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ijirset@gmail.com



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Smart Management of Electric Vehicle Charging Station

Kartikbhai Patil, Vaibhav Patel, Tejas Chaudhari, Kaushal Patil, Prof.(Dr.) Rachit Adhvaryu

Department of Computer Science Engineering, Parul Institute of Engineering and Technology, Vadodara,
Gujarat, India

Department of Computer Science Engineering, Parul Institute of Engineering and Technology, Vadodara,
Gujarat, India

Department of Computer Science Engineering, Parul Institute of Engineering and Technology, Vadodara,
Gujarat, India

Department of Computer Science Engineering, Parul Institute of Engineering and Technology, Vadodara,
Gujarat, India

Associate Professor, Department of Computer Science Engineering, Parul Institute of Engineering and Technology,
Vadodara, Gujarat, India

ABSTRACT: In Later a long-time car companies like TATA, TESLA presented and dispatched modern electric cars in the showcase. For charging these cars a few of the stations are to set up. But considering the current. In circumstance, these cars take at least 15 minutes to half an hour to charge. In case the station is full, and all the spaces are filled already at that point other clients have to be held up for a long time. Our thought is to create a system which can solve these sorts of issues. We are creating a system in which we are going to connect all the electric car charging stations together. By utilizing our system client can discover the station according to their choice and it'll be useful for those who want to travel for long distance with their EV cars and it'll be time sparing. It'll be exceptionally simple to use. If the given time opening is accessible at that point your place for the given slot will be booked. Otherwise, the system will ask to enter the new time plan. In this system the client has got to pay a few percent of sum Online to affirm their booking. Our system will too give the shortest outline route to reach the given station. Our system will also provide an interface for charging stations to see all accessible openings as well as booked space records and oversee slot timing. This system will be particularly created for android web based devices. We will leverage Time-slot allocation techniques as well as Google Maps API for direction sensing to create this system. Our chatbot System will use voice instructions to control software. Users can instantly pay money through an internet payment Channel. People will save a lot of time by using the system, and they will be able to conveniently view and reserve. Appropriate stations.

KEYWORDS: Smart management, charging slot, EV Cars, Map, Chatbot.

I. INTRODUCTION

In an era defined by the urgent need for sustainable energy solutions, the global community faces a pressing challenge: how to effectively manage the transition to renewable sources while addressing the growing demand for electric transportation. With climate change and fossil fuel depletion looming as existential threats, governments worldwide have turned to initiatives such as the Feed-in Tariff (Fit) scheme in Japan to incentivize the adoption of photovoltaic (PV) systems, thus accelerating the deployment of renewable energy infrastructure. However, the rapid proliferation of PV installations has introduced new complexities, particularly concerning grid stability and optimal energy distribution.

Against this backdrop, electric vehicles (EVs) emerge as a beacon of hope, promising to revolutionize transportation and reduce carbon emissions. Yet, the widespread adoption of EVs hinges on the availability of robust charging infrastructure capable of accommodating diverse user needs. Recognizing this imperative, our research seeks to address the critical gap in EV charging management through the development of a hybrid web-based Android application.

The central premise of our study lies in the convergence of advanced technologies to streamline the EV charging experience and maximize the utilization of renewable energy resources. By introducing a comprehensive system that integrates AI-driven chatbot functionality, seamless digital payment options, and real-time navigation capabilities powered by GMAPS API, we aim to redefine the paradigm of EV charging station management. Through proactive slot booking mechanisms and contextual planning approaches, our system seeks to optimize resource allocation, minimize wait times, and enhance user convenience.

At its core, our research represents a concerted effort to bridge the gap between renewable energy integration and electric mobility, thereby laying the foundation for a sustainable transportation ecosystem. By leveraging emerging technologies and innovative design principles, we aspire to facilitate seamless interaction between users, infrastructure, and renewable energy sources, thus driving the transition towards a greener, electrified future.

In this paper, we delineate the conceptual framework, technical specifications, and implementation strategies underlying our proposed hybrid application for smart management of EV charging stations. Through empirical analysis and case studies, we elucidate the potential benefits, challenges, and implications of our approach, thereby contributing to the ongoing discourse on sustainable energy management and electric mobility. Ultimately, we envision our research as a catalyst for transformative change, paving the way towards a more resilient, efficient, and environmentally conscious transportation landscape.

II. RELATED WORK

The transition towards electric vehicles (EVs) is accelerating globally, necessitating innovative propulsion systems and charging infrastructure to support their widespread adoption. One proposed solution involves the utilization of a coreless axial flux endless attraction machine as the propulsion motor, integrated with a three-phase inverter and a three-harborage DC/DC motor. This system, powered by inputs from solar panels and batteries, leverages GaN bias to achieve high switching frequencies, thereby enhancing motor efficiency and reducing size. By facilitating bidirectional power flow between the propulsion motor and battery, coupled with current decaying techniques for operation over a wide range of speeds, this approach addresses the unique requirements of solar race cars, ensuring optimal performance and energy utilization.

Additionally, the integration of small-sized superconducting magnetic energy storage (SMES) systems in EV charging stations presents a promising avenue for enhancing grid stability and optimizing energy transfer. A comparative analysis of quick response energy storage systems, including flywheels and capacitors, highlights the distinct advantages of SMES in terms of rapid power response and efficient energy management. Through a comprehensive energy operation strategy, which controls the transfer of energy among PV units, SMES, EV batteries, and the power grid, the EV charging station system demonstrates improved reliability and performance.

Furthermore, the evolution of charging station topologies is essential to meet the growing demand for fast and efficient charging solutions. Current advancements in fast charging technology, including 240 kW fast charging stations, underscore the need for scalable and modular charging infrastructure capable of supporting multi-megawatt charging scenarios. A topological analysis of charging stations emphasizes the importance of grid support, power flexibility, and cost-effectiveness in enabling future growth and ensuring high-quality service delivery.

In parallel, the development of scheduling algorithms for EV charging in smart grids is crucial for optimizing grid integration and managing charging demand effectively. Recent research efforts have focused on classifying charging algorithms based on charging directionality, centralization, and mobility considerations. By addressing key challenges in charge scheduling, such as grid stress and mobility constraints, these algorithms contribute to the efficient and sustainable operation of EV charging networks.

Moreover, advancements in DC/DC motor technology, exemplified by the Boost Bidirectional Buck Converter (B3C), offer promising solutions for integrating PV, battery, and charging systems seamlessly. The proposed B3C motor, characterized by high integration and single-stage power conversion, enables efficient power transfer between multiple sources while minimizing electromagnetic noise. Through advanced control and modulation

techniques, such as Maximum Power Point Tracking (MPPT) and voltage regulation, the B3C motor ensures optimal performance and energy utilization in diverse operating conditions.

In summary, the literature survey highlights the interdisciplinary nature of research in electric vehicle propulsion, charging infrastructure, and grid integration. By leveraging innovative technologies and control strategies, researchers aim to address the complex challenges associated with EV adoption, paving the way for a sustainable and electrified transportation future.

III. METHODOLOGY

“In light of the growing demand for electric vehicle (EV) charging infrastructure, this research aims to design and develop a hybrid web-based Android application that enables users to efficiently book charging slots for their electric vehicles. Additionally, the system proposes a novel approach to slot booking by considering the specific charging socket types available at each charging station. By addressing the challenge of optimizing slot allocation based on charging socket compatibility, this study seeks to enhance the usability and accessibility of EV charging facilities, thereby promoting the widespread adoption of electric vehicles and sustainable transportation practices.

The main purpose of carrying out this project is to develop a hybrid web-based android application for the EV car proprietors to avail the charging station slot booking system to book a slot of the charging station prior of planning to charge the vehicle. As well as system also gives shortest route to reach to destination through GMAPS API.

Proposed System:

We propose a Smart EV Charging station System where we used a slot booking system to book EV vehicle charging Station to charge vehicles. We further categories these slots according to the charging socket type. We have also used AI voice assistant to communicate with the user with the system via vocal commands. We also used GMAPS API to show shortest route to reach the destination. The system uses NLP for AI voice assistance as well as MySQL databases for storing a System logs as well as slot management.

This research paper proposes the integration of a small-sized Superconducting Magnetic Energy Storage (SMES) system into an Electric Vehicle (EV) charging station, alongside a Photovoltaic (PV) generation system. The primary objective is to investigate the practical application and effectiveness of SMES technology within the context of EV charging infrastructure.

To provide a comprehensive comparison, the study evaluates three quick-response energy storage systems: flywheel, capacitor (super-capacitor), and SMES. Special attention is given to elucidating the distinctive features and advantages of SMES in this context.

The proposed system configuration involves the interconnection of SMES, PV generation system, and EV battery to a common DC bus, each equipped with corresponding converters. A Voltage Source Converter (VSC) facilitates grid connection, ensuring seamless integration with the power grid.

Given the rapid power response characteristics of SMES, it is deployed to stabilize the DC bus voltage, thereby enhancing the overall reliability and performance of the charging station. An energy management strategy is devised to govern the transfer of energy among PV units, SMES, EV battery, and the power grid over extended operational periods.

To validate the functionality and performance of the proposed system, comprehensive modeling and simulation tests are conducted using MATLAB/Simulink. Through rigorous analysis and experimentation, this research seeks to provide valuable insights into the practical implementation and benefits of integrating SMES technology into EV charging infrastructure.

Workflow Diagram:

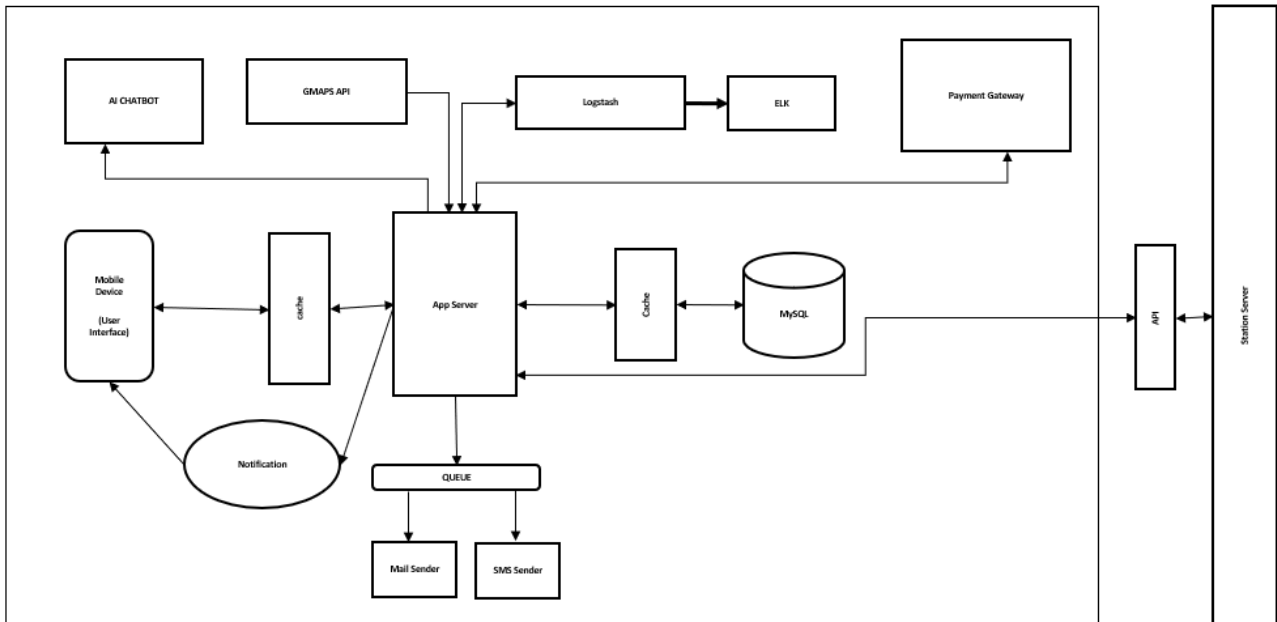


Fig.1 Booking System Architecture

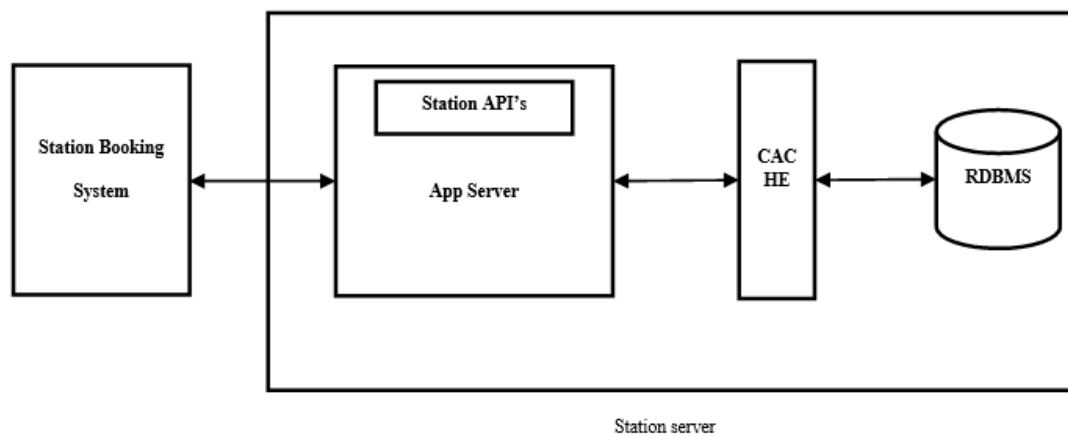


Fig.2 Station System Architecture

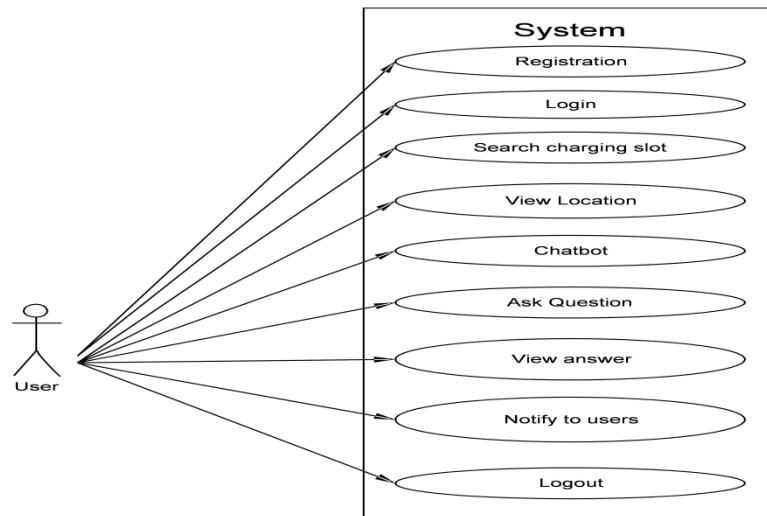


Fig. 3 Use case Diagram

IV. EXPERIMENTAL RESULTS

The experiments were conducted on a personal computer equipped with an Intel Core i3-2120 CPU @ 3.30GHz and 4GB memory, running Windows 7 as the operating system. The backend database employed was MySQL 5.1, providing robust data management capabilities for the system. The application itself was developed as a web application using Eclipse IDE and deployed on a Tomcat server, facilitating seamless execution and integration with existing infrastructure.

The experimental evaluation focused on various aspects of the Smart Management System, including slot booking functionality, AI voice assistant integration, and navigation features using the GMAPS API. Performance metrics such as response time, scalability, and resource utilization were measured to assess the system's efficiency and effectiveness in managing EV charging stations.

Implementation Sample Pages:

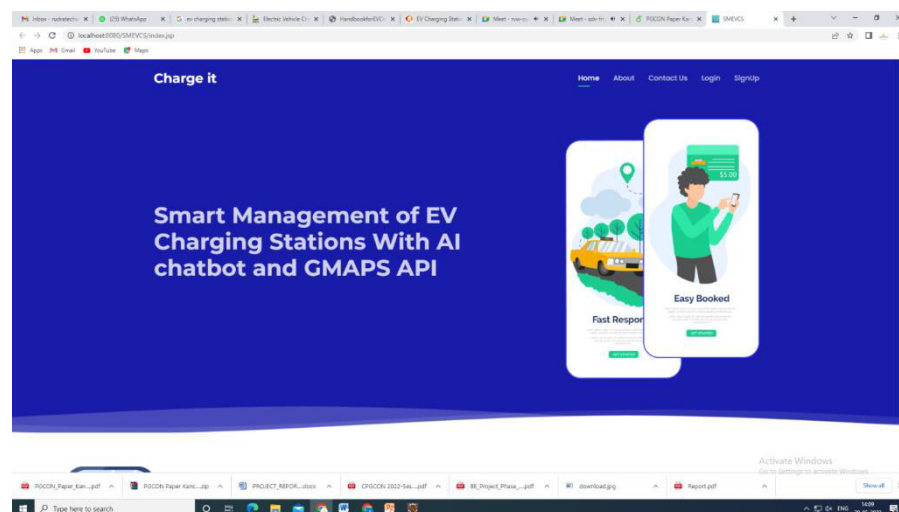


Fig 4. Introductory Page

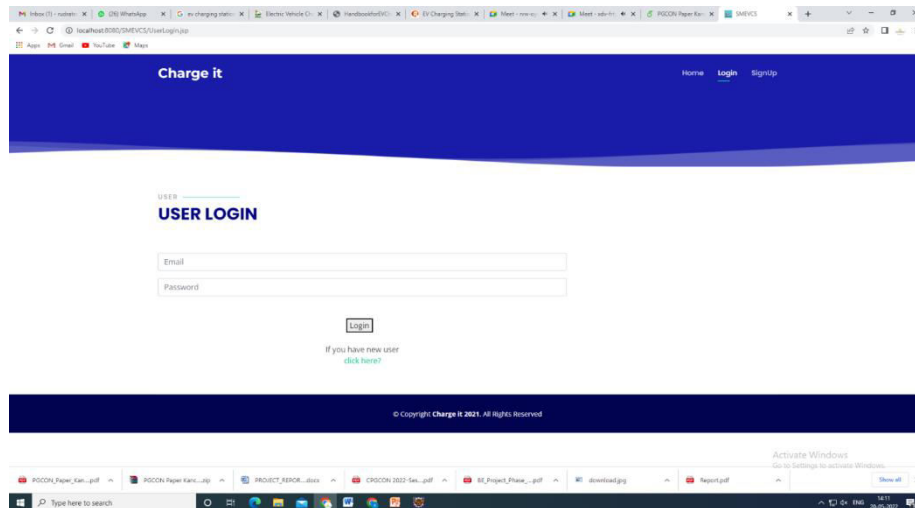


Fig.5 User Login Page

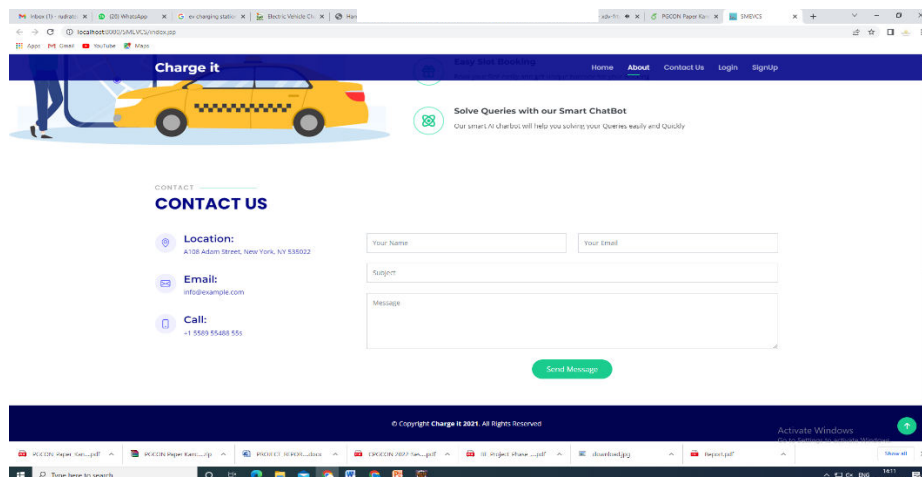


Fig .6 User Query Page

V. CONCLUSION

A lot of work has been done in this field much obliged to its broad utilize and applications. This section mentions some of the approaches that have been implemented to attain the same reason. These works are mainly differentiated from the techniques for smart management of EV charging stations systems. System is developed as a “Smart Management of EV Charging Stations” with hybrid approach of android application development. The system also proposes the booking of charging slot according to the type of charging socket to the car. This system also contains the AI for query solving as well as GMAPS API for direction sensing.

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