ORIGINAL RESEARCH PAPER

Information Technology

ELECTRIC VEHICLE CHARGING INFRASTRUCTURE ENHANCEMENT USING INFORMATION TECHNOLOGY INTEGRATION

KEY WORDS: electric vehicles, charging infrastructure, information technology integration

Vineet Kumar

ABSTRACT

The electric vehicle chargers have a communication protocol to ensure there is a reporting of usage, occupancy, faults, and other features to the owners and other parties. There is a need to ensure a communication channel between customers and chargers, considering a holistic picture of entire electric vehicle charging stations in an area is seen from users' applications. It must report live updates on availability, occupancy of chargers, next availability, waiting times, usage charges, availability of amenities, and many more. This will significantly improve the user experience when they plan to visit a charging station while they are commuting on-road. Significant improvement in user experience will be achieved via a live update via a cellular network and conveyed using mobile apps or search engine websites.

INTRODUCTION

The electric vehicle charging stations (EVCS) and their widespread usage are eminent from [1] [2]. The chargers have both electrical power components and communication components attached to ensure greater user satisfaction [3] with the charging session.

Each charging session typically ranges from 20 minutes to a whole day, depending on the type of chargers and state of charge of the vehicle charged. Depending on the type of battery used in a given electric vehicle (EV), there are variations due to battery efficiency and chemical composition of the battery.

The EV and the EVCS communicate with each other using several low-level communications. This communication is to ensure EV console knows the state of charge (SOC) and time remaining to attain 100% SOC. The connector for charging often uses pins that have control and proximity options conveying the information using a pulse width modulation (PWM). Another option is to use the high-level communication. This utilizes the flow of information using the electrical conducting path via the charging port and EVCS. Some applications of this communication between the EV and EVCS are ensuring safety checks and statuses [4], controls on charging speeds, alerts on abnormal charging characteristics, payment, and upgrades to the software. Some other applications include capabilities in informing customers of time-of-day tariffs, other incentives, and smart grid integration. Reliability of chargers in the United States of America is 78% [5].

A detailed study to include locations where an electric vehicle charger fits into existing parking spaces presented in [6] for restaurants, parking places solve the issues of seeking the availability of spaces.

The aim of this paper encircles the EVCSs and the EVs together for a given geographical area where both of them are in close vicinity at a given point while drivers commute or while parked in the area. The system is supposed to detect the location then start populating the details on the nearest charging stations from an integrated communication channel between both.

An Open Charge Point Protocol (OCPP) networks the electric vehicle chargers together by an open-source communication between the EV and the EVCS. The advantages of OCPP make the EVCS compliant with software key access features for making products available to a larger audience.

It increases the customer experience and stimulates competition in the market [7] [8]. However, communication between utilities and EVCS is ensured using a communication protocol [9]. Types of connector were shown in Figure 1.

Figure 1: Types of Connectors
Source: https://www.moredaydc.com/

METHODS

The simplistic model is the usage of the communication protocol between the EV and EVCS plugged in, as well as EVs that are near the given EVCS. The users are notified of the current status of their state of charge and the time required to fully charge, together with notifications on any other EVs willing to occupy their spot with or without any urgency. This allows them to plan their charging sessions. It is known that when the battery SOC increases, it takes longer to charge subsequently to increase SOC. Drivers can opt to move after, say, 70% SOC to allow other customers to take their spot. This may be encouraged with an incentive or credit for allowing the next customers to charge. This improves customer service and wait times for following drivers. Additional applications are when the cars are communicating they get to communicate using a cellular network and seek updates on the availability, occupancy, next availability, and waiting times using either a mobile app or search engine updates. There are many other applications, such as conveying the cost of charging sessions at a given time of the day, availability of amenities, wait times for amenities, and many more.

A reasonable understanding of this topology, presented in Figures 2 and 3 becomes a resource when the aim is to ensure customers have the least dissatisfaction with charging session times. When author in [3] mentioned that the need to provide a maximum number of charging spots at the EV charging hubs becomes a point of debate when the cost factor comes into the picture. So, it is recommended to use the approach of utilizing

the IT element by integration using communication protocols and channels with apps and user-available interfaces to gauge their needs depending on the live conditions of the chargers.

This model presented how an integration of the EV and EVCS improves by usage of cellular communication and status updates to the EV while on commute or parked in a given area to learn about the charger availability, and waiting times to avail the charger and the amenities near them. Development of software and mobile applications is limited by customer demand and resilience from cyber security. A breach in the information leads to outages to a large volume of customers. Thus, it becomes crucial to develop a software with safety and security from external cyber threats.

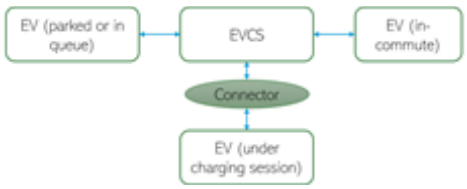

Figure 2: Communication between EV and EVCS

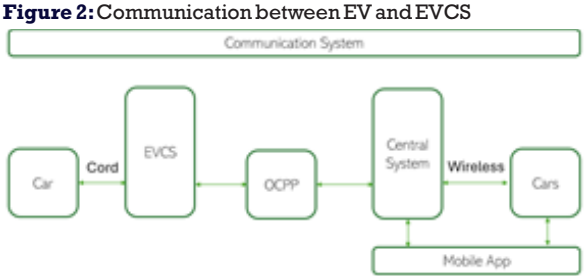

Figure 3: Mobile App

CONCLUSIONS AND DISCUSSIONS

The simplistic model is the usage of the communication protocol between the EV and EVCS plugged in and other EVs. This paper proposed a mobile app use for easing the communication between the elements by provisions of availability and waiting times information with the customers. The unique way to ensure amenities availability for improving the waiting time experience for customers was also proposed for this application. Thus, IT applications have a vast scope of improvements to EV and EVCS integration.

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