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EV IoT an intelligent automation system for electric vehicle charging station

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ABSTRACT

Ever-increasing pollution levels and its impact on the environment, governments are looking for alternate energy options for transportation services. Rapidly depleting global oil reserves and rising oil import bills of governments are also driving the need for alternate energy sources for the transport vehicles. As EVs become more commercial, there will be a need to create an efficient slot booking system as the charging process can be time consuming and the need for more stations will be demanding. Developed the Framework and Architecture of the Next-Generation Communication System based on IoT Slot Prediction and Online EVs Charging Slot Booking at Charging Station. We built the stochastic queuing model for EVs in the charging station. The proposed model of the slot prediction and booking system is designed to create a cost effective and efficient system. Our Cloud based Charging Station Management platform is developed to network and manage multiple charging stations. The proposed IoT and server-based real-time forecast charging infrastructure avoids waiting times and its scheduling management efficiently prevents the EV from halting on road due to battery drain out.

Keywords: EV IoT Charging, Cloud Based Station, NODEMCU, Slot Booking and Tracking.

INTRODUCTION

Introduction to electric vehicles

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. 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(shown in fig 1), 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. 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.

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Fig 1: Electric Vehicle

Types of electric vehicles: bev, phev and hev

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 (bev)

Battery Electric Vehicles (shown in fig 2), 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.

Fig 2: Battery Electric Vehicle

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. DC fast chargers are found at dedicated EV charging stations and charge a battery up to 90 miles range in approximately 30 minutes. BEV Examples that can charge on DC Level 3 Fast Chargers.

Ev charging station

An electric vehicle charging station (shown in fig 3) is equipment that connects an electric vehicle (EV) to a source of electricity to recharge electric cars, neighborhood electric vehicles and plug-in hybrids. Some charging stations have advanced features such as smart metering, cellular capability and network connectivity, while others are more basic. Charging stations are also called electric vehicle supply equipment (EVSE) and are provided in municipal parking locations by electric utility companies or at retail shopping centers by private companies. These stations provide special connectors that conform to the variety of electric charging connector standards.

Fig 3: Electric Vehicle Charging Station

Dashboards provide detailed real-time visibility into charging activity of stations, vehicles and other onsite resources. Charge Point provides the ability to create workflows to help streamline charging operations by organizing activities into tasks, alerts and notifications. Tasks, alerts and notifications ensure that vehicles are ready to go when needed.

LITREATURE SURVEY

A genetic-algorithm based scheduling method of charging electric vehicles

Sugii et al. proposed a genetic algorithm-based scheduling method of charging electric vehicles. It manages to determine a sub-optimal charging timetable which satisfies the given electric load curve under the structural constraints of their system. An ideal load curve is defined as a step function in order to make use of the late-night off-peak electricity prices. Problem is split into two: (i) connecting problem (selecting a charger to which the EV should connect) and (ii) scheduling problem (determine the starting time of charging). The results show that controlled charging manages to level off the electric load as well as to reduce the capacity and cost of charging equipment, as opposed to the uncontrolled one.

Intelligent scheduling of hybrid and electric vehicle storage capacity in a parking lot for profit maximization in grid power transactions

Hutson et al. proposed an intelligent binary particle swarm optimization (BPSO) based approach to schedule the usage of available energy storage capacity from EVs. Next to the vehicles being able to take power from the grid and charge the batteries, they introduce an idea of also providing power to the grid when parked, so called vehicle-to-grid (V2G) concept. A scalable parking lot model, with the objective of maximizing profit for the operator, is developed. A day is split into 1-hour intervals (to match the hourly prices), and an infinitely large connection to the grid is assigned to each parking lot, meaning they do not consider available power as a resource. The results show that multiple transactions result not only in significantly higher profits, but also reduce the net power out to the grid.

EXISTING METHOD

First come first serve (fcfs) priority for charging

In "Recharging Phase", each CS performs scheduling for EVs already parking herein based on the FCFS order, or even with smart method by knowing the anticipated EVs arrival information (as included in EVs reservation information).

Admission control algorithm

The admission control mechanism can be viewed as a virtual scheduling procedure. Whenever a new task i arrives, it will be put into an active scheduling task set I together with the existing admitted tasks. Since each admitted task must achieve the requested SOC while departure, if any existing admitted task or the newly arrived task itself cannot be charged to its requested battery SOC at the departure, the new task should be declined of service; otherwise, it should be admitted.

Electric Vehicles Recharge Scheduling with Time Windows (EVRSTW)

It is closely related to the resource allocation and resource constrained scheduling problems. EVRSTW, in its special case, belongs to the class of Complete problems, meaning that exact methods are usually unable to cope with large problem instances in reasonable time, and display unpredictable runtimes. In order to build a real-world dynamic system based on user requests and almost immediate system responses, we need to find methods which can operate within a short, bounded execution time.

Drawbacks of Existing System

- Charging an EV could be very time-consuming,
- So reaching a CS and all of the connectors are being used could be frustrating and make us wait in line.
- The number of stations providing full recharge of batteries is quite rare
- Decentralized
- Today, charging stations and cars may not yet be equipped for smart charging.

PROPOSED METHOD

Proposed system

Stochastic Queuing Models

Stochastic Queuing Simulation (SQS) is a methodology for characterizing and simulating large-scale workloads (e.g., to evaluate new server configurations, scheduling policies, etc.). The technique builds upon analytic foundations, but adds simulation to account for cs workload properties that make closed-form solutions intractable. While pieces of these methods may be well known to queuing theorists or statisticians, they have not been presented in a cohesive manner, or widely adopted by the systems community. A queuing model is composed of a collection of "slots" which process charge. We model each charging station as a single queuing system; this queuing system may have multiple "slots" which correspond to individual CS in a multicore CS. car arrive into the system according to an inter arrival time distribution and their size(measured in time) is distributed according to a service time distribution. A queuing discipline must be chosen to determine how queued jobs are scheduled and processed.

Forecasting in Open Car Parks with Charging Point

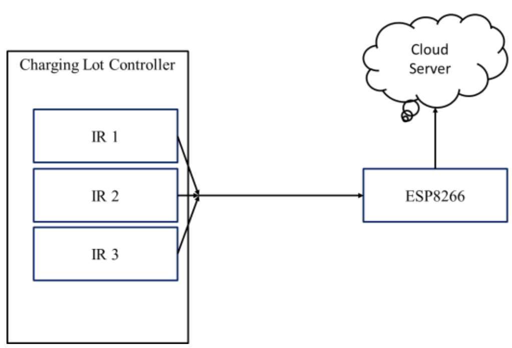
Web and mobile application the innovative advantages over other charging stations are the web and mobile application. When a user registers, all the functions of the system can be managed through the application. With the application, charging of EV becomes reliable, and the trip less stressful, as the application allows the user:

- Find the nearest charging station,
- Reserve charging time,
- Navigation to the location,
- Easy charging activation,
- Charging limit setup (amount of energy, amount, time),
- Flexible payment system (payment cards, PayPal system…);
- Live monitoring of charging during other activities (meeting, shopping, viewing the show...)

Advantages of Proposed System

- Automatic EV authentication at DC charging stations through communications protocols which provide plug & charge principles of use
- Notification of start and end of charging via SMS messages
- The possibility of determining the amount of energy or charging cost with possibility of automatic interruption
- Control of the parking space intended for filling
- A flexible payment system allows charging in a way that promotes optimum use of the infrastructure
- Find all the details about the charger including customer reviews, recent rating trends etc.
- Seamlessly book your slot with secure payment options

Block Diagram



The below-mentioned figure 4 depicts a parking area where system can be implemented along with the way in which communication happens between various actors. The primary actors that constitute the system are:

a)Sensors: This IR sensor can be placed in every parking space for smart parking system. The IR sensors are used to detect the object. It uses a voltage up to 0.5 volts-0.25 volts. These sensors are easily available at the market and less in cost. It determines whether a parking space is vacant or not. If any vehicle is detected, IR sensor shows output as red otherwise, it shows output as green. Then, it sends the data to the micro-controller IoT device by using wireless communication.

b)Processing unit: All the sensors are wirelessly connected to the processing unit. Processing unit is nothing but microcontroller device which is considered as main part of the system. It acts like an intermediate between the sensors and cloud. It collects sensors data using wireless communication and it processes the data. Furthermore, it sends the processed data which contains the number of free vacant spaces in the parking area to the cloud.

c)The cloud: The cloud will receive the processed data from the processing unit and it done two main tasks. First is to process the received data with help of Google API and store them. Second is to send the information to a user's mobile application. Cloud acts as a data base to store all the records associated with parking areas. It keeps a track of each user connected to the system and maintains information like time at which the car was parked, time duration for parking a car, amount paid by the user and mode of payment. In case of any kind of system failure to quick recovery of data, Continuous backup is made of the data stored on cloud.

ESP 8266

The chip first came to the attention of Western makers in August 2014 with the ESP- 01 module, made by a third-party manufacturer Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at first there was almost no English-language documentation on the chip and the commands it accepted.

Fig 4: ESP 8266

OLED

OLED (Organic Light Emitting Diodes) is a flat light emitting technology, made by placing a series of organic thin films between two conductors. When electrical current is applied, a bright light is emitted. OLEDs are emissive displays that do not require a backlight and so are thinner and more efficient than LCD displays (which do require a white backlight).

Fig 5: OLED

IR Sensor

When the IR transmitter emits radiation, it reaches the object and some of the radiation reflects back to the IR receiver. Based on the intensity of the reception by the IR receiver, the output of the sensor defines.

Fig 6: IR Sensor

RESULT AND DISCUSSION

Using stochastic queuing model an efficient electric vehicle processing has been done with accurate allocation of slots and booking procedures for charging infrastructures. As a result, electric vehicles can prominently attain their booking processes for charging and access the charging station in an enhanced manner. The below graph shows the date wise slot booking information from which charging station admin can acquire proper knowledge about entire procedures.

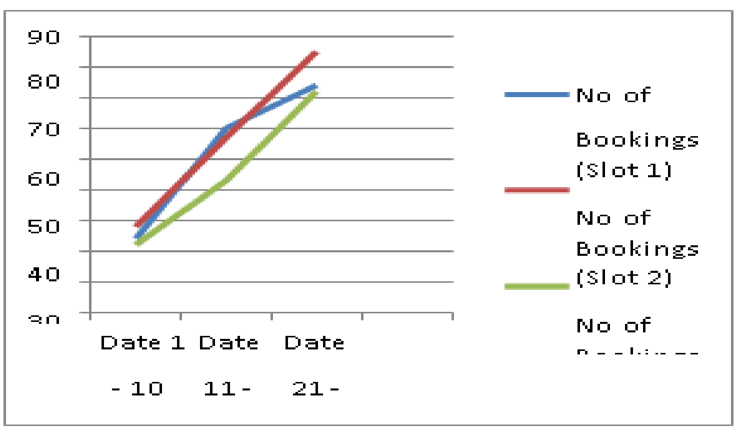


Fig 7: Date wise booking information

The below graphical representation provides the details of total number of used slots that has been allocated to users to book their electric vehicles and perform charging operation. Since stochastic queuing model has been implemented comparison between used booking slots and total number of booking slots has been acquired with high accuracy. It helps the charging station admin to intimate upcoming users that which are all electric station slots are available and how many slots has been used and total slots which are free are provided in the below representation.

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 Android Phone. 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 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.

to analyze the charging process. How to schedule the charging activity according to different pricing schemes and how to integrate the incentive mechanism to achieve a win-win solution for both the customers and the charging operator are some further directions for us to consider.

Future Enhancement

To further extend our work and utilize the M/G/K queue

REFERENCES

1. Cao, Yue and tao, Jiang and Kaiwartya, O. and sun, Hongjian and Zhou,Huan and Wang, ran. IEEE transactions on systems, man, and cybernetics. Systems. 2019 'Toward pre-empted EV charging recommendation through V2V based reservation system.
2. Throughput and fairness analysis of 802.11-based vehicle-to-infrastructure data transfers conference; October 2011. doi: 10.1109/MASS.2011.30 · Source: DBLP.
3. Bayram IS, Papapanagiotou I. A survey on communication technologies and requirements for internet of electric vehicles. EURASIP J Wirel Commun Netw. 2014;2014(1):223. doi: 10.1186/1687-1499-2014-223.
4. Cai L, Pan J, Zhao L, Shen X. Networked electric vehicles for green intelligent transportation. IEEE Commun Stand Mag. 2017;1(2):77-83. doi: 10.1109/MCOMSTD.2017.1700022.
5. Hatton, Chandler E., Satish K. Beella, J. C. Brezet, and YC2009 Wijnia."Charging Stations for Urban Settings the design of a product platform for electric vehicle infrastructure in Dutch cities." World Electric Vehicle Journal 3, no. 1 2009: 134-46.
6. Del Razo V, Jacobsen H-A. Smart charging schedules for highway travel with electric vehicles. IEEE Trans Transp Electrific. 2016;2(2):160-73. doi: 10.1109/TTE.2016.2560524.
7. Gusrialdi A, Qu Z, Simaan MA. Distributed scheduling and cooperative control for charging of electric vehicles at highway service stations. IEEE Trans Intell Transp Syst. 2017;18(10):2713-27. doi: 10.1109/TITS.2017.2661958.
8. Djahel S, Jabeur N, Barrett R, Murphy J. Toward V2I communication technology- based solution for reducing road traffic congestion in smart cities International Symposium on Networks, Computers and Communications (ISNCC), Hammamet, 2015; 2015. p. 1-6. doi: 10.1109/ISNCC.2015.7238584.
9. Savio DA, Juliet VA, Chokkalingam B, Padmanaban S, Holm-Nielsen JB, Blaabjerg F. Photo voltaic integrated hybrid micro grid structured electric vehicle charging station and its energy management approach. Energies. 2019;12(1):168. doi: 10.3390/en12010168.
10. Lokesh BT, Min JTH. A framework for electric vehicle (EV) charging in Singapore, energy procedia. Vol. 143; 2017. p. 15-20, ISSN 1876-6102.
11. Bayram IS, Papapanagiotou I. A survey on communication technologies and requirements for internet of electric vehicles. J Wireless Com Network. 2014;2014(1):223. doi: 10.1186/1687-1499-2014-223.
12. Qin H, Zhang W. Charging scheduling with minimal waiting in a network of electric vehicles and charging stations. Proceedings of the 8thACM VANET; 2011. p. 51-60. doi: 10.1145/2030698.2030706.
13. Subramaniam U, Ganesan S, Bhaskar MS, Padmanaban S, Blaabjerg F, Almakhles DJ. Investigations of AC microgrid energy management systems using distributed energy resources and plug-in electric vehicles. Energies. 2019;12(14):2834. doi: 10.3390/en12142834.
14. India CSE. The urban commute; 2017.
15. Yang S-N, Cheng W-S, Hsu Y-C, Gan C-H, Lin Y-B. Charge scheduling of electric vehicles in highways. Modell. June 2013;57(11-12):2873-82. doi: 10.1016/j.mcm.2011.11.054.
16. Awasthi A, Venkitusamy K, Padmanaban S, Selvamuthukumaran R, Blaabjerg F, Singh AK. Optimal planning of electric vehicle charging station at the distribution system using hybrid optimisation algorithm. Energy. 2017;133:70-8. doi: 10.1016/j.energy.2017.05.094.
17. Timpner J, Wolf L. Design and evaluation of charging station scheduling strategies for electric vehicles. IEEE Trans Intell Transp Syst. April 2014;15(2):579-88. doi: 10.1109/TITS.2013.2283805.