slot Booking System". The paper [5] states the benefit of replacing fuel based vehivles with electric vehicles, the paper also discusses about the excess carbon outlet by fuel based vehicles which can be reduced using electric vehicle. A vehicle to grid system is used in this paper which deals with saving of excess of power stored in the battery and effictively sending it back to the grid in order to avoid the power wastage and reduce the amountof power consumption

Heiko Knospe, Scarlet Schwiderski-Grosche "Online Payment for Access to Heterogeneous Mobile Networks". This paper

[6] explains the architecture where access to different mobile networks is given based on an online payment systems. Subscribed post-pay customers can use the GSM networks. Using technology, prepay users may also receive services from operators. This paper proposed an advanced design that uses an application for payments.

Ange Ouya, Blanca Martinez De Aragon, Cecile Bouette "An Efficient Electric Vehicle Charging Architecture basedon LoRa Communication" This paper [7] proposed a new communication method between Electrical vehicles and Charging stations. This method manages the energy generated by solar panels that EVs need. As a result, locally installed panels are major shift in the field of energy. This article aims to improve the generated solar panels energy required forelectric vehicles.

Puja Singh Pinki Nayak Arpita Datta Depansha Sani Garima Raghav Rahul Tejal "Voice Control Device using Raspberry Pi". This paper [8] the voice control device uses Raspberry Pi.It uses Query Processing; with the help of NLP it extracts the required meaningful text from the command given by the user.With the help of text to speech engine, it gives the output to the user in the form of a voice. The limitations of this system are that it requires the Raspberry Pi as a hardware device and we are implementing this algorithm directly on android device.

Binod Vaidya1 Hussein T. Mouftah IET "Smart Electric Vehicle Charging Management for Smart Cities". In this paper [9] they developed an intelligent electric vehicle charging management system, which uses charging

strategies including an efficient reservation system and allotment of charging station locations. Calculating the overall price including the period of waiting, period of charging, approximated charging cost, and customer dissatisfaction factors in this approach, the planned scheme will provide a better solution.

Qinglong Wang, Xue Liu, Jian Du, and Fanxin Kong "Smart Charging for Electric Vehicles: A Survey From the Algorithmic Perspective". In this paper [10] a survey is done with the help of algorithmns to gain a particular outcome. We gone through the different various proposed theories in the paper, like how they used them in the paper for the electric vehicle charging system. Later all the related uncertainities and probabilities were discussed in the paper taking all ofthem in consideration.

IV. METHODOLOGY

In the recent era where global warming and scarcity of fossil fuels are leading to major problems.To solve this problems renewable resources have proved to be boon for man kind. In Japan, the introduction of Feed-in tariffs (FIT) has led to the rapid expansion of photovoltaic systems. However, the increased output power from these system might face repercussions on the basis of frequency and distribution voltage, leading the Japanese government to reconsider theFIT system.

To address this problem, a Smart EV Charging Station System is proposed as an aggregator, utilizing a fixed battery for electricity trading. This system provides a platform for booking charging slots at nearest charging stations according to the needs of the customer. Features such as AI chatbots for booking, map integration for direction sensing, notifications, and emails are included.

Electric vehicles runs on battery and can be charged used on the basis of battery requirements and their socket type, time for charging. The basics and features required for EV chargers are also discussed, there is also huge requirement of EV charging connection.

The proposed Smart EV Charging Station System includes a slot booking system for charging EVs, categorized by charging socket type. The system utilizes GMAPS API to show the shortest route to reach the destination. The system uses AI for chatbot assistance and MySQL databases for storing system logs and slot management.

Continuous battery monitoring helps to alert the user to chargethe battery at the nearest charging station. An ESP32 micro- controller is used to achieve continuous battery monitoring. The device continuously monitors the battery level every 5 secsand sends battery level data to the system through bluetooth connectivity. The user gets an alert notification when the EV battery goes below the 20%, 10% or as per-user-defined percentage. The device interface with LCD helps the users to view the current battery status while driving.

A. Architectural Overview

Figure 1 shows the booking system architecture that we have used in the designing of the system.

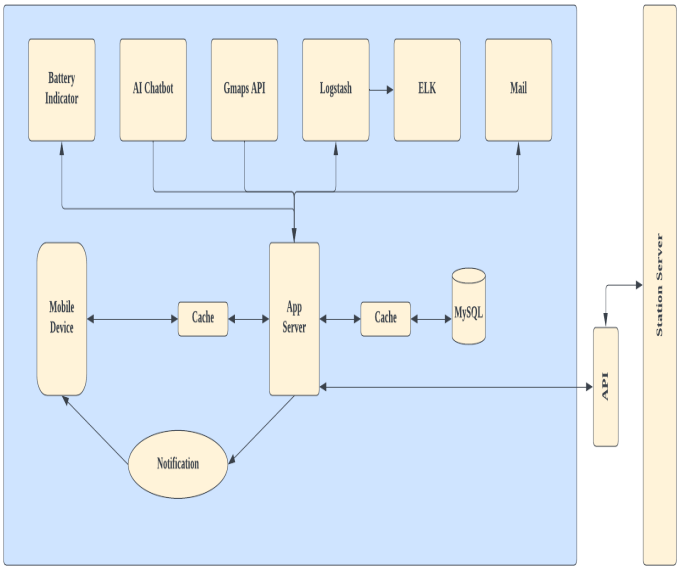

Fig. 1. Booking System Architecture

Figure 2 shows the flow of events in our slot booking system from registration till confirmation.

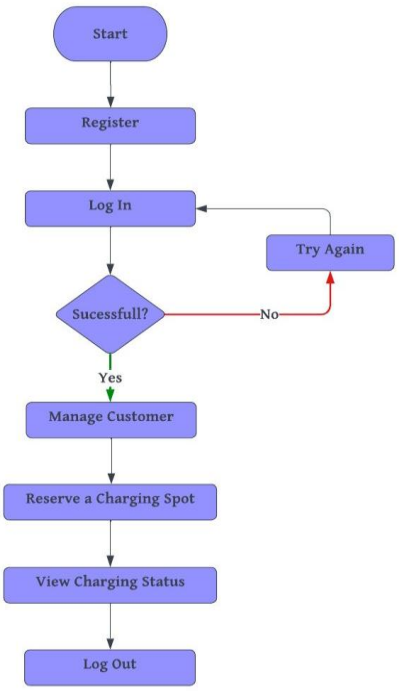

Fig. 2. System Flowchart

Figure 3 shows the architecture of the station system

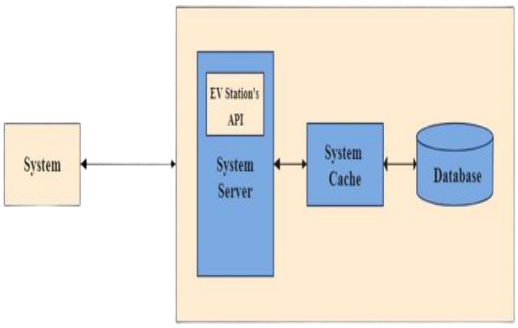

Fig. 3. Station System Architecture

B. UML Diagrams

Figure 4 is the class diagram of our system. Here in this diagram, There are 2 classes. The User and the System. Each class has its attributes and operations. The user registers in registration and logins into the system. He can search the locations and view the results. And the system displays the chatbot and shows the map.

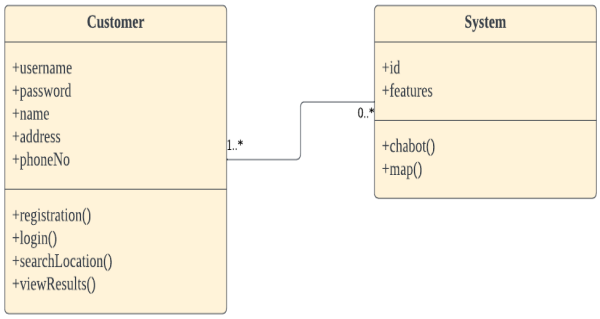

Fig. 4. Class Diagram

Use case dig of our system is depicted in Figure 5. The use case diagram of our system has two actor that is the user and the admin. The user is directly related to registration, log in, searching charging slot, asking question, using chatbot and receiving notifications and the admin handles the registration, slot booking, etc. activities.

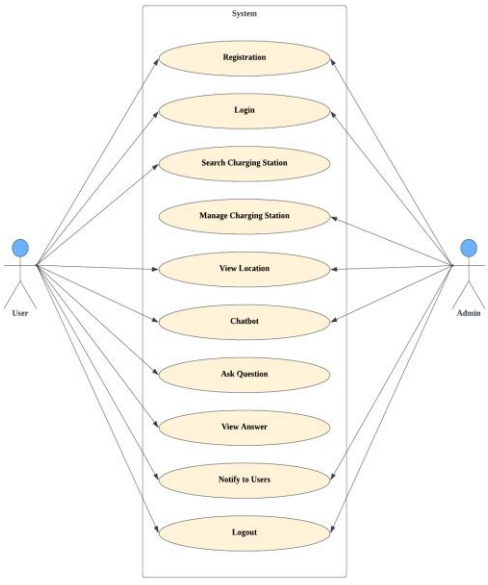

Fig. 5. Use Case Diagram

Component diagram of our system is displayed in Figure 6. In the diagram components communicate with each other using interfaces. The interfaces are linked using connectors. In our system we have 6 components namely JDK, Client, MySQL, .jar and .exe that is connected with the main web server. These components interact with each other when required and revert back to the main web server.

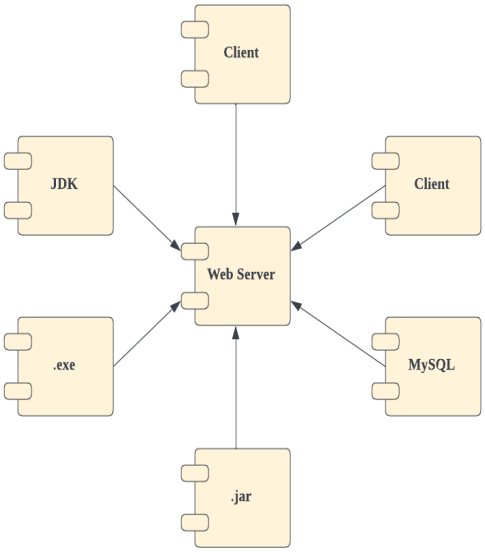

Fig. 6. Component Diagram

Figure 7 shows the deployment of the system. In this diagram, a node represents the client's computer. A component represents the web browser that is linked to the web pages. There's an interaction between the Clients computer and the web server. Web browsers and web pg depend on the web servers' HTTP and SSL. And java servlet depends on MySQLas a database server. These 3 nodes i.e. a client computer, web server, and database server are connected with a TCP/IP connection.

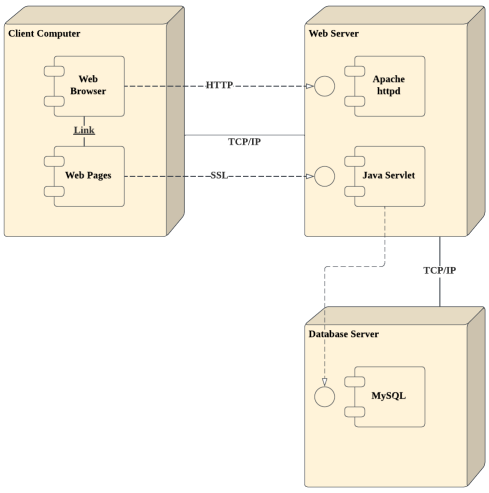

Fig.7. Deployment Diagram

V. RESULT

Figure 8 shows the LCD display that is connected with the bateery that displays the current battery percentage of the battery.

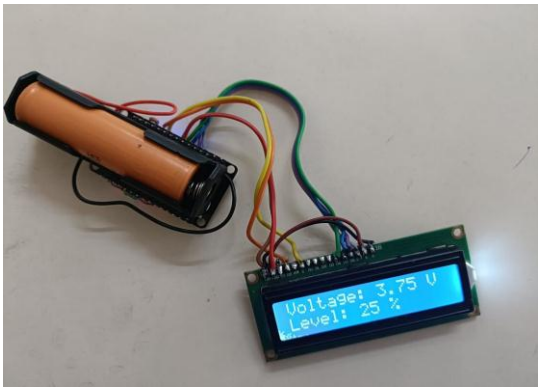

Fig. 8. LCD Display

Figure 9 is the final system that shows the LCD sisplay along with the system sdk present in the mobile. Both the LCD screen and the system displays the battery percentage. The system sdk also have the feature of slot booking, GMAPSAPI to guide you to the nearest charging station.

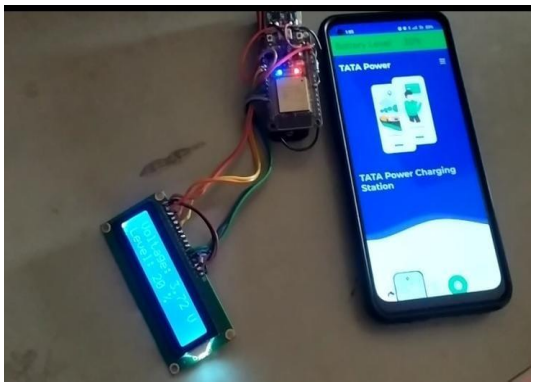

Fig. 9. LCD Display and Mobile SDK Connectivity

Figure 10 displays the Main page of the system from where we can navigate different menus present on the page.

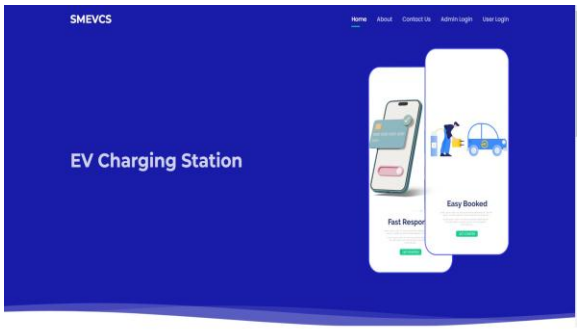

Fig. 10. Main Menu

Figure 11 shows the about us option that gives the brief description about our company and contact us where the user can contact us.

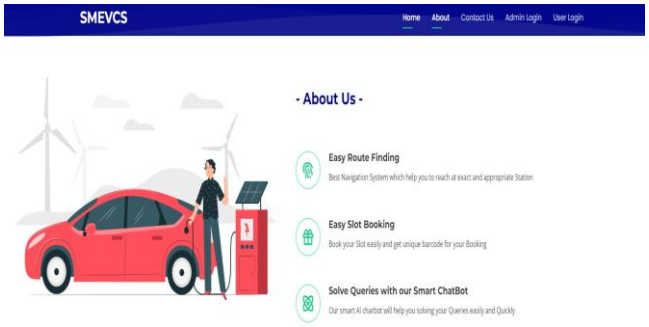

Fig. 11. About us and Contact us

Figure 12 displays the user registration menu where the new user can register and move forward to book their slots.

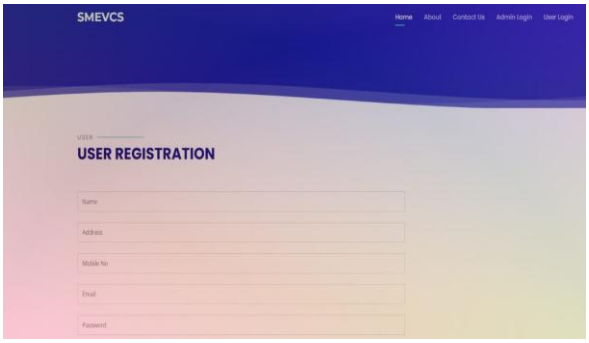

Fig. 12. User Registration Page

Figure 13 displays the user login page where the already registered customer can log in and move forward to book the slot

Fig. 13. User Login Page

Figure 14 displays the screen which gives the details of their booking and the GMAP API to book a charging station.

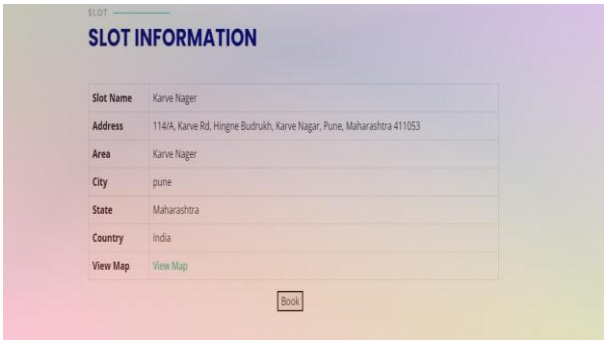

Fig. 14. Slot Details

Figure 15 shows the map that direct us to the booked chargingstation.

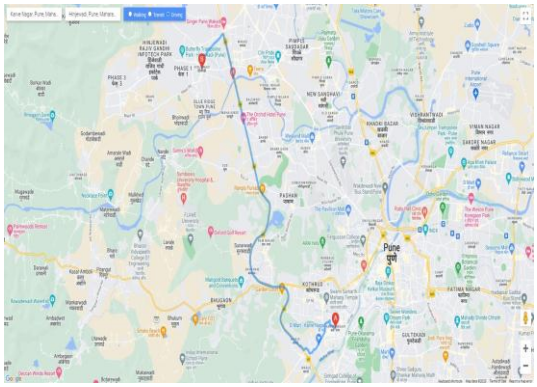

Fig. 15. Map

There will also be a system login menu which can only be accessed by the admin from where the admin can view the slots, add more slots and add or delete more slots Figure 16,17 shows the admin panel from where admin can add charging slot and see the slot details

Fig. 16. Adding slot

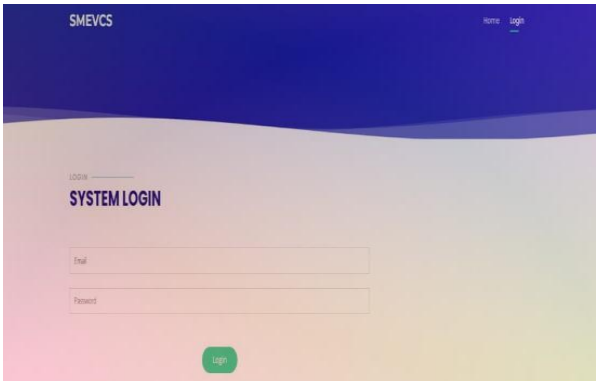

Fig. 17. System login

VI. CONCLUSION

System is developed as a Smart Management of EV Charging Stations with a hybrid approach of android application devel- opment. The system also contains a LCD display indicating the battery percentage which is also reflected in the application. This system also contains the AI chatbot for query solving as well as GMAPS API for direction sensing.

VII. FUTURE WORK

This project can be transformed into a proper android/ios application or else can be installed in the electric vehicles according to different battery and expand it to a large scale project.

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