Research and Analysis on the Use of 5G and Big Data in Urban Electric Vehicle Public Charging Networks

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Abstract. In recent years, the electric vehicle sales market has been expanding, but the existing urban electric vehicle public charging network system is not optimistic. Most of the researches on the construction of charging facilities and charging network are still at the stage of qualitative analysis. This paper uses the method of questionnaire survey to investigate the current situation of electric vehicle public charging network system in China. Using 5g new technology and big data technology for research and analysis, from the city level, we can explore whether the establishment of electric vehicle public charging network is feasible. The big data analysis technology can not only promote the efficiency construction of charging pile network, but also improve the user experience of charging pile charging station. At the same time, it also increases the application scenarios of charging pile network, which is not only of great significance to the development of the entire electric vehicle industry, but also greatly promotes the rapid development of the city.

Keywords: Electric Vehicles, Public Charging Networks, 5G Technology, Big Data

1. Introduction
With the development of the 5G industry, the construction and development of "smart cities" has entered the fast lane, and the number of base stations in the 5G era will greatly increase [1-3]. 5G smart light pole has 5G small base station, security alarm, surveillance camera, public broadcasting, multimedia information display, public broadcasting, wireless Wi Fi, new energy electric vehicle charging pile and other functions. Using cutting-edge technology, such as information perception, computer processing and data communication transmission technology, the collected information and data are extracted into the software library to realize the core functions of smart city management in the big data interactive environment. The biggest purpose of my country's development of new energy vehicles is to protect the resources and environment. The use of electric vehicles instead of fuel vehicles is conducive to environmental protection and air pollution prevention. In the context of paying more attention to the "new infrastructure" of hard-core technology, it will be further upgraded with the support of 5G, big data, artificial intelligence, industrial Internet and other digital technologies to improve international competitiveness [4-5].
Recently, the Chinese government has introduced a series of assistance measures to explore how to promote the development of the electric vehicle industry \cite{6-8} and support the development of the electric vehicle industry, that is, the infrastructure construction of electric vehicle charging and switching networks. However, because of the limitations of battery technology, the battery used has a long charging time, high cost, uneven distribution of charging demand, and cannot well meet the needs of electric vehicle users. The charging process is complicated and the electric vehicle industry The current business model is not clear for these reasons, which has affected the purchase of electric vehicles and the construction of charging and replacement facilities. In order to ensure that the planning and construction of China's electric vehicle charging network is more reasonable in the future, and to improve its operation and service capabilities, it is particularly important to study the evaluation methods and simulation technologies of electric vehicle operation and service capabilities. The vehicle charging network evaluates and feeds back existing charging facilities and services to further guide its development.

This paper studies the existing urban electric vehicle public charging network system. The results found that the current research on charging facilities and charging network construction is still at the level of qualitative analysis, and the public charging network system for urban electric vehicles has obvious shortcomings. Therefore, this paper studies the public charging network of urban electric vehicles \cite{9-10}. Based on the research of the 5G public charging system and the feasibility of using it in China, it is feasible to establish a new electric vehicle charging network in China. From the city level, these measures are of great significance to the development of a city's electric vehicle industry and the development of the city.

2. Electric Vehicles and 5G Big Data Technology

2.1 Electric Car
In theory, an electric vehicle refers to a vehicle that uses batteries, fuel cells, or super capacitors as power sources, and is fully or partially driven by electric motors. It is a fusion product of electrification and automobile. Therefore, in a broad sense, electric vehicles can be classified from three aspects: pure electric vehicles, fuel cell electric vehicles, and hybrid vehicles. The hybrid vehicle is a type of vehicle that contains two or more power sources (including electric motors) and complies with my country's traffic safety regulations. Currently, the most widely used is plug-in hybrid electric vehicles. After the battery is fully charged, the motor is driven by the battery. After the battery is exhausted, the vehicle will be driven by fuel to generate electricity. This kind of car cannot get rid of its dependence on gasoline and can only be used as a transitional model for the development of electric vehicles. In the modern economy, it is advocated to convert the chemical form of energy produced in the process of fuel oxidation into electric energy as the power source of electric vehicles. It has high conversion efficiency and does not require charging. A pure electric vehicle is a type of vehicle that can only be powered by charging the battery. This type of electric vehicle powers the vehicle's electric motor through the on-board battery, and then drives the vehicle. This type of vehicle is considered by everyone to be the most ideal type of vehicle so far because of its "zero emission".

2.2 5G Big Data Technology
With 5G high bandwidth, low latency and artificial intelligence functions, the industry value of big data needs better exploration and improvement, because the business forms it carries have more diversity and complexity. The main function of 5G and big data is reflected in the city. People living in cities can generate large amounts of big data every day, and their demand for communication technology is also increasing. They involve public health, urban planning, traffic management, etc. Calculate the relevant data of the city through 5G communication technology and big data, so as to obtain the relationship between the data. Then we can find some problems and find solutions based on the results to promote the development of the city. Nowadays, wireless network virtualization technology has become more and more mature, and has developed towards 5G mobile communication.
Therefore, the requirements for network infrastructure are not very high, which will gradually separate facilities and services, and greatly reduce the cost of operators. When service providers provide different types of services, they use wireless networks for sharing purposes. Top special services, VoIP and other services with their own characteristics can become the characteristics of 5G and big data. In this way, virtual network operators can bring more customer resources to mobile operators. At the same time, certain services can greatly reduce the workload of operations.

We can use different transmission points with overlapping coverage to perform interference cancellation and mobility management, and we can flexibly use resources to perform uplink and downlink transmissions for each covered cell, and directly select between devices, and advanced interference cancellation technology It can effectively allow the Internet of Things to connect more devices. New applications such as mission-critical control or traffic security need to reduce latency and enhance reliability [11].

3. Experimental Ideas and Design

3.1 Experimental Ideas
As far as the entire electric vehicle industry is concerned, the relatively lagging development of the construction of charging and replacement facilities has made the users of electric vehicles often in a dilemma that they cannot find a place. Therefore, before the large-scale construction of charging and replacement facilities in cities, the first thing that must be done is to plan the layout, which is an indispensable measure to solve this problem. However, most of the current researches on the construction of charging facilities and charging networks are still at the level of qualitative analysis. There are still obvious shortcomings in the urban electric vehicle public charging network system. Therefore, this article uses 5G new technology and big data technology to study and analyze the domestic urban electric vehicle public charging network system, and explore the feasibility of establishing an electric vehicle public charging network at the city level.

3.2 Experimental Design
In the design, this article mainly adopts the form of questionnaire survey and on-site interview to study and analyze the urban electric vehicle public charging network system, aiming to explore the current situation of the urban electric vehicle public charging network system in my country. In view of the limited operating range of electric vehicles currently on the market, users of electric vehicles far away from urban residential areas will have great inconvenience in driving electric vehicles out. Therefore, the research focuses on residential areas near the city center. 772 questionnaires were collected, of which 667 were valid questionnaires. In order to conduct an effective analysis, this paper analyzes the openness of urban charging infrastructure, and the results are shown in Table 1. The goal of 5G and big data technology is to effectively explore the feasibility of establishing a public charging network for urban electric vehicles.

| question                          | answer                                      | Proportion (%) |
|-----------------------------------|---------------------------------------------|----------------|
| Are there visitor parking spaces  | There are visitor (public) parking spaces   | 47             |
|                                   | No visitors (public) parking spaces          | 53             |
| Are private parking spaces adequate | Sufficient, the number of parking spaces is significantly larger than the number of vehicles | 6              |
|                                   | Insufficient, parking spaces are basically equal to the number of vehicles | 31             |
|                                   | Insufficient, the number of parking spaces is significantly less than the number of vehicles | 54             |
|                                   | Data is missing or there are no parking spaces in the community | 9              |
| Willing to open public            | willing                                     | 11             |

Table 1. Survey on the distribution of electric vehicle charging facilities
parking spaces | Unwilling | 89

4. Discussion

4.1 Analysis of Urban Electric Vehicle Public Charging Network Construction under 5G and Big Data

With the enhancement of people's environmental awareness in China, the development of new energy vehicle industry has become the key to reduce air pollution and solve the problem of oil shortage. Driven by social demand, private capital and government support, the total number of new energy vehicles in China has exceeded 3.44 million, with a year-on-year increase of 72.9%. With the continuous promotion and development of the new energy electric vehicle industry, especially the introduction of taxi and tram policies and the popularization of online trams, it is urgent to construct the public charging network of urban electric vehicles reasonably. As can be seen from Figure 1, by the second quarter of 2019, the number of low-cost AC charging piles in China has reached 248000, accounting for more than 50%; second, there are 178000 DC charging piles with fast charging speed and high cost. In 2019, China has started to build 5g network, and plans to put 5g network into commercial use in 2020. The development of 5g network technology will also be one of the key technologies of electric vehicle charging pile industry. Combined with big data technology, it is planned to build public charging network for urban electric vehicles. Edge computing entities in the access wireless network can preprocess the data in advance, and then upload the data to the cloud computing cluster of businesses providing charging services after processing the data. After the comprehensive evaluation and analysis of the previous behavior data of electric vehicle users, the charging service operators can effectively predict the charging service demand of each region, so as to further optimize the configuration of electric vehicle charging and exchanging network, so as to improve the utilization rate of charging and exchanging network. Big data in electric vehicle charging business has the characteristics of high processing speed, multiple types, large scale and low value density. In view of this characteristic, the traditional statistical analysis method cannot dig out the value of these data thoroughly and effectively, so it is necessary to use computational intelligence method to analyze the data. Using 5g and big data analysis technology can greatly improve the construction efficiency of charging and swapping network, and provide users with a better experience of charging and changing electricity, and provide more applications for charging and changing network.

![Figure 1. The composition ratio of public charging piles in China in 2019](image)

In addition, this article further studies the problems existing in the development of toll pile network property management companies. As can be seen from Figure 2, the main problem is the lack of a viable business model. In addition, the second main reason is the clarity of rights and increased management costs and difficulties. Real estate companies will inevitably consider whether their own interests and responsibilities are clear, and whether they can make up for costs and difficulties after
opening up. These problems will inevitably bring troubles to the property, because there is no comprehensive laws and regulations, and there is no domestic business case to learn from. In the final analysis, the construction and utilization of electric vehicle charging and swapping network facilities is a major problem that is difficult for the electric vehicle industry to move forward.

4.2 Recommendations for the Development of Urban Electric Vehicle Public Charging Networks under 5G and Big Data

1. Distributed construction

Since the construction of distributed charging stations is a top priority, we can transform the construction of distributed charging stations into low-cost multiple charging stations. Avoid all the shortcomings of traditional charging station construction. In the construction of distributed charging pile groups, the meaning of network should be paid attention to. In the early stages, there may be several points. As users increase and scale expands, a service-oriented urban network will gradually be formed. This will also be the future ecological structure of the city's charging and swapping infrastructure. Of course, operators that first build networks, are large in scale, and provide better services will occupy the commanding heights of the industry in the future.

2. Built with user characteristics

At this moment, new energy electric vehicles are still being promoted, and the target customer group is relatively fixed, most of which are concentrated in the public transportation field, some private car fields and some specific industry fields. Its usage time, usage habits, parking place, etc. all have certain regularity. The infrastructure construction of the charging and swapping network should meet the needs of users as the standard, and the charging piles should be built according to the needs of users, and should be as close to users as possible.

3. The charging pile goes with the car

Due to the area of land, the construction of the distributed charging pile group has not been greatly consolidated, and the mechanism of the city is also very different, which has strong flexibility in the planning of urban charging infrastructure. The distribution plan of the charging pile group can be adjusted according to changes in user needs. The relocation of charging piles is to a large extent more convenient than the relocation of charging stations. In this case, the reuse rate of equipment will also be greatly improved. This reflects the new development of the local government to a certain extent. This is also mentioned in the plan.

5. Conclusions

In the research of urban electric vehicle public charging network system, using 5G and big data analysis technology, in the charging and swapping network construction arrangement and design, we need to analyze the data information of traffic information, grid load and operation information to
satisfy the needs of electric vehicle users, environmental protection, power grid management, transportation network management departments, and the needs of operators, etc., have all been subject to fair and reasonable constraints. Congestion and grid load. Through investigation and analysis, it is found that the construction and utilization of electric vehicle charging and swapping network facilities are relatively backward. Therefore, this is also a stumbling block for the development of my country's electric vehicle industry. Adopting 5G and big data analysis technology can greatly improve the construction efficiency of the charging and swapping network, and it can also provide users with a better charging and swapping experience, and provide more applications for the charging and swapping network.

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