Journal of Science Engineering Technology and Management Science
Volume 02, Issue 04, April 2025 *ISSN: 3049-0952*
www.jsetms.com *DOI:10.63590/jsetms.2025.v02.i04.105-110*

REVOLUTIONIZING EV CHARGING WITH REAL-TIME RESERVATIONS

B. Suresh Kumar, Kona Sumanth, Bommisetty Hemendra Siva Sai, Kaki Praveen Kumar

Department of Electronics and Communication Engineering, Geetanjali Institute of Science and Technology, Nellore, Andhra Pradesh, India.

To Cite this Article

B. Suresh Kumar, Kona Sumanth, Bommisetty Hemendra Siva Sai, Kaki Praveen Kumar," Revolutionizing EV Charging With Real-Time Reservations", Journal of Science Engineering Technology and Management Science, Vol. 02, Issue 04, April 2025,pp: 105-110, DOI: http://doi.org/10.63590/jsetms.2025.v02.i04.pp105-110

Submitted: 09-03-2025 *Accepted: 18-04-2025* *Published: 26-04-2025*

ABSTRACT

With the rapid rise in electric vehicle (EV) adoption worldwide, the need for a reliable and efficient charging infrastructure has become more critical than ever. One of the major challenges faced by EV users today is the lack of a proper reservation system at charging stations. Most existing stations operate on a first-come, first-served basis, forcing users to manually check availability upon arrival, which often leads to long queues, wasted time, and user frustration. To overcome these issues, this system introduces an automated EV slot reservation solution designed to streamline the charging process. The proposed system enables users to remotely pre-book charging slots through a user-friendly interface, significantly enhancing accessibility and convenience. It integrates various technologies including IoT devices for real-time monitoring of charging slot status, a Real-Time Clock (RTC) module to ensure accurate scheduling and time tracking, GSM modules for seamless remote communication, and an LCD display for clear on-site user interaction. These components work together to provide live updates on slot availability and ensure bookings are managed efficiently. By allowing users to plan their charging sessions in advance, the system not only reduces congestion at charging stations but also improves the overall user experience. Furthermore, the use of remote communication and automated scheduling enhances the security and management of the charging infrastructure. Ultimately, this smart reservation system aims to make EV charging more efficient, reliable, and user-centric, supporting the continued growth of electric mobility.

Keywords: EV Charging Infrastructure, EV Slot Reservation, LCD, Keypad, ESP3.

1. INTRODUCTION

The global transportation sector is undergoing a significant transformation, marked by the increasing shift from conventional fuel-powered vehicles to electric vehicles (EVs). This shift is driven by the need to reduce greenhouse gas emissions, mitigate fossil fuel depletion, and promote sustainable mobility solutions. The transportation industry is a major contributor to environmental pollution, and governments worldwide are implementing initiatives such as subsidies, incentives, and infrastructure development to encourage the adoption of EVs.

However, despite the advantages of EVs, challenges persist in managing charging infrastructure. Unlike traditional fuel stations, EV charging stations require longer durations for recharging, resulting

in long waiting times, underutilized infrastructure, and user inconvenience. Range anxiety—the fear of battery depletion before locating a charging station—further complicates the adoption of EVs.

To address these issues, an intelligent EV Slot Reservation System is proposed. This system integrates emerging technologies such as IoT, cloud computing, and AI to ensure optimal charging station utilization, minimize waiting times, improve user experience, and promote sustainable energy management through smart load balancing.

2. LITERATURE SURVEY

Zhang et al. developed an intelligent EV charging slot reservation system that leverages real-time traffic data and energy demand forecasting to optimize charging station usage. Their system dynamically analyzes traffic conditions and predicts energy demand to pre-allocate charging slots efficiently. The model improves overall charging efficiency, minimizes user waiting times, and reduces the occurrence of underutilized stations. By incorporating predictive analytics, the system ensures a seamless EV charging experience and contributes to the smooth operation of EV networks [1].

Kumar et al. (2020) proposed an IoT-enabled EV slot reservation framework integrated with cloud computing technology. Their system facilitates real-time slot booking by connecting IoT sensors at charging stations to a centralized cloud database. This approach ensures that users receive immediate updates on slot availability, while also optimizing energy consumption based on usage patterns. The research demonstrates how cloud-based reservation systems can enhance user convenience, reduce operational costs, and improve resource utilization across charging networks [2].

Lee and Park (2022) explored blockchain implementation in EV charging slot reservation systems to strengthen security and prevent fraudulent reservations. Their decentralized framework employs smart contracts to ensure transparent, tamper-proof transactions. This approach not only enhances data integrity but also protects against unauthorized slot bookings. The research shows that integrating blockchain technology into EV slot reservation systems effectively addresses trust and security concerns while maintaining operational efficiency [3].

Chen et al. (2021) developed an AI-driven predictive model for charging slot allocation. Their system utilizes historical demand patterns combined with real-time data to anticipate peak usage times and allocate slots accordingly. By employing machine learning algorithms, the model continuously improves its predictions over time. The study highlights how predictive analytics can significantly enhance the efficiency of EV charging networks and reduce user wait times [4].

Singh et al. (2019) presented a dynamic pricing model designed to regulate EV charging demand. The pricing strategy adjusts slot rates based on real-time demand fluctuations and congestion levels, encouraging users to utilize off-peak hours. This approach effectively balances the load on charging stations, promotes energy efficiency, and prevents grid overloading. The research demonstrates how dynamic pricing mechanisms can optimize resource distribution and improve user behavior [5].

Patel et al. (2020) proposed a cloud-based scheduler for EV charging stations. The system manages slot reservations by processing real-time user requests alongside station availability data. The scheduler allocates charging slots dynamically, ensuring fair load distribution and preventing overutilization of specific stations. The research emphasizes how cloud integration and real-time scheduling can improve service reliability and user satisfaction [6].

Wang et al. (2021) designed an optimization framework that incorporates power grid constraints into EV slot reservation systems. Their model takes into account available grid capacity, energy demand, and user requests to distribute charging slots effectively. This approach minimizes grid imbalance and improves station efficiency. The research suggests that such integrated frameworks are crucial to ensuring reliable, scalable EV charging networks [7].

Li et al. (2022) integrated EV slot reservation systems into smart grids to balance electricity loads and prevent network congestion. Their system allows coordinated charging by synchronizing reservations

with real-time grid conditions. This coordination reduces stress on power distribution systems, supports sustainable energy use, and enables better load management. The research underscores the importance of smart grid integration in modern EV infrastructure [8].

3. PROPOSED SYSTEM

In recent years, the application of deep learning techniques, particularly Convolutional Neural Networks (CNNs), has revolutionized various domains, including image classification. One of the fascinating areas where CNNs have demonstrated remarkable performance is in the classification of larvae images. Larvae, being a crucial stage in the life cycle of many organisms, pose unique challenges for classification due to their diverse morphological features and subtle differences between species. Accurate and efficient classification of larvae images holds immense significance in various fields, including biology, ecology, agriculture, and environmental science.

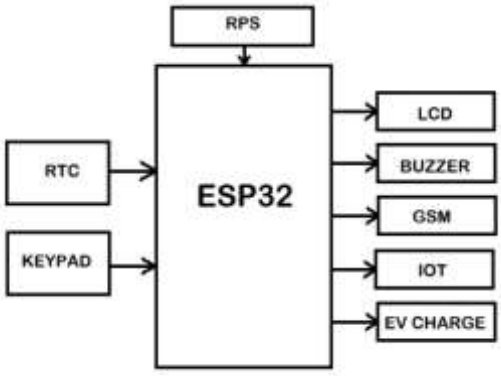

Fig. 1: BLOCK DIAGRAM

The working of the EV Slot Reservation System is explained here. During the initial setup, the system is programmed to monitor charging slot availability and store real-time data on a cloud server. The user interacts with the system using a custom-designed 3-key keypad module. The keypad consists of three functional keys: Increment (I), Decrement (D), and Enter (E), which are programmed to navigate slot options and confirm bookings. When the user arrives at the charging station, they first use the keypad to browse through the available charging slots displayed on the 16x2 LCD monitor. The Increment key allows the user to scroll forward through the slots, while the Decrement key enables backward navigation. Each slot's current status (Available/Occupied) is clearly displayed on the LCD.

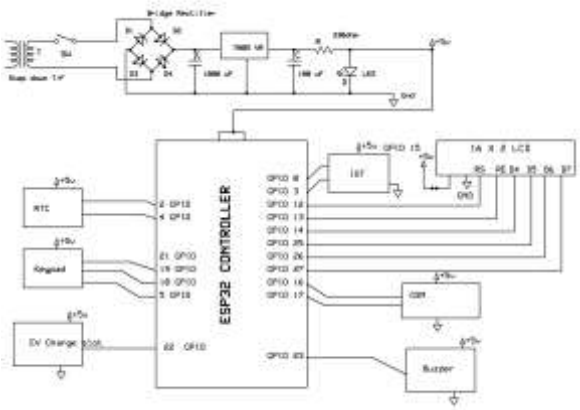

Fig. 2: SCHEMATIC DIAGRAM

This is the pin diagram where all the hardware components are connected to the ESP32 microcontroller. The ESP32 microcontroller has 38 pins, including multiple GPIO pins functioning as

both digital and analog input/output. It supports both Wi-Fi and Bluetooth communication internally. The system uses a Regulated Power Supply (RPS) consisting of a step-down transformer, bridge rectifier, capacitor, voltage regulator IC, resistors, and LED.

4. RESULTS DESCRIPTION

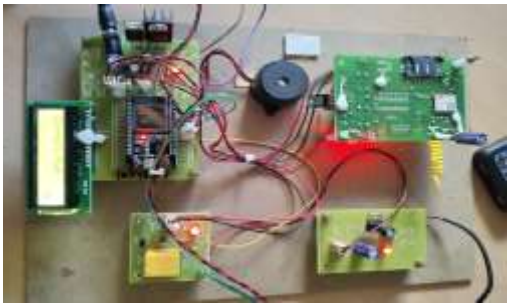

Fig. 3: Hardware equipment

The hardware prototype of the EV Slot Reservation System consists of various integrated electronic components meticulously arranged to achieve the intended functionalities of reservation, authentication, and control. The core of the system is based on the ESP32 microcontroller, which manages all operations and communication between modules.

Fig. 4: Commands

The EV Slot Reservation System integrates an efficient SMS-based communication protocol that enables remote registration, slot booking, and authentication using predefined commands. This mechanism enhances user convenience by allowing slot reservations and password verification via simple text messages. The following commands are employed within the system:

Fig 5: Website for Remote Monitoring

The IoT Server acts as the central monitoring and control hub for the EV Slot Reservation System. It facilitates real-time data logging, charger status updates, and user authentication tracking, thereby enhancing the transparency and efficiency of the system. The interface is designed with simplicity and clarity to allow administrators to easily oversee charging activities and password validations

5. CONCLUSION

The Electric Vehicle (EV) Slot Reservation System presents a smart and efficient solution to address the growing challenges associated with EV charging infrastructure. With the rising adoption of electric vehicles worldwide, the demand for organized and scalable charging systems has become imperative. This project introduces a user-friendly and intelligent platform that enables EV users to reserve charging slots in advance through a simple interface, thereby eliminating long waiting periods and ensuring optimal utilization of available resources. By integrating IoT-based hardware components, including the ESP32 microcontroller and a custom-designed 3-key keypad, the system offers real-time interaction and seamless communication between users and the charging station. The inclusion of an LCD display enhances the usability of the system by providing instant feedback during the reservation and charging process. Moreover, the implementation ensures secure slot allocation, remote monitoring capabilities, and data logging features to support transparent operation and auditing. This project not only contributes to the convenience and satisfaction of EV users but also supports the broader vision of smart city development and sustainable transportation. Through its modular design and scalability, the system holds the potential for integration with larger energy management networks and renewable energy sources in the future. Overall, the EV Slot Reservation System stands as a significant step toward building intelligent, eco-friendly, and user-centric infrastructure for the rapidly evolving electric mobility landscape.

REFERENCES

[1] Zhang et al. developed an intelligent EV charging slot reservation system that leverages real-time traffic data and energy demand forecasting to optimize charging station usage. Their system dynamically analyzes traffic conditions and predicts energy demand to pre-allocate charging slots efficiently. The model improves overall charging efficiency, minimizes user waiting times, and reduces the occurrence of underutilized stations. By incorporating predictive analytics, the system ensures a seamless EV charging experience and contributes to the smooth operation of EV networks.

[2] Kumar et al. proposed an IoT-enabled EV slot reservation framework integrated with cloud computing technology. Their system facilitates real-time slot booking by connecting IoT sensors at charging stations to a centralized cloud database. This approach ensures that users receive immediate updates on slot availability, while also optimizing energy consumption based on usage patterns. The research demonstrates how cloud-based reservation systems can enhance user convenience, reduce operational costs, and improve resource utilization across charging networks.

[3] Lee and Park explored blockchain implementation in EV charging slot reservation systems to strengthen security and prevent fraudulent reservations. Their decentralized framework employs smart contracts to ensure transparent, tamper-proof transactions. This approach not only enhances data integrity but also protects against unauthorized slot bookings. The research shows that integrating blockchain technology into EV slot reservation systems effectively addresses trust and security concerns while maintaining operational efficiency.

[4] Chen et al. developed an AI-driven predictive model for charging slot allocation. Their system utilizes historical demand patterns combined with real-time data to anticipate peak usage times and allocate slots accordingly. By employing machine learning algorithms, the model continuously improves its predictions over time. The study highlights how predictive

analytics can significantly enhance the efficiency of EV charging networks and reduce user wait times.

[5] Singh et al. presented a dynamic pricing model designed to regulate EV charging demand. The pricing strategy adjusts slot rates based on real-time demand fluctuations and congestion levels, encouraging users to utilize off-peak hours. This approach effectively balances the load on charging stations, promotes energy efficiency, and prevents grid overloading. The research demonstrates how dynamic pricing mechanisms can optimize resource distribution and improve user behavior.

[6] Patel et al. proposed a cloud-based scheduler for EV charging stations. The system manages slot reservations by processing real-time user requests alongside station availability data. The scheduler allocates charging slots dynamically, ensuring fair load distribution and preventing overutilization of specific stations. The research emphasizes how cloud integration and real-time scheduling can improve service reliability and user satisfaction.

[7] Wang et al. designed an optimization framework that incorporates power grid constraints into EV slot reservation systems. Their model takes into account available grid capacity, energy demand, and user requests to distribute charging slots effectively. This approach minimizes grid imbalance and improves station efficiency. The research suggests that such integrated frameworks are crucial to ensuring reliable, scalable EV charging networks.

[8] Li et al. integrated EV slot reservation systems into smart grids to balance electricity loads and prevent network congestion. Their system allows coordinated charging by synchronizing reservations with real-time grid conditions. This coordination reduces stress on power distribution systems, supports sustainable energy use, and enables better load management. The research underscores the importance of smart grid integration in modern EV infrastructure.