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## **DISTRIBUTED ELECTRIC VEHICLE CHARGING SERVICE SYSTEM DESIGN BASED ON BLOCKCHAIN TECHNOLOGY**

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### **ABSTRACT**

Under the background of the rapid development of electric vehicles and the imperfect charging service system, this study investigates the current problems in the existing charging system and the user's usage scenarios. meanwhile, the development and advantages of the blockchain technology are discussed as well. Using the model of shared economy, the study discusses the design of electric vehicle charging system based on blockchain technology combined with system service design and distributed economic thinking in the hope of improving the user's charging experience.

Key Words: Blockchain, Distributed economy, Service design, Vehicle charging system

## 1. INTRODUCTION

With the increasingly severe global environmental conditions and the ever-increasing total number of automobiles, the environmental problems brought about by automobile exhaust have received extensive attention at home and abroad. Various countries have issued their own fuel vehicle lock-up schedules. Countries such as the Netherlands, Norway, Germany, and India state that they will ban fuel vehicles by 2030 while China endeavours to achieve this goal around 2035<sup>1</sup>. The spring of electric vehicles has arrived, and there will be more and more “green card” cars driving on the streets of China. However, with the continuous increase in the number of electric vehicles, the charging problem of electric vehicles has also begun to emerge. Many electric vehicle owners face problems such as the inability to charge in time, the long duration of charging, and the damage of charger. Meanwhile, the problems of charging have also limited the electric car owners to drive in a relatively small scale.

## 2. RELATED DEVELOPMENT BACKGROUND OF DOMESTIC DEVELOPMENT

### 2.1. Status of development of electric vehicle

According to the statistics from China Automobile Association, the Chinese private car market experienced its first negative growth in 2018. Nevertheless, different from the decline of overall sales for private cars in China, sales of electric vehicles in China are increasing successively, which mainly benefits from the support of national policy and the subsidy of car purchase.

In the five years of rapid development of electric vehicles, the consumer group has undergone a positive change, and the main body of consumption has changed from the original work unit to the private user. This shows that more and more private users are entering the group of electric car owners. As for the main consumption areas of electric vehicles, the major purchase areas have also expanded rapidly from restricted cities to non-restricted cities. Compared with previous years, the purchase area of electric vehicles nowadays is mainly non-restricted cities. This in turn shows that consumers are increasingly accepting electric vehicles and will think of electric vehicles at once when buying a car. It can be seen from these two points that the development trend of electric vehicles in China is unstoppable.

### 2.2. Problems with domestic car charging service system

By analysing the use of the existing vehicle charger APP, the author summarizes the scope, density, features and cost of the charger owned by several enterprises with the highest occupancy rate (see Table 1).

[Table 1] Comparison of different charging service companies

Brand	Scope	Density	Features	Cost
State Grid	All around China	Very high	Charging card(without network)	Medium
Star charger	Most city	High	Public & private charger	High
Telaidian	All around China	High	.....	Low
Putian Electric	Most main city	Low	Pay by special card	Low
Judian Technology	Most main city	Low	.....	High
Tesla	All around China	Medium	free	free
.....				

It is found that domestic charger enterprises are better than TESLA in terms of scale and compatibility. However, the survey of most users found that the charging satisfaction of Tesla owners is much higher than that of domestic electric car owners. The main reason is the difference in charging time. Along with the public charger, Tesla also focuses on the private charger. Although domestic car manufacturers provide installation services for private charger as well, compared with Tesla owners, most of the domestic electric car owners do not have their own private parking spaces, and the installation rate of private charger is much lower than that of Tesla. Different from the domestic electric vehicles, looking for charging of public charger during the day, Tesla’s night charging mode saves time and improves the user experience.

### 2.3. The rise and widespread application of blockchain technology

Since the birth of blockchain technology, its decentralization, anti-falsification of information, openness and transparency, traceability and other characteristics have attracted a great number of investments. The main application mode of the blockchain thus comes to be clearer. The first mode is to build an ecological business synergy on account that the advantages of the blockchain can help the entire business organization to form an ecosystem layer, to dilute the boundaries of the company’s interests, and to form flexible synergies with external resources. The second mode is to build cross-organizational data and process connectivity, the core of which is data sharing, digital-based sharing, commercial automation, and even integration with AI. The third mode is about asset trading in the hope of reducing the cost and the risk of capital flow by virtue of digital currency for it is peer-to-peer and transparent.

<sup>1</sup> Base on the data from BEIJING BUSINESS TODAY.

### 3. MAIN BODY AND FACILITY PROCESS DESIGN IN EXISTING SYSTEMS

The main mode of the existing system is “equipment manufacturer +facility operator +Internet platform”<sup>2</sup> and it becomes the core link in the existing electric charging service system design. Besides, the objects that need to be involved in this system include electric vehicle owners, major car charger companies, Internet service platforms, power supply companies, charging equipment manufacturers, government agencies, etc. (see Figure 1).

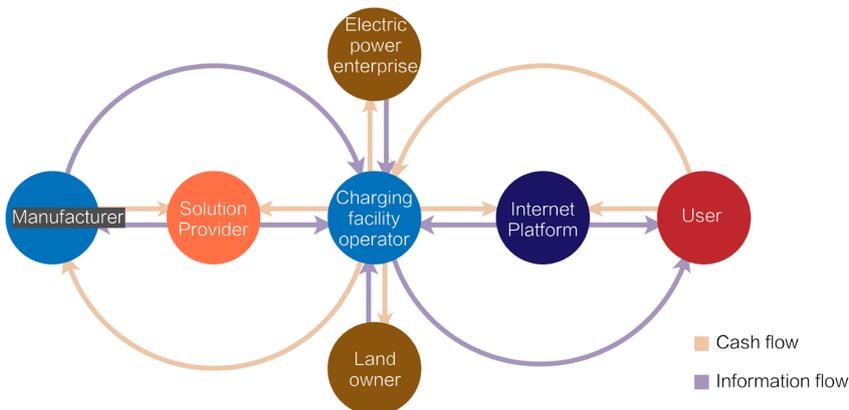


Figure 1 Current electric vehicle charging service system diagram

However, the main problem with this system is that with the establishment of more and more charger Internet platforms, the current electric charging system has presented a model of “small farmer economy”. Electric car owners cannot use cross-platform charger until download a lot of different APPs. This may lead to the burden of use and even financial losses (the disappearing shared bike is an obvious example).

### 4. DESIGN OF ELECTRIC VEHICLE CHARGING SERVICE SYSTEM BASED ON BLOCKCHAIN

Based on the design of the existing charging system, this paper conceives to use blockchain technology to manage all the devices of the charging service platform, including private charger.

#### 4.1. The business model and user usage scenarios base on this system

In the current concept, the main difficulty of the system design is how to unify the needs of different platforms and ensure the benefits of the major charger platforms. The author believes that through the point-to-point payment function of the blockchain, the user can directly pay the fee to the charger enterprise account after using the charger. And the anti-falsification of information ensures accurate use of records and capital flows. The blockchain service platform can obtain operating expenses and self-interest from the major charger manufacturers by taking commission.

For user, integrating all the charger into the blockchain system network means that he can perform the charging service once he sees the charger and does not need to care about the brand of the charger. It avoids the use load and financial risk caused by multiple APP switching. At the same time, once the private charger is unoccupied, it can provide charging service for users in the same cell as well, which can protect the users from the search for charger during the day and the long charging waiting process.

#### 4.2. Design of charging service system based on blockchain technology

In view of the above ideas, the author designed a charging service system diagram based on this concept (see Figure 2).

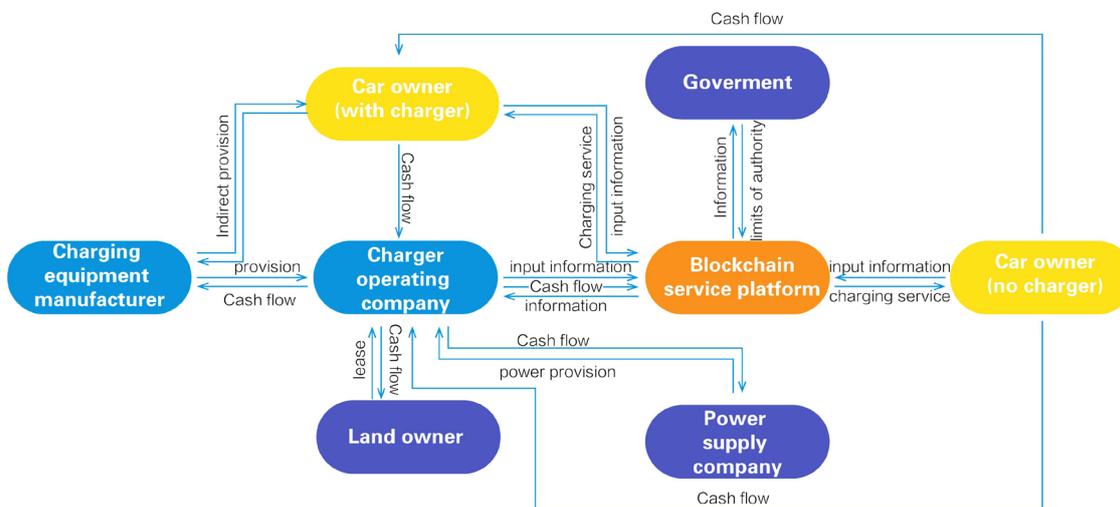


Figure 2 charging service system diagram based on blockchain technology

<sup>2</sup> Referred to www.analysys.cn

In the system diagram, a charging system connects the electric vehicle owners and the major charger service providers with the blockchain service platform as the core is formed mainly by joining the blockchain service platform and the private charger master. The operation of the system requires the process of charging the pile information - user registration - user information entry - user service. As more and more information being entered on the charger, it will also bring a growing number of fast charging services, thus attracts more users.

#### 4.3. Summary and discovery

The biggest problem with the proposed charging service system may be how to quickly form a wide coverage charging service network. In 2017, the US company eMotorWerks proposed a shared charger project for electric vehicles based on blockchain technology, and advocated sharing the charger to increase the utilization rate of charger. Thus, encouraging people to join the blockchain system is a long process. The author hopes to increase the user traffic by letting the special charger enterprises join the service system, and then attracting more charger owners through publicity and profit.

## 5. CONCLUSION

The development of electric vehicles is an unstoppable trend. In order to meet the charging needs of the owner and improve the service experience of the owner, it is necessary to make full use of the existing resources and to provide a faster and safer form of transaction. Under the background of the continuous maturity of blockchain technology, there seems to be a solution to such a requirement. Through the design of the charging service system based on blockchain technology, this paper uses the blockchain platform to make full and efficient use of the entire charger system resources, hoping to provide a better user experience.

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