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Research on Feasibility Analysis of ETC Application in Parking Lot in China

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ABSTRACT

In the face of the current problems of "disorderly parking fees" and "low traffic efficiency" in parking lots, as well as the development trend of "ETC+ " industry integration, it is of great significance to study and promote the application of ETC charging system in urban parking scenes to meet people's demand for efficient parking and convenient travel, and to improve the comprehensive service capability of urban transportation. The reason why the author chose this topic is that with the progress of The Times, self-driving has become the mode of travel for most families, and the ensuing parking and parking charges have also become the pain point and bottleneck of the development of people's livelihood. The main development of ETC on the highway has become an important part of the intelligent transportation system, while in the parking lot, the development of ETC is still mainly in the imagination stage. Some cities have started trial operations, but most parking fees are mainly paid in cash and online. After discussion, this paper believes that the introduction of ETC system in the parking lot can imitate the ETC mode of China's highway, broaden the ETC application scenario, build a special channel in the parking lot, solve the problem of inconsistent, non-standard and inconvenient parking lot payment system, and realize the direct access of ETC card to the parking lot.

KEYWORDS

Feasibility Analysis; ETC Application; Parking Lot; China

1 Introduction

With the progress of The Times, self-driving has become the way of travel for most families, and the ensuing parking and parking charges have also become the pain points and bottlenecks in the development of people's livelihood. Many parking lots often cause traffic jams when charging slowly, most parking lots are sloping, and inefficient charging methods are easy to create security risks. Some car parks will adopt online mobile payment in advance, but the mobile payment method is more complicated, and some elderly citizens may not understand how to operate it. As an automatic Toll Collection system for highways or Bridges, ETC (Electronic Toll Collection) is becoming more and more mature in China in recent years. Through a series of technologies, toll collection time can be greatly shortened and the possibility of vehicle slope accident can be reduced. This system adopts automatic electronic toll collection system, which can make road toll paperless and cashless, fundamentally eliminate the loss of toll tickets, and solve the problem of financial management confusion in road toll collection. In addition, the implementation of an automated electronic toll collection system can also save money and administrative costs. In the face of the current problems of "disorderly parking fees" and "low traffic efficiency" in parking lots, it is of great significance to study and promote the application of ETC toll system in urban parking scenes to meet people's needs for efficient parking and convenient travel, and to improve the comprehensive service ability of urban transportation.

Therefore, the application of ETC toll system in the parking lot can effectively realize "no parking charge, efficient and convenient passage" and "reduce traffic flow". Many parking lot sizes can join the platform to register relevant information (such as location, parking lot size, etc.), and customers can also bind their bank cards to the platform. When entering and leaving the parking lot, there is no need to use mobile phones or cash to pay, and the parking lot system can automatically deduct money according to the parking time and vehicle type. At the same time, considering that the original business model of merchants is generally to reduce parking fees through coupons, the current stage generally adopts the mode of coupon exchange, which is relatively low efficiency. After using the ETC mode, it can be set directly by the merchant side. When the customer has spent a certain amount, the merchant can set the deduction amount on the system. The system will automatically calculate the discounted parking fee, which can reduce the problem of long parking payment time and complicated mobile payment. At the same time, in addition to the automatic deduction of fees, owners can also understand their parking consumption records on the mobile phone, so that owners are more assured. In recent years, with the gradual maturity of parking charging technology, the parking industry has gradually developed in the direction of intelligence, more public closed parking lots and state-owned roadside parking Spaces are undergoing intelligent upgrading of parking charging systems, and most of the parking lots have bid farewell to the past model of pure manual control. Its payment method has been developed from manual swipe card charging to intelligent charging. Therefore, in the face of the current situation of the parking industry and the development trend of parking charging services, how to realize the application of ETC charging system in parking lots has become a national policy requirement and an internal and urgent need for urban development.

2 Literature Review

2.1 ETC and Parking

Zhang proposed that Kunming study the application of ETC charging systems in parking lots (Zhang, 2022) [1]. By studying the development status of ETC systems at home and abroad and interviewing related ETC users, the author designs the scheme and application realization of the ETC charging system in the Kunming parking lot, The author has many suggestions on the application of ETC toll system in parking lot, which are worth learning.

Xin proposed an ETC Application analysis of free-flow charging technology in parking lots (Xin, 2021) [2]. The author mainly analyzes the current situation of ETC in highway and parking lot, how to break through ETC technology, and puts forward the idea of applying ETC free flow toll technology in parking lot. At the same time, the author also analyzed the core functions of the ETC parking lot operation management platform and finally concluded that intelligent transportation can provide more efficient and fast travel services, so it should follow the trend of the development of The Times, and vigorously promote the application of emerging technologies to meet the beautiful needs of people's convenient travel in the new era of transportation development.

Lian et al.analyzed the technology of ETC electronic charging without parking (Lian et al.,2007)[3]. By understanding the current status of technology research and problems faced, the main technologies adopted by ETC electronic non-parking toll, and the analysis of system trial operation results, the authors conclude that the electronic non-parking toll system combines China's national conditions and adopts the method of multi-technology integration and distributed processing.

2.2 ETC and Free Charge for Parking

Ma proposed a brief discussion on the system of charging without parking (Ma, 2015)[4]. By analyzing the principle and type of the system and exploring the system's current situation in foreign countries, the problems of the system and the results of the implementation of the system in China are forecasted.

Chen et al.analyzed ETC technology and its development (Chen et al., 2001)[5]. The authors reached their conclusions by analyzing the technology of the ETC system and the principles of its various components. The author understands ETC's system technology and its various components through this literature.

Fei & Ren found that ITC extended application platform design and implementation (Fei & Ren, 2020)[6]. The authors draw their conclusions by understanding the new payment model of "Internet + transportation", smart parking systems, and connected vehicle platforms.

Zhang proposed Thinking from the development status of ETC in China (Zhang, 2006)[7]. Zhang analyzes the data used by ETC in China and the phenomenon of ETC standards. Zhang believes that it is urgent to develop ETC standards and also analyzes the problems caused by technical service and after-sales service, as well as the obstacles caused by the manual network charging system.

2.3 Parking Fee and Smart

Yang proposed designing and implementing an Intelligent parking payment system based on the Internet of Things (Yang, 2012)[8]. The author analyzed the Internet of Things technology, RFID technology, and ARM embedded technology, understood the demand analysis of intelligent parking payment systems, collected various data, and finally reached a conclusion.

3 Results

3.1 Development of ETC in Parking Lot

The parking lots in major cities in China have exceeded 3000, more than hundreds of thousands of parking spaces; even if the number of parking spaces and parking Spaces in China is so much, there are still difficulties in parking; parking is a slow situation. And the existing parking charging mode is "miscellaneous, chaotic, and poor". In recent years, with the gradual maturity of parking charging technology, the parking industry has gradually developed in the direction of intelligence. Airports, schools, hospitals, major shopping malls, and other closed parking lots and state-owned roadside parking Spaces are in the intelligent upgrading of the parking charging system; most parking lots have bid farewell to the past pure manual control mode. Its payment mode has evolved from manual or card charging to the intelligent (online) charging stage. Most of China's parking lots have fully entered the intelligent charging stage, but the entire parking industry still has the problem of being "miscellaneous, chaotic, and poor". The main performance is 1. The intelligent parking charging system on the market is varied; there is no unified standard, and it is difficult to form scale effects, so

operators are faced with the embarrassing situation of "spending money but not buying stable equipment". 2. In order to improve the efficiency of parking fee access in parking lots, some parking lots have introduced the way of scanning code and paying in advance, which has improved the parking fee access efficiency to a certain extent. However, scanning code payment in advance involves too much program binding and information authorization, and owners and the public will think that online charging is too troublesome. Hence, the software function of the intelligent parking fee collection system needs to be continuously improved. So, the general trend is the ETC toll system from the highway scene to the parking lot scene.

3.2 Application Cases of Smart Parking System in Singapore(Similar to ETC)

In Singapore, the design and application of smart parking and charging systems align more with China's national conditions and urban development status. Singapore requires vehicles to install RFID vehicle identification cards and requires large and medium-sized parking lots to install unified charging terminals. Adopt a unified toll system, connect to a single settlement center, and share a unified payment platform with the no-stop toll system. In general, developed countries represented by Singapore have fully entered the era of intelligent parking fees and are developing rapidly towards the intelligent management and control platform model. It can also be seen that the expansion and application of ETC technology are of great significance for driving the construction of smart cities.

4 Discussion

First, it can imitate the ETC mode of Chinese expressways, broaden the ETC application scenarios, build a special channel in the parking lot, complete the ETC payment in this channel, and achieve "one second out of the warehouse", solve the problem of inconsistent, non-standard and inconvenient parking lot payment system, and realize the ETC card directly in and out of various parking lots. On this basis, a smart parking application platform can be built, and the parking lot can join the platform and register relevant information (such as location, parking lot size, etc.), Customers can bind their bank card to the platform, and the ID card provided by the platform, without mobile phone payment or cash payment, and the parking lot system can automatically deduct the ID card bound with the bank card according to the parking time and vehicle type. At the same time, considering that the original business model of merchants is generally to reduce parking fees through coupons, the current stage generally adopts the mode of coupon exchange, which is relatively low efficiency. After using the ETC mode, it can be set directly by the merchant side. The merchant can set the deduction amount on the system when the customer has spent a certain amount. The system automatically calculates the discounted parking fee. This can reduce the problem of long parking times and complicated mobile payments.

Second, the construction of a narrower parking lane, only to meet the needs of one car, avoid the use of other people's ETC card, one car, one bar, not crowded and more secure. In addition, the platform is set up to find the payment details of the interface so that as long as the owner of the binding platform, it will record the parking details of the car in the platform, such as which day the car is parked in the parking lot, how much parking fees paid, whether there are preferential conditions and ID card balance and other information, this measure can make the owner more at ease.

In addition, the platform can set a convenience plate according to the pain points of each owner. For example, some owners will forget where their car is parked. At this time, if customers use the car search function of the convenience plate (similar to the shopping mall car search machine, but now the mobile phone can be completed, more convenient than before), the owner can quickly find the location of their car on the mobile phone. Through the parking lot map on the platform, customers can quickly find a car more conveniently than the car machine in the shopping mall. If it is difficult for the owner to find a parking space when parking, at this time, the convenience plate can also help the owner to find an empty parking space according to the parking space displayed on the mobile phone, which is faster than the speed of finding parking Spaces one by one in reality; Sometimes it is also easy for vehicles to enter a full parking lot, which will make the owner find the parking lot again, which is very inconvenient. However, if customers can remember that the parking lot is full at the beginning, they can reduce unnecessary time wasted by the owner. For example, the platform can guide the vehicle to find the nearest, most convenient, and most located parking lot through navigation, rather than entering the nearest parking lot that may not have parking Spaces, and selectively looking for parking Spaces will help the owner save time and find a satisfactory parking space for himself.

5 Conclusion

5.1 Key Findings

In China, the development of ETC on the highway has been relatively mature, and most car owners have begun to use

the ETC system. On the highway, they can identify the payment through the ID card ETC installed in the car, which can greatly save the waiting time of manual payment. In China's parking lot, the current charging methods are mostly online and offline, and special people are responsible for charging. The process of charging online is that customers need to download an APP or small program that is bound to the parking lot, operate on this platform, bind their own car, and then pay the fee. If there is a coupon, they need to redeem it in advance (maybe find a staff member, or the platform can operate directly) and leave the parking lot after paying the fee. Most of the platform operations must be done within the store. Otherwise, if these operations are done while leaving the parking lot, it will cause congestion. Online payments will make driving a car out of the parking lot relatively smooth, but offline payments can be more complicated. In general, when a vehicle enters a parking lot, a machine in the parking lot will record the vehicle's license plate number. When a customer drives to the exit of the parking lot, the machine at the exit tells the owner through the display how much he needs to pay. The owner will need to scan the QR code on the display and pay the fee. For the operator, it costs more money, but the benefits are not obvious. For car owners, online payment is more troublesome; They need to license a lot of apps. The introduction of ETC system in parking lot can solve these problems. Operators can get a big gain with less money, and car owners will have more convenience when parking.

5.2 Research Significance

On the one hand, there are thousands of parking lots in China. If all parking lots can introduce ETC system, it can solve the problem of parking difficulties and achieve the purpose of "no parking charge". The example proves that the application of the ETC charging system in the parking lot can achieve the goal of "reducing personnel input, reducing operating costs and improving management efficiency", and the project's return on investment is relatively considerable and has a good market value. On the other hand, with the rapid development of the Internet, the Internet of Things, and digital technology, the concepts of "smart city" and "smart transportation" have gradually gained popularity, and the promotion and application of the ETC charging system for parking lots can be used as a blueprint for deepening the application of the national "ETC+". In order to create smart city empowerment, drive the rapid development of smart city digital transportation economy so as to realize the transformation of smart city digital transportation economic development mode.

References

[1] Zhang.(2022).Study on ETC charging system applied to parking lot in Kunming City.

[2] Xin.(2021).Application analysis of ETC free flow charging technology in parking lot. Municipal Technology (1),21-23.

[3] Lian et al.(2007). Research on the technology of ETC electronic charging without parking. Computer Engineering and Applications (5), 204-207,210.

[4] Ma. (2015). A brief discussion on the system of charging without parking. Transportation World (Transportation. Vehicle), (1):26-27.

[5] Chen et al. (2001). ETC technology and its development. Highway Transportation Science and Technology,18(3):71-74. (in Chinese)

[6] Fei&Ren. (2020). ETC extended application platform design and implementation. Information Recording Materials, 2019,21(11):148-149.

[7] Zhang.(2006).Thinking from the development status of ETC in China. Transportation World (Transport·Vehicles)(9),66-68,10.

[8] Yang.(2012).Design and implementation of intelligent parking payment system based on Internet of Things.