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Research on Integrated Mobile Payment Technology for High Speed

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Abstract. For the actual need for highway mobile payments, the article proposes an intelligent highway integrated mobile payment architecture. Operations basis of the architecture is mobile payment platform payment management center, mobile payment is the main mode of payment. The mobile payment platform is the transfer station of transactions between users and banks, Alipay, WeChat. Through the application on the Guangxi expressway, the validity and feasibility of the proposed architecture are verified.

1. Introduction

With the rapid development of China's economy, more and more people become cell phone users. The resulting mobile payments have also developed rapidly, its advantages of security and convenience make mobile payment rapidly cover all areas of life, including transfer remittance, online shopping, self-service, public transport, and personal finance and so on. Mobile payment brings convenience to people, will also slowly change people's payment habits.

2016 *The General Operation of the Payment System*, which was published by People's Bank of China On March 16, 2017, shows the rapid growth of mobile payment in China in 2016, it has 25.71 billion mobile payments, with year-on-year growth of 85.82 percent. It has 1575500 billion yuan, with year-on-year growth of 45.59 percent. The amount of mobile payment is 2.12 times the national GDP. Mobile payment has become the most important means of public payment. Therefore, mobile payment will be the most important mode of highway payment in the future. Hunan was the first to build Offline Toll Collection base on mobile payment.

According to the national highway network charging development plan, networked toll system gradually develops from manual semi-automatic toll collection into manual semi-automatic toll collection and electronic toll collection mixed charge mode, to alleviate the serious congestion on the expressway, further improve highway service quality and reduce operating costs.

(1) Current status of mobile payments



With the rapid development of China's economy, more and more people become cell phone users. The resulting mobile payments have also developed rapidly, its advantages of security and convenience make mobile payment rapidly cover all areas of life, including transfer remittance, online shopping, self-service, public transport, and personal finance and so on. Mobile payment brings convenience to people, will also slowly change people's payment habits.

(2) The status of highway tolls

At present, most of China's highway toll is still the traditional manual cash toll model, electronic toll collection was spread to the provinces in the last two years. Electronic toll collection is an improvement over manual semi-automatic toll collection, it provides a very convenient experience for users. However, there are not many ETC users. In order to meet and adapt to the current payment development trend, the toll model of the highway needs to be adjusted accordingly, to meet the user's various payment needs. At present, some provinces have tried to make mobile scanning payment.

In the theoretical research, experts have studied the comprehensive mobile payment from different point of view.

According to the article 1, the application of mobile Internet payment in highway charging scenario under the era background of "Internet +", and put forward the corresponding technical implementation opinion. The paper also introduces the current situation of non - cash highway charges, mobile Internet payment solutions and problems with mobile Internet payment.

According to the article 2, from a systems engineering perspective, introduces the research and implementation of China unionpay mobile payment project. Through the analysis of the characteristics and difficulties of the project, the general requirements and core engineering problems of mobile payment project are summarized, the integration of innovative technology is introduced, and the contradiction between usability and security is solved. In order to improve the efficiency of product release and user experience, rapid iterative development process is adopted.

According to the article 3, taking Hubei province as an example, this paper discusses the application and prospect of mobile payment technology in expressway industry. Different from other provinces, Hubei province has fully considered and studied the characteristics and users of various payment methods when considering expressway mobile payment, and proposed the goal of supporting as many payment methods as possible, and covered all toll stations from the consideration of the whole network.

The article 4 introduces the technical scheme and application of the mobile payment system without stopping on expressways in Shandong province, the main performance and characteristics of the system are analyzed and its application is introduced. The scheme uses Internet payment technology to add no-parking mobile payment function on the basis of retaining the original lane function, which is applicable to all types of lanes and all types of vehicles, and improves the efficiency of toll collection station.

From the three dimensions of public travel industry management and social development trend, the article 4 analyzes the necessity of introducing mobile payment. Based on the reality of Hubei provincial expressway mobile payment, this paper puts forward the expressway mobile payment realization and system solution, constructs the expressway mobile payment system scheme model, and analyzes and studies the model. The characteristics and advantages of this scheme are analyzed from the point of view of POS terminal installation technical scheme and security management measures. Finally, based on the practical application of the scheme, some ideas and Suggestions are put forward in order to provide reference for the decision-making of expressway industry.

The article 6 discusses the necessity and feasibility of the application of mobile payment in expressway toll, and proposes the first technology scheme of scanning code payment in the industry, and introduces the scheme in detail

According to the article 7, based on SIMPass technology, a scheme of mobile payment operation and transaction process in highway toll is developed, the application of mobile phone payment in expressway toll system is presented, and the application of mobile phone payment in expressway toll is realized.

The article 8, 9 and 10 proposes the introduction of mobile payment into expressway tolls, and studies the application of mobile payment in expressway.

The article 11 discusses the mobile payment system of highway without parking from the aspects of application and promotion of key technology system, from the perspective of expressway operation manager, this paper discusses how to cope with the new challenges faced by expressway tolling under the situation of continuous enrichment of new Internet + technology.

2. Research demand

(1) Meet the needs of Internet + convenient transportation

On July 4, 2015, the state council has issued guidance on actively promoting the Internet plus initiative, put forward the key action of Internet + convenient transportation. Our project is designed to meet the needs of Internet + expressway and accelerate the in-depth integration and innovation of Internet and Guangxi expressway toll collection, connect the users, vehicles and road managers through the Internet, implement user self - service application, automatic license plate recognition, cars pass through toll booths without stopping, the system automatically deducts fees and manual or automatic acceptance of road conditions.

(2) The need to improve management efficiency and reduce management cost

With the development of economy and the increase of the number of motor vehicles, the traffic volume and utilization rate of expressways are increasing year by year. Meanwhile, the service quality of expressways is also under pressure, the increase of personnel can no longer meet the needs of toll collection and road management. Great efforts should be made to improve management efficiency, reduce management cost and improve information technology. The implementation of this project can realize non-cash payment and non-parking fees, reduce the input of toll collectors, reduce the cash collection risk and cash management cost, thus improving the management efficiency of expressway and reducing the management cost.

(3) Improve the efficiency of toll station, provide users with a variety of convenient non-cash payment needs

Compared to ETC, which requires the installation of vehicle units and on-site bank contracts, this project uses mobile app to realize self-service online registration and processing, which greatly saves users' time and avoids the inconvenience of on-site installation of on-board equipment and banking, it provides users with more convenient non-cash payment methods other than ETC, leaving the convenience to users. The system also provides technical conditions for future electronic license plate recognition payment.

In this project, mobile phone payment without parking can be realized, which can reduce the traffic time of toll lanes by half, so as to effectively improve the traffic efficiency of toll stations and reduce congestion of toll stations.

(4) The highway intelligence electronics induces system and the need for big data analysis

The system can also push traffic information to the user's mobile phone app, which can voice ahead of time according to the user's location and prompt guidance. The system can also be used as a data source for highway big data construction by obtaining users' information, such as location information of vehicles used to travel. The system provides the basis of big data analysis and mining for road safety management, emergency command, intelligent guiding, aid decision making.

Integrated mobile payment solutions

2.1. Card scanning payment mode

The specific process of integrated mobile payment is highway vehicles are carded in the motorway entry lane, then hand in the card at the exit lane of the highway, then use payment platforms such as WeChat or Alipay to scan the code to pay highway tolls.

The details are shown in the following figure.

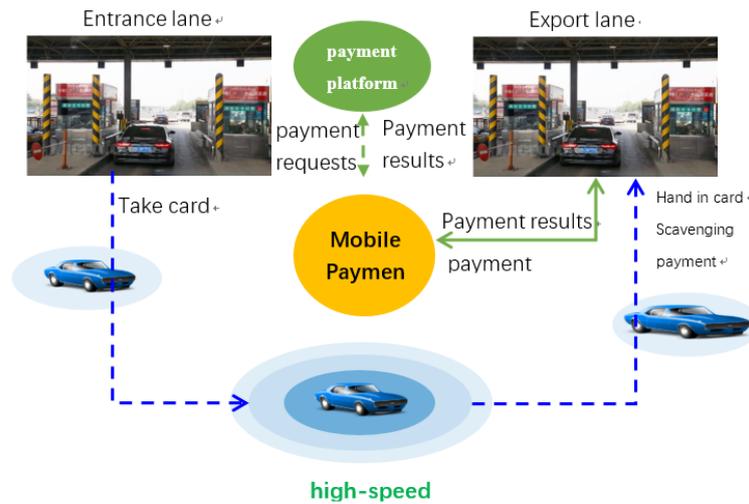


Figure 1. Details of card scanning payment mode

The payment transaction process is as follows.

- (1) The lane system sends scanning results and charges to the mobile payment platform.
- (2) The mobile payment platform records the corresponding lane flow and sends the payment request to the One-card payment platform.
- (3) One-card payment platform (Wechat or Alipay) complete the deduction, the result is returned to the mobile payment platform.
- (4) Mobile payment platforms return the results to the lane system.

Backstage charge logic

The payment transaction process is as follows.

- (1) The lane system sends scanning results and charges to the mobile payment platform.
- (2) The mobile payment platform records the corresponding lane flow and sends the payment request to the card payment platform.
- (3) One-card payment platform (Wechat or Alipay) complete the deduction, the result is returned to the mobile payment platform.
- (4) Mobile payment platforms return the results to the lane system.

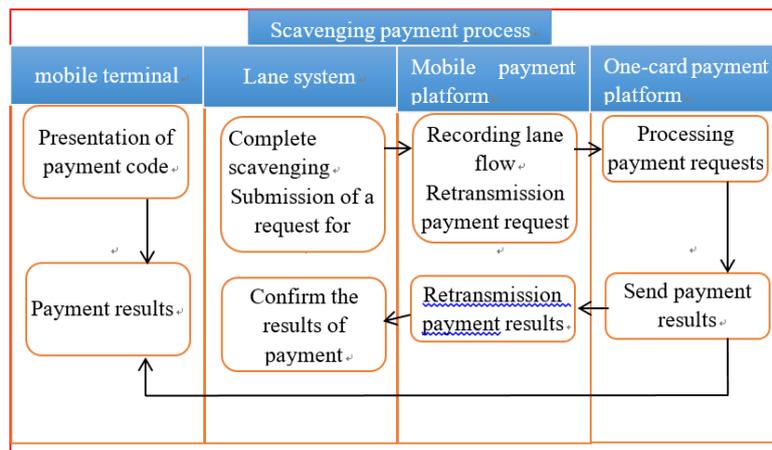


Figure 2. Scavenging payment process

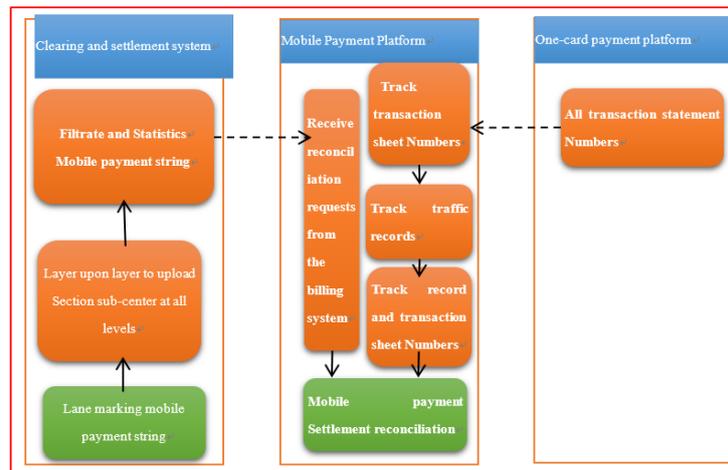


Figure 3. Settlement and reconciliation logic

The payment transaction process is as follows.

(1) Lane markings for mobile payment data

In the existing data of lane charge flow, the mobile payment data of mobile phone should be marked

(2) Mobile payment data screening statistics

According to the marking rules of lane charge flow data, the provincial clearing and settlement system selects mobile payment flow data.

(3) Transaction management of mobile payment platform

The mobile payment platform records and calculates every transaction, checking and binding the transaction information of the vehicle and the transaction sheet number one by one.

(4) Complete settlement reconciliation

The transaction data collected by the mobile payment platform will be checked with the mobile payment data submitted by the clearing and settlement system. According to the information of key fields such as transaction flow number, data matching will be carried out one by one. Finally, the mobile payment funds will be transferred to the owner's remittance account to ensure the fast and safe circulation of the owner's funds.

Invalidate and refund logic on site

If the toll collector fails to deduct the user's amount due to operational error or other reasons during the charging process, the system shall invalidate the transaction flow as soon as possible and return the amount to the user's account.

Invalidate and refund process on site			
mobile terminal	lane system	mobile payment platform	One-card payment platform
	Initiate a request for invalidation.	Initiate a refund request based on the transaction id.	Process the refund request according to the transaction id.
Confirm refund results.	Confirm refund cancellation transaction flow.	Cancel the corresponding transaction flow and inform the driveway staff.	Refund success.

Figure 4. Invalidate and refund process on site

2.2. Get card automatic payment mode

Upgrade the existing charging system using mobile payment technology without affecting the original MTC and ETC business processes. Increase mobile payment platform in the center of the province and distribution of settlement as interactions with the multi-purpose card payment platform, at the entrance at the same time export charge lane software system by the corresponding mobile payment support module, without having to install any additional peripherals, can realize the charge lane online. According to the toll road mobile payment specification, mobile payment platform as a trading center, founded and controlled by the Highways Agency. Steps are as follows.

- (1) Users register on the app and bind the vehicle information and payment account.
- (2) Get card at the entrance.
- (3) Hand in card at the export, and according to the user's choice, choose instant payment or automatic deduction.

The specific process is shown in the figure below.

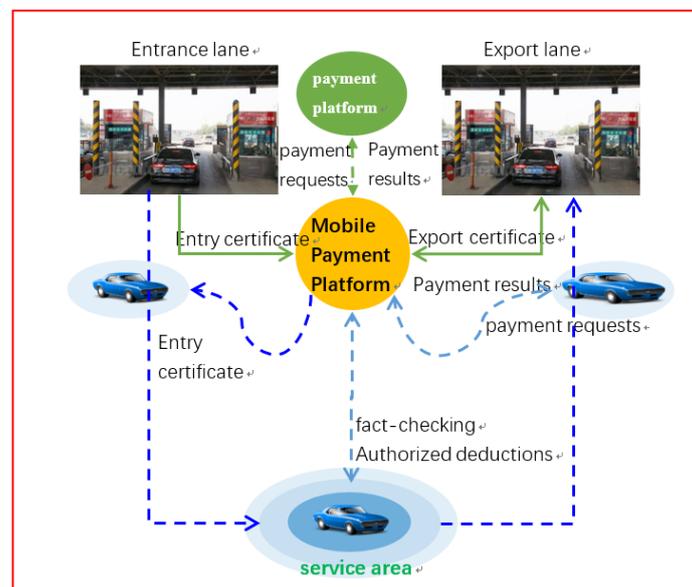


Figure 5. Specific process

The payment transaction process is as follows.

- (1) The lane system sends export certificate information and charge amount to the mobile payment platform.
- (2) The mobile payment platform generates payment requests and sends them to the one-card payment platform according to the export voucher information and the amount of fees, combined with the user's automatic deduction request or online instant payment request.
- (3) One-card payment platform (Wechat or Alipay) complete the deduction, the result is returned to the mobile payment platform.
- (4) Mobile payment platforms return the results to the lane system, meanwhile, the payment voucher is sent to the user's mobile app.

3. application verification

The technical scheme proposed in this paper has been applied and verified in several highway companies in Guangxi.

The vehicle enters from the manual lane, according to the original card issuance process, the toll collector will license car type and other information into the card, give the cards to the car owners and release the vehicles.

4. Conclusion

The comprehensive mobile payment scheme proposed in this paper provides a new payment method for highway traffic, realizing two modes of card scanning payment and card automatic payment, meeting the demand of mobile payment on expressway

The security strategy of mobile payment is the next research focus.

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