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EVIOT-Futuristic Automation System for Electric Vehicle CS Charging Point Prediction and Booking System

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Abstract: The escalating levels of environmental pollution and the depletion of global fossil fuel reserves have accelerated the transition toward sustainable transportation alternatives. Electric Vehicles (EVs) are emerging as a promising solution to mitigate carbon emissions and reduce national oil import dependencies. However, the growing adoption of EVs presents new challenges, particularly in terms of establishing a scalable and efficient charging infrastructure. This paper presents the framework and architecture of a next-generation communication system designed for real-time EV charging slot prediction and online booking, based on the Internet of Things (IoT). A cloud-based platform is developed for intelligent Charging Station Management, capable of networking and handling multiple charging nodes. We propose a stochastic queuing model to simulate EV arrival patterns and service mechanisms at charging stations. Furthermore, we formulate an objective function that optimizes key performance metrics such as minimal queuing delay, optimal charging time, reduced travel distance, and low-cost energy utilization. The system's dynamic scheduling algorithm ensures efficient slot allocation, thereby minimizing wait times and preventing on-road EV breakdowns due to battery depletion. Real-time data acquisition and forecasting capabilities embedded within the cloud and IoT framework significantly enhance resource utilization and customer convenience. The proposed solution represents a step forward in achieving sustainable, cost-effective, and intelligent E-Mobility infrastructure suitable for smart city applications.

Keywords- Electric Vehicles (EVs), Charging Slot Booking, IoT, Cloud Computing, Queuing Model, Charging Infrastructure, Smart Cities, Slot Prediction, Real-Time Scheduling, E-Mobility.

1. INTRODUCTION

In many countries people live in densely populated areas, specifically in apartment buildings. With the proliferation of cars for private use, builders started to add subterranean communal parking areas to allow the owners to safely keep their vehicles when not in use. This concept is radically different from those parts of the globe where people tend to live in family houses, typically far from big cities. Since many car makers are currently developing electric vehicles (EVs), the replacement of current combustion engines seems to be plausible in the years to come. As a result, the creation of a network of public and private charging points will be required, and the grid will have to absorb the increase in demand. In the case of family houses, only a minor electrical renovation might be required, mainly to adapt the installation to provide the current needed for a quicker charge. Communal garages are a different story as parking places do not usually have a socket already installed and, in addition, it is not clear yet how the energy cost will be charged to the owners. It is also worth mentioning that power requirements for a quick charge are very high, which will require running three-phase wires of a certain section to each available socket. An electric vehicle, also called an EV, uses one or more electric motors or traction motors for propulsion. An electric vehicle (EV) is one that operates on an electric motor, instead of an internal-combustion engine that generates power by burning a mix of fuel and gases. Therefore, such as vehicle is seen as a possible replacement for current-generation automobile, in order to address the issue of rising pollution, global warming, depleting natural resources, etc. Though the concept of

electric vehicles has been around for a long time, it has drawn a considerable amount of interest in the past decade amid a rising carbon footprint and other environmental impacts of fuel-based vehicles.

There are three main types of electric vehicles (EVs), classed by the degree that electricity is used as their energy source. BEVs, or battery electric vehicles, PHEVs of plug-in hybrid electric vehicles, and HEVs, or hybrid electric vehicles. Only BEVs are capable of charging on a level 3, DC fast charge.

Battery Electric Vehicles, also called BEVs, and more frequently called EVs, are fully-electric vehicles with rechargeable batteries and no gasoline engine. Battery electric vehicles store electricity onboard with high-capacity battery packs. Their battery power is used to run the electric motor and all onboard electronics. BEVs do not emit any harmful emissions and hazards caused by traditional gasoline-powered vehicles. BEVs are charged by electricity from an external source. Electric Vehicle (EV) chargers are classified according to the speed with which they recharge an EVs battery.

The classifications are Level 1, Level 2, and Level 3 or DC fast charging. Level 1 EV charging uses a standard household (120v) outlet to plug into the electric vehicle and takes over 8 hours to charge an EV for approximately 75-80 miles. Level one charging is typically done at home or at your workplace. Level 1 chargers have the capability to charge most EVs on the market.Level 2 charging requires a specialized station which provides power at 240v. Level 2 chargers are typically found at workplaces and public charging stations and will take about 4 hours to charge a battery to 75-80 miles of range. Level 3 charging, DC fast charging, or simply fast charging is currently the fastest charging solution in the EV market. DC fast chargers are found at dedicated EV charging stations and charge a battery up to 90 miles range in approximately 30 minutes.

2. LITERATURE SURVEY

Cao et al. (2019)

Proposes a V2V (Vehicle-to-Vehicle) based reservation system that enables electric vehicles (EVs) to pre-book charging stations, improving efficiency and reducing waiting times in smart transportation systems.

Throughput and Fairness Analysis (2011)

Analyzes the performance of 802.11 wireless protocols in Vehicle-to-Infrastructure (V2I) communication, focusing on throughput and fairness during high-speed data transfer between vehicles and roadside units.

Bayram & Papapanagiotou (2014)

Provides a comprehensive survey of communication technologies, including cellular and DSRC, necessary for connecting EVs to the Internet, emphasizing data exchange for smart grid and mobility applications.

Cai et al. (2017)

Introduces the concept of networked EVs integrated with green intelligent transport systems, aiming to reduce emissions and enhance real-time decision-making in smart cities.

Hatton et al. (2009)

Presents the design framework for EV charging infrastructure in urban environments, focusing on modular, scalable charging stations tailored to the needs of Dutch cities.

del Razo & Jacobsen (2016)

Discusses intelligent charging schedule algorithms for long-distance EV travel, optimizing charging times and station selection to minimize travel disruption.

Gusrialdi et al. (2017)

Develops distributed and cooperative control algorithms for scheduling EV charging at highway service stations, enabling load balancing and reducing grid strain.

Djahel et al. (2015)

Proposes a V2I communication-based solution for mitigating traffic congestion by enabling real-time vehicle coordination and traffic flow optimization in smart cities.

Savio et al. (2019)

Explores a hybrid microgrid model combining photovoltaic energy with EV charging, offering sustainable energy management and storage solutions for charging stations.

Lokesh & Min (2017)

Outlines a policy and technical framework for EV charging in Singapore, emphasizing regulatory support, infrastructure planning, and smart grid integration.

3.PROPOSED SYSTEM

Problem Identification: Analyze inefficiencies in current EV charging systems—like slot unavailability, queue mismanagement, and lack of slot reservation options. User Requirement Gathering: Survey EV users and charging station operators to identify needs such as live slot updates, early booking, SOC-based prioritization, and system alerts. Use Case Definition: Define critical scenarios like: Slot sensing and occupancy detection EV slot reservation and queue management SOC-based admission control Real-time monitoring through mobile/web interface . Architecture Planning: Design a hybrid architecture with embedded hardware for slot detection and a web-based interface for EV user interaction and admin control. Use IR Sensors with Arduino UNO to detect slot occupancy and transmit data via ESP8266 to the cloud/server. EV Information Collection: Allow users to enter vehicle ID, current SOC, and desired charging duration through the web/mobile application.

The proposed project focuses on optimizing the management and scheduling of Electric Vehicle (EV) charging stations to reduce wait times, increase charging efficiency, and improve user experience. The system uses a First Come, First Serve (FCFS) approach while incorporating smart scheduling techniques that predict EV arrivals based on reservation data. This ensures that vehicles are charged promptly without unnecessary delays. A key feature of the system is the admission control mechanism, which ensures that EVs are only allowed to charge if their requested State of Charge (SOC) can be met within the available time slots, thus avoiding over-promising charging services. Real-time slot availability is tracked using a slot sensing unit consisting of hardware components like Arduino UNO, IR sensors, and the ESP8266 Wi-Fi module, which provides both operators and users with accurate occupancy information. The system is also complemented by a web and mobile application, allowing users to find the nearest charging station, reserve slots, set charging limits, and make secure payments, while also providing live updates on charging progress.

Additionally, the project leverages Stochastic Queuing Simulation (SQS) to manage high workloads and forecast demand based on the expected arrival of vehicles, ensuring efficient scheduling. A flexible payment system, offering multiple payment methods like credit cards and PayPal, adds further convenience for users. The

charging stations also employ automated authentication through Plug & Charge protocols, minimizing manual intervention and enhancing user experience. By combining advanced technologies like real-time data tracking, smart scheduling, and user-centric features, this system aims to address several challenges faced by existing EV charging infrastructure, such as long waiting times and inefficient charging slot utilization. Ultimately, this project provides a more efficient, scalable, and user-friendly solution for managing EV charging stations.

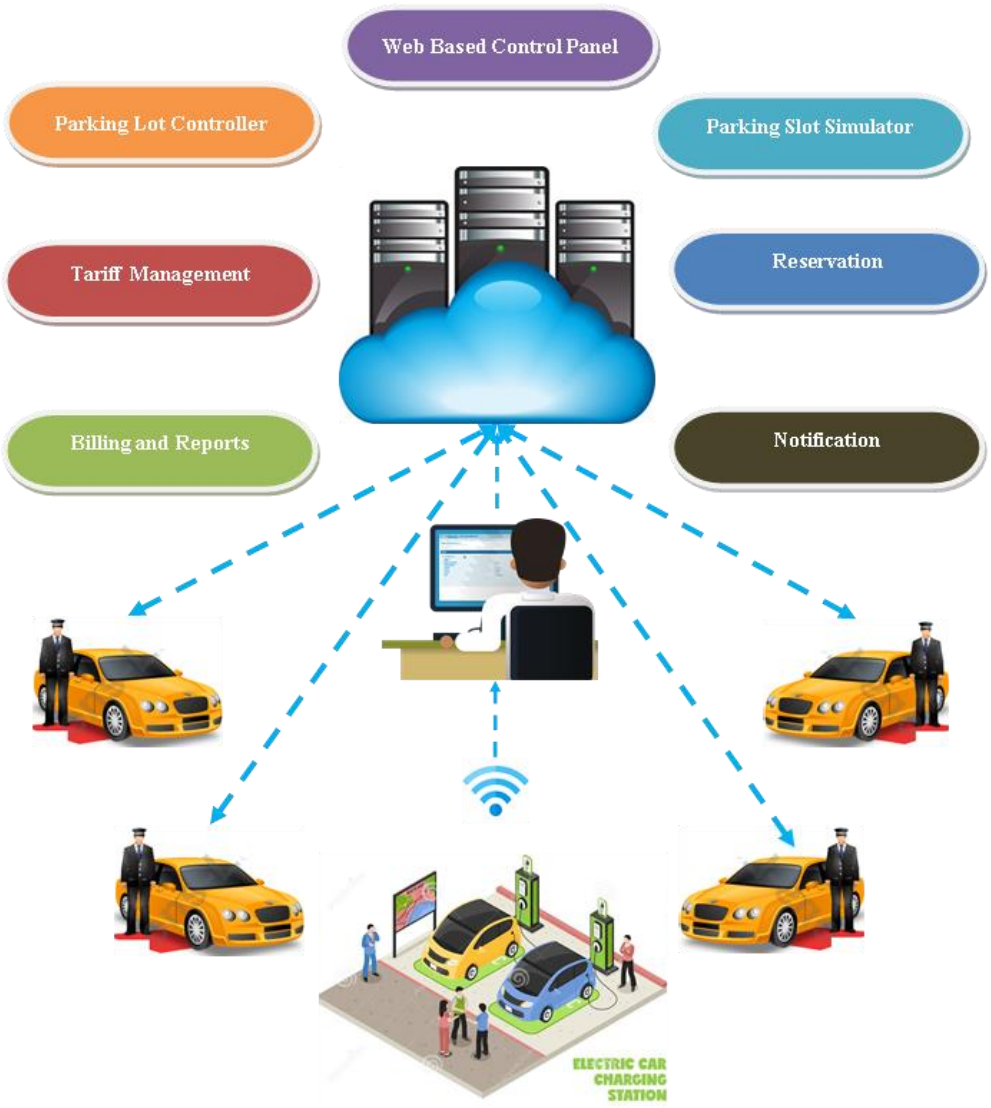

FIGURE 1. System Architecture Diagram.

Manage all aspects of your charging infrastructure, customer & partner relations, billing and payments, view stats and reports. Accessible online with comprehensive access control. The management unit exposes a web application, developed in Angular, which relies on the services exposed and allows the EV platform managers to monitor, configure and operate the platform. It also provides to the platform users a complementary user interfaces that, although supporting only a reduced set of the operations available on the native mobile app, allows the users to interact with the platform using browser-only technologies, available in a wide.Static background is subtracted from video feeds to focus on moving objects (vehicles, pedestrians), helping in better object detection and tracking.

3. RESULTS AND DISCUSSION

The reviewed literature reveals significant advancements in the development and optimization of electric vehicle (EV) charging infrastructure and intelligent transportation systems. Key findings highlight the importance of communication technologies, smart scheduling, and renewable integration to support the growing demands of EVs in urban and highway environments. From the implementation of V2V-based reservation systems (Reference [1]) and throughput analysis of 802.11 protocols for V2I communication (Reference [2]), it's evident that robust, real-time data exchange is foundational to efficient EV operation. The survey by Bayram et al. ([3]) further reinforces that diverse communication protocols—ranging from LTE to DSRC—play a vital role in enabling Internet of Electric Vehicles (IoEV) services.

Cai et al. ([4]) and Hatton et al. ([5]) explore intelligent transportation and infrastructure design, respectively, advocating for the integration of networked systems and modular platforms to handle urban charging needs. Furthermore, charging schedule optimization techniques presented in [6] and [7] demonstrate the efficacy of distributed and cooperative algorithms in reducing wait times, load imbalances, and travel delays during long-distance trips. Meanwhile, smart city traffic solutions using V2I technology ([8]) show promising potential in easing congestion by enhancing traffic coordination. Integration of renewable energy sources, as discussed in [9], suggests a sustainable path forward by incorporating photovoltaic microgrids into EV charging setups. Finally, the Singaporean framework ([10]) presents a holistic policy-driven model emphasizing scalability and eco-efficiency.

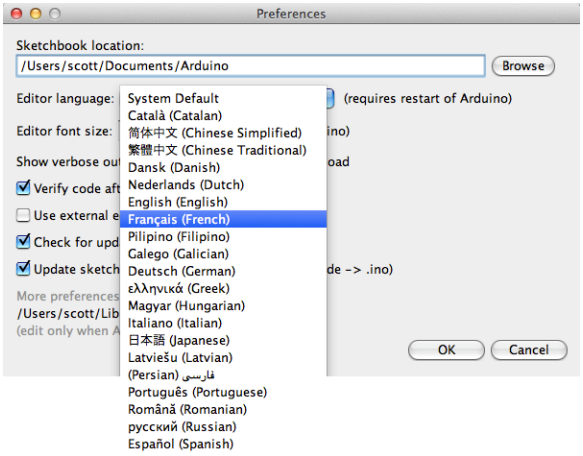

FIGURE 2. The Working Model.

4. CONCLUSION

We have implemented a complete system to supervise the charging of EVs in car parks, using small and cheap is connected to the Internet wirelessly. This system is to ease the drivers to find parking slots during peak hours by using Web and AndroidPhone. This is an efficient system as it helps to solve heavy traffic congestion and reduces the driver's frustrations. The system can be more enhanced by providing the route to the selected parking location with the help of Nano Global Position Search (GPS) System.). The proposed system allows a user to access the information associated with the charging process (cost, effective elapsed time, estimated time to full charge, etc.), and a supervisor to manage different aspects of the process such as billing of consumed energy, charging priorities, etc. The use of a Wi-Fi connection dramatically reduces the wiring and the complexity of the installation, and simplifies the interaction with the users of the system. The main idea behind this is the fact that every single parking space will need to be adapted to serve as a charging point, and given the shared ownership nature of these garages, we need a way to measure and manage the power consumed by the vehicle recharge. Electric mobility is developing rapidly - both in demand and supply. The demand for (better) charging infrastructure is bigger than ever. This is why we've installed charging facilities for electric vehicles in all of our parking locations. Charging stations, charging management, and support

services. All-in-one. We're here to save you from the hours of administration, by taking care of the installation of our charging stations, the monitoring and balancing of their power consumption, the pricing and invoicing of all charging sessions, and technical support altogether.

REFERENCES

1. Deepa, R., Karthick, R., Velusamy, J., & Senthilkumar, R. (2025). Performance analysis of multiple-input multiple-output orthogonal frequency division multiplexing system using arithmetic optimization algorithm. Computer Standards & Interfaces, 92, 103934.
2. Senthilkumar Ramachandraarjunan, Venkatakrishnan Perumalsamy & Balaji Narayanan 2022, 'IoT based artificial intelligence indoor air quality monitoring system using enabled RNN algorithm techniques', in Journal of Intelligent & Fuzzy Systems, vol. 43, no. 3, pp. 2853-2868
3. Senthilkumar,Dr.P.Venkatakrishnan,Dr.N.Balaji, Intelligent based novel embedded system based IoT Enabled air pollution monitoring system, ELSEVIER Microprocessors and Microsystems Vol.77, June 2020
4. Y. Cao, J. Tao, O. Kaiwartya, H. Sun, H. Zhou, and R. Wang, "Toward preempted EV charging recommendation through V2V based reservation system," IEEE Trans. Syst., Man, Cybern.: Syst., vol. 49, no. 12, pp. 2527–2540, Dec. 2019.
5. M. Gruteser et al., "Throughput and fairness analysis of 802.11-based vehicle-to-infrastructure data transfers," in Proc. IEEE Int. Conf. Mobile Adhoc and Sensor Systems (MASS), Valencia, Spain, Oct. 2011, pp. 1–6, doi: 10.1109/MASS.2011.30.
6. I. S. Bayram and I. Papapanagiotou, "A survey on communication technologies and requirements for internet of electric vehicles," EURASIP J. Wireless Commun. Netw., vol. 2014, no. 1, p. 223, Dec. 2014.
7. L. Cai, J. Pan, L. Zhao, and X. Shen, "Networked electric vehicles for green intelligent transportation," IEEE Commun. Standards Mag., vol. 1, no. 2, pp. 77–83, Jun. 2017.
8. C. E. Hatton, S. K. Beella, J. C. Brezet, and Y. Wijnia, "Charging stations for urban settings: The design of a product platform for electric vehicle infrastructure in Dutch cities," World Electr. Veh. J., vol. 3, no. 1, pp. 134–146, 2009.
9. V. del Razo and H.-A. Jacobsen, "Smart charging schedules for highway travel with electric vehicles," IEEE Trans. Transp. Electrific., vol. 2, no. 2, pp. 160–173, Jun. 2016.
10. A. Gusrialdi, Z. Qu, and M. A. Simaan, "Distributed scheduling and cooperative control for charging of electric vehicles at highway service stations," IEEE Trans. Intell. Transp. Syst., vol. 18, no. 10, pp. 2713–2727, Oct. 2017.
11. S. Djahel, N. Jabeur, R. Barrett, and J. Murphy, "Toward V2I communication technology-based solution for reducing road traffic congestion in smart cities," in Proc. Int. Symp. Networks, Comput. Commun. (ISNCC), Hammamet, Tunisia, 2015, pp. 1–6, doi: 10.1109/ISNCC.2015.7238584.
12. D. A. Savio, V. A. Juliet, B. Chokkalingam, S. Padmanaban, J. B. Holm-Nielsen, and F. Blaabjerg, "Photovoltaic integrated hybrid microgrid structured electric vehicle charging station and its energy management approach," Energies, vol. 12, no. 1, p. 168, Jan. 2019.
13. B. T. Lokesh and J. T. H. Min, "A framework for electric vehicle (EV) charging in Singapore," Energy Procedia, vol. 143, pp. 15–20, Dec. 2017.