Electric Vehicles - V2G Technologies

EV Charging Infrastructure; Payment Collection Systems

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Abstract: Electric vehicle technology has become the integral part of grid operation. The vehicle is not only used as means of zero emission transportation but also as source of power. Over the time this concept has emerged and it is being researched and developed continuously which has led to emergence of reliable and low price electric vehicle. Many companies have launched their Electric vehicles like Reva by Mahindra which run on Vehicle-to-grid power (V2G) technology. V2G can also provide storage for renewable energy generation such as hybrid electric vehicle. In order to effectively tap the V2G technology it is necessary to combine the complementary strengths and to merge the complementary needs of the vehicle user and grid. The charging needed by the vehicle can be done in approximately four-five hours' time in the parking lot, street side or in a garage. The payment collection system can be either RFID based or the money can be deducted automatically from the credit card when the card will be swiped. The paper focuses on the recent software development in measuring the range of an electric vehicle that can be covered before it needs to get recharged, the requirement of systems and processes which are needed to tap energy in vehicles and better implementation of V2G technology and the efficient development of payment collection system for electric vehicles.

Keywords— zero transmisson,V2G technology,charging,payment collection

INTRODUCTION

Electric vehicles include electric cars, Lorries, boats, motorcycles, and scooters. Typical vehicles are powered by fuels such as diesel, petrol and natural gas. It is observed that energy conversion efficiency of a fuel input in a conventional vehicle is only around 14%–30% depending on the distance covered. The remaining of the energy is either lost to engine or inefficiencies or it is used to power accessories. Therefore, there is immense potential to improve efficiency of fuel with advanced technologies .Hybrid and plug-in Electronic vehicles are seen having potential for petroleum as well as carbon footprint reduction benefits. Increase in energy security, improvement in fuel economy, lower fuel costs, and reduced emissions (1).

The PHEV vehicles use V2G technology. Under this technology the electricity can be sent back or feed into the Grid. The mass implementation of this technology will prove beneficial to not only the energy producers but also the vehicle owners. Electric engines have better efficiency when you compare them to a typical combustion engine, when the electricity used to charge vehicles comes from a CO2 emitting source, e.g. coal or gas fired powered plant, the overall net production of CO2 from an electric car is typically one third to one half that of the combustion vehicle. Plug-in electric vehicle (PEV) has a great potential of reducing the carbon footprint of transportation

The V2G Technology

Electric-drive vehicles, whether powered by batteries, fuel cells, or gasoline hybrids, have within them the energy source and power electronics capable of producing the 60 Hz AC electricity that powers our homes and offices. When connections are added to allow this electricity to flow from cars to power lines, we call it "vehicle to grid" power, or V2G. Cars pack a lot of power. One properly designed electric-drive vehicle can put out over 10kW, the average draw of 10 houses. The key to realizing economic value from V2G are grid-integrated vehicle controls to dispatch according to power system needs (2).

Vehicle-to-grid can be used with such gridable vehicles, that is, plug-in electric vehicles (BEVs and PHEVs), along with grid capacity. Since maximum vehicles are parked an average of 95 percent of the time, these vehicles batteries could be used to let electricity flow from the car to the power lines. V2G technology is basically a version of battery to grid power applied to vehicles. There are three different versions of the V2G technology.

1. **Hybrid or fuel celled vehicle** which generates power from storable fuel and uses its generator to produce power for a utility at peak electricity usage times.

2. **Battery powered or plug in hybrid vehicle:-** This type of vehicle uses its excess rechargeable battery capacity in order to provide power to the electric grid in response to peak load demands

***3.* Solar vehicle:-** This type of vehicle uses its excess charging capacity to provide power to the electric grid when the battery is fully charged.

CHARGING SYSTEM

The charging parameters of PHEV includes power requirement, energy needed, and cycles and time duration of charging, which can be analyzed by evaluating the daily vehicle trips and distance traveled.

Charging conditions plays a crucial role in determining the energy storage condition (i.e., battery size) for PHEVs. In the absence of charging infrastructure while traveling it is observed that around 40 miles is considered as charge depleting range for an average PHEV. In case of availability of public charging infrastructure the charge depleting range can be decreased to 13 miles. Thus it is important to calculate charging accessibility for both residential as well as commercial surroundings.

The proposed charging infrastructure models assessed includes the following
(1) Charging in a home garage when required,
(2) Overnight charging at an apartment complex, and
(3) Charging at a commercial facility at prescribed rates.

Above described scenario proves to be advantageous as it will

- Eliminates the requirement for a battery room that take up immense warehouse space
- Eliminates the need for dedicated battery room personnel
- Reduces costs by eliminating the need to buy battery handling and changing equipment
- Lift truck operators do not need to travel from their work area to the battery room to change out batteries, saving thousands of dollars in lost productivity.
- Batteries weighing thousands of pounds no longer need to be hoisted in and out of lift trucks, reducing the potential for employee injuries

Idle losses which are around 3% can be used to store the can be used to Charging parameters involve Actual PHEV driver behavior and an evaluation of charge power requirements (based on experience with charge characteristics of various battery chemistries) bring additional light to charging infrastructure requirements for PHEVs. Upon conducting these evaluations, it was concluded that 40 miles of charge depleting range is necessary for an average PHEV if no infrastructure is available outside of the owner's primary residence. If public charging infrastructure is available, allowing PHEV charging outside of the owner's primary residence, the charge depleting range can be lowered to 13 miles. It is, therefore, considered important to evaluate charging infrastructure in both residential and commercial settings because the availability of a rich charging infrastructure can reduce the onboard energy storage requirement (i.e., battery size) for PHEVs.
Typical charging infrastructure scenarios evaluated include (1) overnight charging at a home garage, (2) overnight charging at an apartment complex, and (3) opportunity charging at a commercial facility. Each scenario was described, the infrastructure and onboard power electronics requirements determined, and the typical cost for the infrastructure and onboard power electronics developed.

Payment Collection

Introduction to Payment Collection System:-
Electric vehicle Payment collection system is one of important feature which needs to be taken care of while focusing electric vehicle system. Design of a reliable system should be there for calculating and collecting electric charge fee for electric vehicle. A electric vehicle payment collection system consist of a charge control unit, a power usage amount, cost calculation unit and a collection means.
The function of charge control unit is to receive power from a power supply means and charges battery of the electric vehicle. Function of a power usage amount is to measure the amount of power which is supplied to the battery from the power supply means and to calculate an electricity rate corresponding to the measured power usage amount. A collection is also provided which primary function is to collects the electricity rate from a user.

VARIOUS DETAIL OF PAYMENT COLLECTION SYSTEM:-

Probably a charge control unit may consist of a plug which is to be electrically connected to Power supply mains. The charge unit will charge the battery by using the power supply which is being supplied with the help of plug from power supply mains. The power usage amount and cost calculation unit consist of power usage amount measuring unit with a database and an electricity rate calculation unit. The amount of Power supplied to the battery from power supply mains is measured by power usage amount measuring unit. Database will store information about the electricity rate according the amount of power usage amount. The function of electricity rate calculation unit is to calculate an electricity rate for a preset time period or at each charge from a power usage amount for a preset time period or at each charge on the basis of information stored in the database.
Further system will consist of a double metering blocking unit which delivers a metric prohibition request signal to the power supply means. The request signal include a power usage amount of a vehicle and specific information of the vehicle. Accordingly, the metric prohibition request signal will be transmitted together with a power usage amount of a vehicle and specific information of a vehicle (3).

In a particular viable scenario, collection system will consist of data transmission unit, data receiving unit and controller. The Data Transmission unit will deliver an electricity rate generated in a preset time period or at each charge to an electronic payment means of a user for payment request. With the help of the electronic payments means, the data receiving unit will receive an electricity rate payment success signal or an electricity rate payment failure signal.

The controller will update electricity rate record for a preset period stored in the database 24 with the newly paid electricity rate if the payment success signal is received from the electronic payment means, while it may deliver a charge prevention request signal to the charge control unit if the payment failure signal is received from the electronic payment means. By this technique, the electric charge fee can be paid in a convenient and secured manner without dual billing problem.

A detailed flow chart is being shown in fig 1.1 which describes a system for calculating and collecting an electric charge fee for an electric vehicle. As shown in flowchart a user will inserts the plug of a vehicle into the outlet of the power supply. The charge units of the charge control unit will charges the battery by using the power supplied from the power supply means. The power usage measuring unit of the power usage amount and cost calculation unit measures the power usage amount supplied to the battery from the power supply.

The electricity rate calculation unit of the power usage amount and cost calculation unit calculates the electricity rate for a power usage amount for a preset time period or a power usage amount measured in each charge on the basis of the electricity rate table by power usage amount stored in the database. The double metering blocking unit delivers the metric prohibition request signal of the power usage amount to the power supply. The collection means a guides a user by using the additional guide unit (not shown) in a preset time period or at each charge with regard to the payment of the electricity rate so that the electronic payment contacts the data transmission/data reception unit of the collection means (4). The collection delivers the electricity rate(s) generated to the electronic payment through the data transmission unit and requests the payment. The data reception unit of the collection receives the electricity rate payment success signal or the electricity rate payment failure signal from the electronic payment.

In the case of receiving the electricity rate payment success signal from the electronic payment means, the controller updates the electricity rate record for a preset period stored in the database with the newly paid electricity rate. On the other hand, in the case of receiving payment failure signal is delivered from the electronic payment means, the controller delivers the charge prohibition request signal to the charge control unit .

A. Figures and Tables

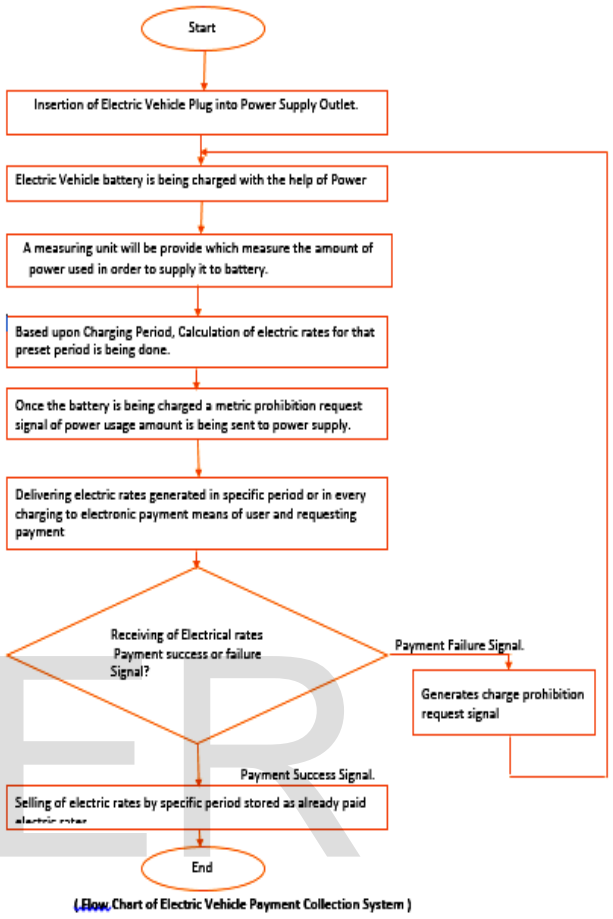

Fig 1

Summary

With the rigorous development in right direction and combining all of the research a predicted 40-50% improvement can be achieved.

In many areas with suitable driving conditions we can drive up to around 400 miles even. Many established companies are coming up with electric cars in the market and soon this technology will be able to supersede the existing system. Electric vehicles are the future.

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