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Electric Vehicle Charging Station System Using Round Robin (RR) Scheduling Algorithm

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Abstract: *Electric vehicles are arising to be an ever-increasing number of basic nowadays. With the developing interest in Electric vehicles, the charging foundation is basic for supporting the E-Mobility administrations. As EVs become more business, there'll be a requirement to form a productive opening booking framework because the charging interaction is often tedious and therefore the requirement for extra stations will be requested. The framework and Architecture of the Next-Generation of the level of Communication-based Online EVs Charging will be Slot Booking at the Charging Station. The stochastic lining model for EVs within the charging station. The target capacity of EV charging at charging focuses on charging stations to decide the ideal charging time, insignificant charging cost, least distance, negligible lining delay, and the ideal length for specific charging openings. The proposed model of the booking framework is meant to form a financially savvy and productive framework. This presents a novel approach for modeling the 24-hour charging demand profile of a plug-in electric vehicle (PEV) charging station using queuing analysis. The Poisson process with different arrival rates over the day. A distribution optimal power flow (OPF) model is employed to review the impact of the PEV charging load of the charging station on distribution system operation. The project will enhance the level of future when you charge the bike, how much distance it will be gone and what is the distance of the charging while it's running, and the period of the time while distancing, then find out the EV station bunk via through the google map.*

Keywords: Electric Vehicles (EVs), EV Charging Stations, Plug-in Electric Vehicles (PEVs), Charging Demand Forecasting, Optimal Power Flow (OPF)

I. INTRODUCTION

The global transition toward sustainable energy has significantly accelerated the adoption of electric vehicles (EVs) in recent years. As environmental concerns and the depletion of fossil fuels gain prominence, EVs have emerged as a viable alternative to traditional internal combustion engine vehicles. However, the widespread deployment of EVs brings with it a critical dependency on the supporting charging infrastructure. Efficient and scalable charging solutions are essential to ensure the seamless integration of EVs into daily transportation systems, particularly in urban and semi-urban settings.

One of the primary challenges faced by EV users is the availability and accessibility of charging stations. Unlike traditional refueling, EV charging is time-intensive and requires more systematic planning to avoid congestion and long waiting times. As the number of EVs continues to rise, there is an urgent need for smart, communication-based frameworks that facilitate efficient slot booking and power distribution at charging stations. Such frameworks can alleviate the burden on both users and power systems while enhancing the overall user experience.

This paper presents a next-generation EV charging architecture that leverages an intelligent slot booking mechanism to optimize the charging process. The proposed model uses a stochastic queuing approach based on a Poisson arrival process to simulate real-world charging demand fluctuations throughout a 24-hour period. By analyzing vehicle arrival rates and service times, the system predicts queue lengths and allocates slots to minimize delays, reduce waiting times, and improve the throughput of charging stations.

In addition, the study integrates a distribution Optimal Power Flow (OPF) model to assess the impact of EV charging loads on the electrical distribution grid. This ensures that charging activities are conducted in a grid-aware manner, balancing load and minimizing stress on the infrastructure.

An innovative aspect of the proposed solution includes the use of Google Maps API integration to allow users to dynamically locate nearby charging stations, check availability in real time, and select optimal routes based on remaining vehicle range and travel distance. Furthermore, a Round Robin scheduling algorithm is incorporated into the slot allocation process to ensure fairness and efficiency among multiple users requesting simultaneous charging slots.

The ultimate goal of this project is to create a cost-effective, efficient, and user-friendly charging management system that not only addresses the current limitations of EV charging but also supports the sustainable scaling of e-mobility services. By integrating intelligent algorithms, queuing models, and real-time navigation, the proposed system contributes to the development of a smarter and more reliable EV charging ecosystem.

II. ROUND ROBIN(RR) ALGORITHM

The Round Robin (RR) scheduling algorithm is a preemptive, cyclic scheduling technique that is commonly used in multitasking systems, particularly for time-sharing environments where the fair allocation of resources is crucial. It is one of the simplest and most widely used algorithms for managing process execution in operating systems, and its principles are equally applicable to systems requiring efficient resource distribution, such as in Electric Vehicle (EV) charging stations.

In its basic form, Round Robin allocates each process a fixed time interval, referred to as a time quantum or time slice, during which it can execute. After this quantum expires, the process is preempted, meaning it is temporarily paused, and the CPU or resource (in the case of EV charging, the charging station slot) is handed over to the next process in the queue. The preempted process is placed at the end of the queue and will resume execution from where it left off in the next cycle.

Time Quantum Allocation:

Each process (or EV charging request) is assigned a fixed time quantum. For instance, if a vehicle needs 20 minutes to charge, but the time quantum is set to 5 minutes, the vehicle will receive access to the charging station for 5 minutes before being preempted. If charging isn't completed, the process returns to the queue to await its next opportunity for access.

Preemption and Context Switching:

When the time quantum expires, the currently executing process is preempted. The state of the process—which includes variables such as the progress of charging and the vehicle's specific charging requirements—must be saved. The process is then placed back into the queue to be scheduled again after all other processes have had a chance to use the resource.

Context switching refers to the mechanism that saves the state of the preempted process and restores the state of the next process in the queue.

Fairness:

Round Robin scheduling ensures fairness by giving all processes an equal share of the resource. This is particularly important in environments like EV charging stations where multiple vehicles may arrive simultaneously and need to be allocated charging slots in an orderly manner. It helps to ensure that no single EV monopolizes the charging station for an extended period of time.

Queue Management:

The processes are managed in a first-come, first-served (FCFS) manner within the queue. As each process completes its time quantum, it is moved to the back of the queue, ensuring that the system maintains a constant and predictable flow of process handling.

III. IN EV VEHICLE CHARGING SYSTEM

Role of Round Robin Scheduling in Electric Vehicle Charging Station System

In the proposed Electric Vehicle Charging Station System, the Round Robin (RR) scheduling algorithm plays a crucial role in efficiently managing the allocation of limited charging slots among multiple electric vehicles (EVs) that arrive for charging. Due to the increasing demand for EVs and the limited number of available charging stations, there is a pressing need for a fair, efficient, and systematic approach to assign time-based charging opportunities to each EV. The

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Round Robin algorithm addresses this by ensuring equal and cyclic distribution of the charging resource among all vehicles in the queue.

Overview of Implementation

In this system, every EV that arrives at the charging station is considered a "process" in the queue. Each vehicle is assigned a fixed time quantum during which it can use the charging slot. If the vehicle completes its charging within this time, it exits the queue. If it still requires more charging, it is moved to the end of the queue and must wait for its next turn to charge again.

This cyclical rotation ensures that all EVs get an equal opportunity to charge, regardless of their arrival time or remaining battery percentage. It prevents any single EV from occupying the charging port for an extended time while others are waiting.

Key Functions of Round Robin in the System

- Time Quantum Allocation: Each EV receives a predefined time slot (quantum) for charging. For example, if the time quantum is 10 minutes, every vehicle charges for 10 minutes before the next vehicle in the queue is given access.
- Queue Management: Vehicles that have not completed charging are not prioritized unfairly. Instead, they are placed at the end of the queue to wait for another round, maintaining fairness and reducing starvation.
- Preemptive Scheduling: After each time quantum, the current charging session is paused (if needed), and the next vehicle begins its charging. The system saves the charging progress (state) of each EV, allowing it to resume from where it left off in the next round.
- Dynamic and Scalable: The system handles fluctuations in vehicle arrivals using a Poisson process for modeling incoming EVs. The RR algorithm ensures that regardless of how many vehicles arrive, the scheduling remains consistent and manageable.

Advantages in EV Charging Context

- Fair Resource Allocation: Round Robin ensures that all vehicles, whether partially or fully discharged, get fair access to charging.
- Reduced Waiting Time for All: No vehicle is allowed to monopolize the charging station, minimizing the maximum waiting time for others.
- Scalability: This algorithm easily scales for busy or multi-port charging stations where many vehicles are waiting to charge.
- Predictable Charging Pattern: Users can be informed of their estimated next charging window, improving transparency and user satisfaction.

Integration with Other Modules

- Google Maps Integration: The Round Robin algorithm works alongside the navigation system. Once a user identifies a nearby station via Google Maps, they can view slot availability and queue length, which is managed in the backend by RR logic.
- Smart Slot Booking System: The booking system updates in real time. As each vehicle completes its time quantum, the system automatically updates queue positions, available slots, and estimated wait times.
- Distance-Based Slot Recommendations: When vehicles register for charging, the system can consider their current battery level and estimated remaining range, then recommend a station where they will be fairly scheduled using Round Robin with minimal delay.

IV. EXISTING SYSTEM

The problem will offers a systematic approach that guides implementing authorities and stakeholders on planning, authorization, and execution of EV charging infrastructure. It presents an overview of the technological and regulatory

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frameworks and governance structures needed to facilitate EV charging, along with a step-by-step approach to build out the implementation roadmap. While the handbook focuses on the present needs of charging infrastructure development, it also touches upon considerations for future planning.

DISADVANTAGES

- Recharge Points.
- Electric fuelling stations are still in the development stages.
- The Initial Investment is high
- Electricity isn't Free.
- Short Driving Range and Speed.
- Longer Recharge Time.

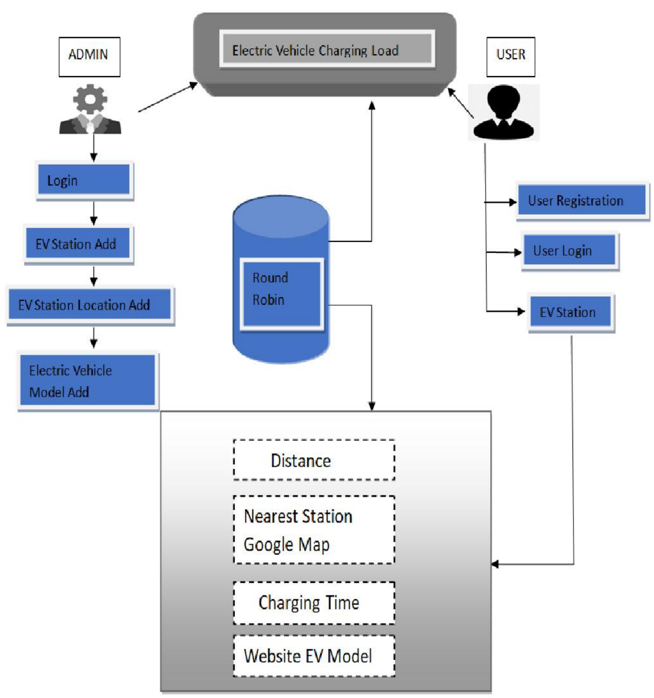
V. PROPOSED SYSTEM

The Proposed system a peak load management (PLM) scheme used to schedule EVs for charging or discharging service according to the power demand with the timing and location where EV needs to be served. This scheme supposes prior EV-SG communication when EVs are on road and takes profit from various EV profiles and the unused stored power in EV batteries to contribute to the utility meeting its peak load demand. An algorithm, called PLM, is adopted for this Round Robin scheme.

ADVANTAGES

- local consumption of distributed generation;
- cost efficient energy management
- peak load shaving

VI. SYSTEM ARCHITECTURE DIAGRAM



VII. MODULES

LIST OF MODULES :

Admin Login :

- EV Station Add
- EV Station Location Add
- Electric Vehicle Model
- Create EV bunk location
- Manage bunk details
- Manage recharge slots

User Login :

- Login
- Registration
- View bunk details
- View slot vacancy
- EV Station View

Admin Login

This module is the first module. From this page, only the admin can navigate to the project. Only the known person will enter by giving valid information. If the user provides invalid information then permission is denied to navigate to other pages. This authentication module concentrates on the security of the project from unauthorized users. Admin can authenticate only if the cloud authority provides permission else the access is denied to the user.

EV Station Add

The charging station also called an EV, is a piece of things that belongs to the Ev charging station that provided electrical power for charging plug-in electric vehicles (including hybrids, neighborhood electric vehicles, trucks, buses, and others).In this module, all the necessary information about the admin working in the EV station is maintained. Admin details such as their station id, station name, phone, address, city, other information and they're maintained in this module.

Ev Station Location Add

In geography, location or place are used to denote a region (point, line, or area) on Earth's surface or elsewhere. The term location generally implies a higher degree of certainty than place, the latter often indicating an entity with an ambiguous boundary, relying more on human or social attributes of place identity and sense of place than on 8 geometry . In this module all the necessary information about the admin adds in the EV station location is maintained. Admin details such as their station id, station name, location, Google map, others information and their maintained in this module.

Electric Vehicle Model

The electric vehicle model will be uploaded by the portal it will update all the types of Electric vehicles that will be added, then the upcoming models will be also added and included by the admin to visit at the portal

User Register

This module is designed for users who need this project. The new user has to be registered. This system wanted proper authentications level and the user definition for accessing the features behind this system. For getting the features to access the problems users have to register to this system. Once registered the system will provide the access rights to the users to work in this system.

User Login

In the login module, the authenticated admin will enter details. This module will be accessed by the authorized user who knows the password which is developed by admin side. This module will be the content with module for the project that will help to enter the data.

EV Station View

The EV station model will be updated to view at the EV station at the portal, the user can view the EV station which is located around by the nearest place, via the google map.

- Distance
- Nearest station Google Map
- Charging Time

VIII. CONCLUSION

A whole framework to the utilization of EVs in-vehicle leaves, implementations of the little and modest is allocated with the Internet remotely. The proposed framework permits a client to get to the data related to the charging cycle (cost, successful slipped by time, assessed the time to full charge, and so forth), and chief to oversee various parts of the interaction like charging of burned-through energy, charging needs intricacy of the establishment, and works on the communication with the clients of the framework. This project provides an electric vehicle charging protocol based on the multi-cut-off Round Robin scheduling model. This proposed protocol aims to use the PEV battery as energy storage and coordinates conveniently the EV charging processes. Two algorithms are proposed PLM which is used to schedule EVs for charging service according to the power demand with the timing and location where EV needs to be served. This algorithm uses efficiently unused stored energy in the PEV battery to supply the grid to fulfill power demand, especially in peak times during the day.

XI. FUTURE WORK

In the future work plan to extend our proposed electric vehicles charging/discharging scheme onto a global guidance system for EV which will be seen as an enabler of SG. This guidance system can be more challenging, especially when considering the Micro-Grid concept with energy transaction features. Moreover, EV can be also seen as a principal actor for the public electricity markets, especially with multi charging service providers and additional constraints in the context of smart cities with an open market.

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