IOT based charging station technology for EVs.

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Abstract: The electrification of the transportation sector is one of the viable solutions to minimizing carbon emissions over the atmosphere. EVs are paving the path to a sustainable future and energy efficiency. Also, helping in reducing the carbon footprint and with cost-cutting strategy, it is becoming the user's choice. Due to the rapid growth of EVs in the market, electric vehicle charging infrastructure will be the primary need. This paper showcases the importance of power grid charging techniques and sustainable futuristic IoT-based approach to deal with current issues in EV industries. Using IoT saves the time spent by the user looking for the station location with the possibility of knowing the location of the charging stations by using a mobile application. The user performs the charging action, calculates the corresponding charges, and deducts the amount from the owner's e-wallet. The proposed system will provide a smooth charging experience and a better method to control the entire charging process.

Keywords*: IOT- Internet of Things, EVs – Electric Vehicles, SoC - the State of Charge, Charging Station, DC voltage charging stations*

1. Introduction

In recent years, there is an increase in demand for electric vehicles as the cost of electricity required for charging an electric vehicle is less than the cost of using petrol for a similar-sized vehicle driving the same distance. One of the biggest advantages of using electric vehicles is that impact our environment. Electric vehicles are more popular in many countries, and our government is taking serious steps on this topic.

Technologically, adopting electric vehicle technology is a good initiation to going green. The cost invested in fuel for normal car users could be invested in this Electric Vehicles system. This paper focuses on EV charging stations and the associated factors. The world has been witnessing a rising trend of electric vehicles. The number of electric vehicles in the world has increased from 2.2 million in 2011 to 3.1 million in 2016, being led by China and Western Europe. China is an early adopter of electric vehicles and its government is making efforts to promote the use of EVs. Charging stations that are compatible with both AC and DC charging for public use and installed the corresponding infrastructure for private use such as residential parking lots and office parking spaces. The

installation of smart charging equipment at EV charging stations can be used to control the charge rate and battery temperature during charge, which will help increase the life span of batteries while reducing battery degradation over time

2. Literature:

[1] This paper suggests that World facing issues regarding the rising fuel demand and its effects. So, the project is moving towards electrical vehicles. But still, users are not able to prevail over the benefits of EV cars. The main issue is because of a low number of charging stations and poor infrastructure. Even if few charging stations are available, it is necessary to spend extra time charging the vehicle. Also, present-day car parking has become a major issue in urban cities. The office parking lots should install sustainable charging ports based on IoT to enhance users' experience by saving their time and effort to reach charging stations. This will reduce the efforts of roaming for the slot of parking. The ample amount of time by users invested in finding charging stations and charging EVs. This paper put focuses on the wireless charge transfer technology for EVs and charging systems with the help of IoT.

[2] This paper put light on methods that are helpful in transportation systems as it allows charging the batteries in an electric vehicle with minimal human intervention. The user can view the data in the Android App. Also, the user can locate the nearby charging stations' location and transaction history on the app. Once the acknowledgment is received from the user the system will perform the charging action and calculate the corresponding charges and deduct the amount from the owner's e-wallet and transfer it into the charging station's owner's account. In this way Internet of Things (IoT) based smart charging has been proposed to provide a smooth charging 1g experience and a better method to control the entire charging process.

[3] The electric charging station is our main concern when comes to charging the existing EVs. The availability of charging points for an EV is processed with the help of a mobile application that provides better connectivity and is convenient for users. Data processing is made a lot easier and more efficient with the help of IoT. Users can get the live feed of the charging status and other customs features.

[4] Arunkumar P and Vijith. K proposes IOT Enabled smart charging stations for Electric Vehicle. This system will improve city planning and makes city life easy. With the IoT, we can easily manage the whole V2G system which will save time and money. This work is to make a smart application to connect
with the grid and to know the different traffic rates of the grid. An IoT system will streamline EV charging performance and look at the impacts. This method is helpful for the transportation system, and V2G systems.

[5] In this paper, for EV charging they have designed a whole live real working model in which they used the IO platform to track the inputs and outputs from the EV batteries. Made a working circuit using modules such as LPC 1768, ESP 8266,

and ARM 1768. With the Wi-Fi xsi-enabled feature, a user can easily track the data generated with the help of an application. The IoT-based smart charging feature is achieved in this project. The data storage backup lasts for 30 days which enables accurate data processing and gives feedback.

[6] In this paper, the working prototype assembly is achieved. The components are Arduino, relays, and an RFID reader, these together give a seamless experience for charging batteries. The whole cycle is meant to replicate the real scenario of the EV charging station. These components communicate together to produce data and verify the user credentials. There are power controllers to limit instability and regulate the power supply.

[7] MyeongHyun Kim proposes that EV charging station comes with the threat of cyber-attacks, leaking data, or privileged insider attacks activity. With the use of blockchain, this can be eliminated. Blockchain works on hash technology and has data blocks that generate transactions with data stored in them. Also contributed to simplifying the charging mechanism and lowering the transaction fee. Hyperledger architecture has nine components for the smooth running of the system. The picture below is of the Proposed blockchain-based charging system model for an electric vehicle. Figure 1 can see the cycle of EV charging with the help of Blockchain and IoT-based application and system.

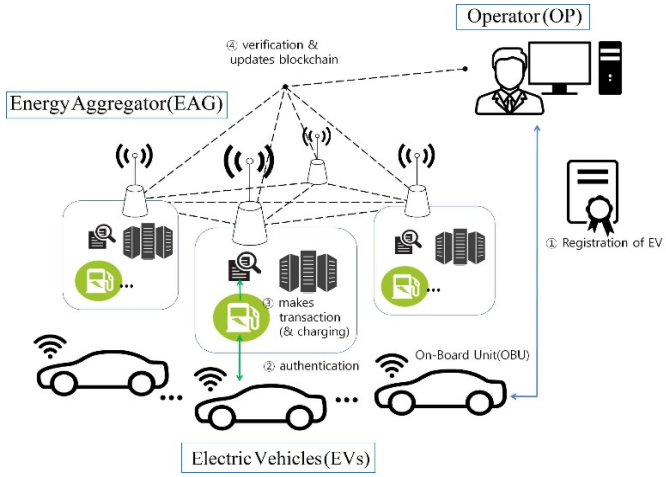

Figure 1: The EV Charging Blockchain

[8] Bin Duan and Kaihua Xin propose that EV charging is more reliable with a power grid system, it is influenced by the stable operation of the power system. The overloading of a grid system with several different power consumption cars is a crucial point when comes to constant efficient power delivery, power flow cycle, and charging a price per unit. Here also depicts the overloading factors and ways to improve such sort of anomalies when the system goes live with the customer. EVs connect with cloud-based technology, that enables sustainable charging by balancing the power consumption in EVs by limiting the charge as per the criteria and requirements. The different types can be seen in figure no 4, which depicts all the valid and supportable EVs charging.

[9] Zhen Wang and other fellows proposed that EV charging could be simplified using a cloud-based system. The Charging scheduling network graph model gives the real-time location of the vehicle and stations in the vicinity to ease the load factor at a station. Works in sub-nodes and roots as vehicles and charging stations. The algorithm makes it more time-saving and cost-efficient. The cloud computing center manages all the factors that come into the car using data generated by the car system.

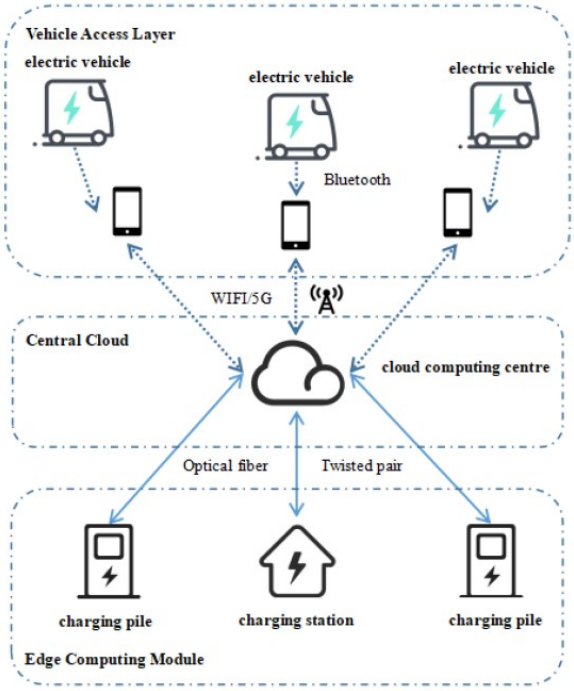

Figure no: 2 Cloud based Model

[10] The adoption rate of EVs by the customer is mostly dependent on the availability of charging stations and the capacity of batteries of EVs. The increase in demand for EVs since fossil fuel prices is hiking all over the globe. The power grids should use more renewable energy resources and use V2G technology to maintain energy balance. Hybrid electric vehicles, plug-in electric vehicles, and fuel-cell electric vehicles are some of the best options are sustainable growth in EVs for different geographic locations. The scheduling of batteries for charging in meantime as well as in peak time can be optimized with the battery swapping stations. The need for infrastructure and development in the area of EVs is still in its premature phase. The new policies and sustainable development are key to the emergence of EVs in the vicinity. Coal and other fossil fuel's electricity is not liable source as well as it causes a tremendous number of environmental issues. The variable power supply capacity and level of charging based on requirement help in managing the power supply throughout the supply chain of energy distribution to EVs. Below is the figure, can see the variable model of infrastructure is designed for types of requirements.

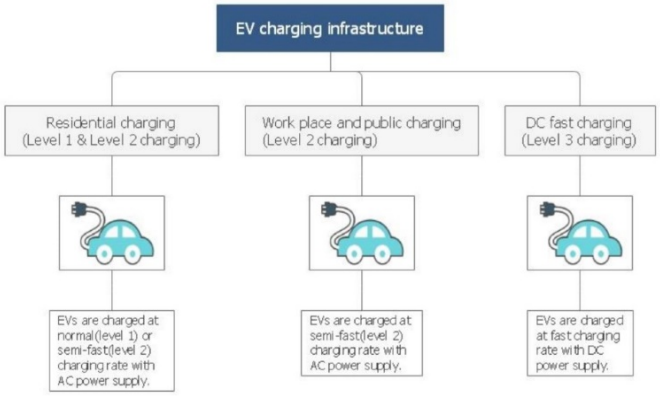

Figure 3. EV Charging Infrastructure

[11] DC microgrid systems are getting popular these days, as they give the best results in charging batteries. The secret lies in simple voltage regulation and can be tracked in real-time, so there is no loss of data or prevent malfunction. Charging rooftops and workplaces reduce the initial cost of investment and land consumption. As most of the vehicles stay in parking lots for around 6-7 hours a day. The IoT-based web application and apps can give more flexibility to find more convenient charging places. Microgrid infrastructure and its types can help reduce the complexity customers face for charging and correct information is delivered with the usage of IoT-based tools. Electric wireless charging lanes, battery swapping, and charging through conductive coupling. Electric vehicles' current and future generations will be charged through inductive coupling. This is because it is the most practical charging method for EVs. There are a lot of factors that contribute to the power balance in EV charging stations. These include the type of EV, the type of charger, and how much power is being drawn from the grid. This section will introduce the concept of IoT-based electric vehicle charging stations. The idea is to have multiple charging points for EVs to charge at the same time, which will help in reducing the time taken for them to charge. One approach is called Multi-Point EV Charging Station (or MPECS). It uses RES Powered, which is a company that specializes in renewable energy solutions. They develop and operate a network of electric vehicle charging stations that are connected with IoT technology. This ensures that the charging stations are always up and running. Figure no 4 shows the types of grids and types of vehicles which needs different sorts of charging modules as well as power delivery.

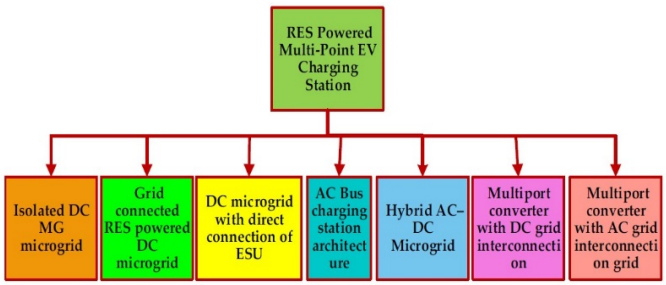

Figure 4: Types of Microgrid

Points to consider

- To develop a smart charging system for Electric Vehicle through,
- Designing an Android app that displays nearby charging stations.
- Displaying payment transactions for an Electric vehicle with the help of the Android app.
- Determining the availability of charging slots with the help of IoT.

The power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. Raspberry Pi works as a controller. The Linux-based operating system is used by Raspberry Pi. It makes it possible for applications to utilize the hardware of the computer itself. Current Transformer measures overall consumed current.

Relays control one electrical circuit by opening and closing contacts in another circuit. In this case, it controls charging ports. A Cloud network enables the client device to access data and cloud applications over the internet from servers and databases. The android app is used to browse EV charging points on a Map. It helps to locate EV charging stations close to the user's location.

Result and discussion

The EV charging station market is growing exponentially. The electric vehicle charging station market is expected to grow at a CAGR of 23% from 2018-2023. The electric vehicle charging station market is segmented into product, application, and geography. The products are further segmented into onboard chargers, off-board chargers, and conductive coupling chargers in EVs. The applications are divided into public and private installations while the geography is divided into North America, Europe, Asia Pacific, and LAMEA. There are many factors attributed to the growth of this industry such as an increase in the adoption of EVs, increased government incentives for EVs, and increased demand for cleaner energy sources among others. However, some challenges still need to be addressed before this industry can reach its full potential. Fossil fuel electricity generation is still the main challenge for EVs. It's the 21st century, and the world is shifting towards the far better end of using technology. This review paper compares almost every aspect and factor related to EVs and charging stations. The EVs play a genuine role while promising a clean and better future. The infrastructure is also a dominant factor when comes to the customer mindset of charging vehicles at stations. The traditional methods do not meet the actual requirement. The low infrastructure is a big hurdle when comes to adapting to new technologies. Making customer data more secure than beforehand cutting costs per unit of power supply. The alternative can be a renewable energy source, i.e. solar, tidal, wind, and many more. These can significantly impact providing clean energy and sustainable growth of EV future in coming decades. Types of microgrids are also a revolutionary technique in the EV industry and development.

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