Design of Urban Smart Parking Management System Based on Credit System

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Abstract. With the rapid development of national economy, the increase of the number of vehicles and the shortage of parking resources has become the main contradiction of urban parking in China, and the problem of "difficult parking" in cities is becoming more and more serious. Under the joint action of "Internet plus" and sharing economy, "shared parking" comes into being. Shared parking is a solution to the problem of "difficult parking" in cities with multi-party participation and win-win situation, rather than a "single-player game". This paper designed a set of urban intelligent parking management system based on credit system, through the upgrade of the parking lot, parking spaces comprehensive sharing as core business applications, solves the contradiction of large gap of parking spaces, the high vacancy rate of parking spaces,, low utilization rate of resources in advanced technical means to achieve the parking spaces of fine management, achieve the purpose of the urban parking level resource sharing.

Keywords: Credit System · Smart Parking · Shared Parking

1 Introduction

With the rapid development of national economy, vehicle ownership is rising in China. It has become the main contradiction of urban parking in China between the increasing number of vehicles and the shortage of parking resources, and this contradiction is worsening, becoming a pain point of many cities [2]. The problem of "difficult parking" in cities is becoming more and more serious. Increasing the supply of parking spaces is the most direct way to solve the parking problem. The parking gap rate in China is more than 50%, and the average vacancy rate is 51.3%. Existing parking Spaces are not fully utilized, resulting in a serious waste of resources.

How to improve the use efficiency of parking resources to alleviate the problem of "parking difficulty" has become a hot research direction. "Internet+" city smart parking mode is, in the era of "Internet+" through the internet related technologies applied to the traditional parking scenario, to integrate urban parking resources relying on mobile internet, big data, cloud computing and other advanced technology to enhance the level of parking information service, and maximize the parking resource utilization, improve the owner parking experiences and services. Under the joint action of "Internet plus" and sharing economy, "shared parking" comes into being. Shared parking is a solution

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to the problem of "difficult parking" in cities with multi-party participation and win-win situation, rather than a "single-player game". At the same time, smart parking is an important aspect of the construction of smart city.

This paper designs a set of urban intelligent parking management system based on the credit system, integrating the parking resources of the city's closed parking areas such as government parking lots, enterprises and institutions parking lots, commercial parking lots, residential parking lots and so on. Through the transformation and upgrading of parking lots, the basic data information is collected uniformly, and the data of parking berth resources in the whole city are managed uniformly. The comprehensive sharing of parking space is the core of business application, and the contradiction of large parking space gap, high parking space vacancy rate and low resource utilization rate is solved. The refined management of parking space is realized by advanced technical means, and the goal of city-level parking resource sharing is achieved.

2 Design of Urban Credit System

Shared parking system Based on parking resources in enclosed parking areas such as government, enterprises and institutions, commercial area, and community, The biggest difficulty is how to ensure that parked vehicles in accordance with the rules of orderly parking, not overtime, not disorderly parking, does not affect the normal operation of the unit. In order to solve this problem, we designed a set of credit system, based on the shared parking behavior of urban residents, to regulate residents' parking behavior.

The credit system was initially widely applied in the financial field, and later extended to other fields such as government affairs and social services, which is the necessary foundation for the development of social commerce. In order to ensure that shared parking behavior does not affect the daily work of each unit, the credit system should not be too complicated.

We simplify the credit system and design a set of credit system suitable for shared parking, which is only linked to residents' shared parking behaviors, and standardizes people's parking behaviors through credit scores to achieve the purpose of management. The credit system does not conflict with the city-level/national-level credit system, nor is it linked with it for the time being. It is only used within the urban shared parking. In the future, with the development and classification of urban credit system, it can be considered to connect to the platform of urban credit system.

The credit system is only linked to the daily activities of shared parking, not economic activities. The system is only available to resident residents of the city who participate in shared parking activities, and rewards and punishments will be given based on whether or not they park in accordance with regulations. Aliens and vehicles are not allowed to participate in shared parking activities [5] (Fig. 1).

The design of the credit system is as follows:

a) Only local residents have the qualification to register an account, and people outside the city cannot register and enjoy the shared parking service;
b) Only registered users can use the shared parking service with their real names.

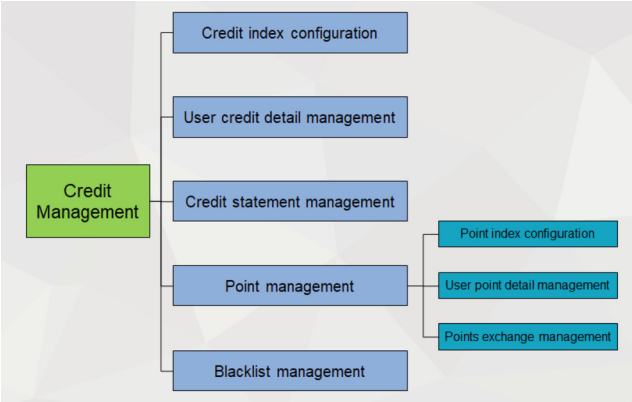

Fig. 1. Subsystem of Urban Credit System

c) The personal information required for real-name authentication includes: name, ID number (photo uploading), phone number (SMS verification), license plate number (driving license), home address (house ownership certificate) and other relevant information.
d) In principle, only locally licensed vehicles will be considered to provide convenience services and welfare policies for people living and residing locally. Local residents shall provide id cards, and non-local permanent residents shall provide property ownership certificates. The unit may collect personal information and issue a certificate collectively to the resident who works locally and does not own a local house [3] (Table 1).

Table 1. Design form of Credit System

Authentication level	Basic materials	Identity Card Requirements	License plate Number (vehicle license)	Other
Registered user	Name & telephone number	/	/	/
Authenticated user	Name & telephone number	ID card	Local license plate & driving license	/
Advanced User (Local resident)	Name & telephone number	Local ID card	Local license plate & driving license	/
Advanced Users (non-resident residents)	Name & telephone number	ID card	Local license plate & driving license	property ownership certificate
Advanced Users (Enterprise collective registration)	Name & telephone number	ID card	Local license plate & driving license	Enterprise collective register table

Different parking scenarios have different safety requirements for parking management. The system will establish the certification level system, according to the commercial area, community, enterprises and institutions to improve the level in turn. See the following table for details (Table 2):

Table 2. Design form of Certification Level System

Scenario	Certification Level Requirements	certification requirement	certification materials	Overdue/blacklisted vehicles
commercial area parking lot	registered user	register	telephone number	information cue
community parking lot	Authenticated user (Local License plate)	real name authentication	Id card, driving license and registration, telephone number, property ownership certificate	information cue
Government or enterprise parking lot	Advanced users (Local License plate & Local Resident)	real name authentication	Id card, driving license and registration, telephone number, property ownership certificate, Enterprise collective register table	No Entrance

a) Users can register and improve the certification materials to improve the certification level.
b) If the parking time exceeds, the owner of the community or the staff of the unit will be affected to park normally, the first contact to move the car;
c) If the user refuses to move the car or the car is parked for a serious time, corresponding restrictions and punishment measures will be taken: deduct the platform credit points (percentage system) of the reservation application owner, and the user and the vehicle will be added to the system blacklist.
d) After the vehicle is locked on the blacklist, it will not be able to enjoy shared parking service for a period of time (3 months). After the penalty period expires, they can use the service again, and if they do it again, they can never use the shared parking service.
e) Provide account points for punctual car owners, increase account points and redeem coupons later.

The parking behavior of all vehicles will be retained in the system in the form of points and credit points, which will affect the service level of vehicle and personnel parking sharing.

For specific point management, please refer to the following Table 3: [1, 4, 6].

Table 3. Parking behavior credit system design form

Scene Classification	Notifications	Punitive Measure	Remark
punctual visitors	/	/	Account points plus 1 point
15 min before finish	WeChat, Application	/	/
Overtime less than 30 min	WeChat, Application and short message	Minus 10 credit points	Credit Score Below 60 to join the blacklist
Overtime less than 2 h	WeChat, Application and telephone	Minus 20 credit points	Credit Score Below 60 to join the blacklist
Overtime less than 6 h	WeChat, Application and telephone	Minus 40 credit points	Credit Score Below 60 to join the blacklist
Overtime more than 6 h	WeChat, Application and telephone	Drop the credit score to zero	Drop the credit score to zero and join the blacklist

3 Key Module Design of System

3.1 Overall Architecture

The overall architecture of the whole system is divided into five areas, which are successively from bottom to top: in-road parking data collection area, off-road parking data collection area, urban parking application service area, car owners' public service area and data exchange service area [5]. In addition, it reserves with illegal stop evidence capture system, urban traffic guidance system, charging parking integration system (Fig. 2).

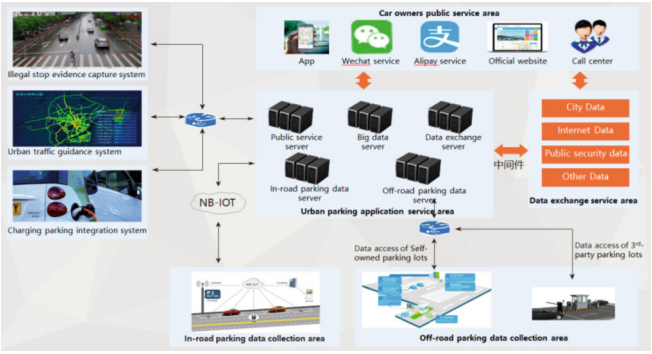

Fig. 2. The overall architecture of the whole system

3.2 Shared Parking Process Design

Shared parking requires car owners to register and verify their vehicle and personnel information in the mobile APP in advance, and complete the real-name authentication.

Free parking Spaces will be provided on "first come, first served" during shared parking hours. Car owners can also navigate by looking for free parking Spaces on their mobile apps. After parking, you can pay by yourself in the mobile APP or set it to automatic deduction. The exit camera recognizes the license plate and automatically clears (Fig. 3).

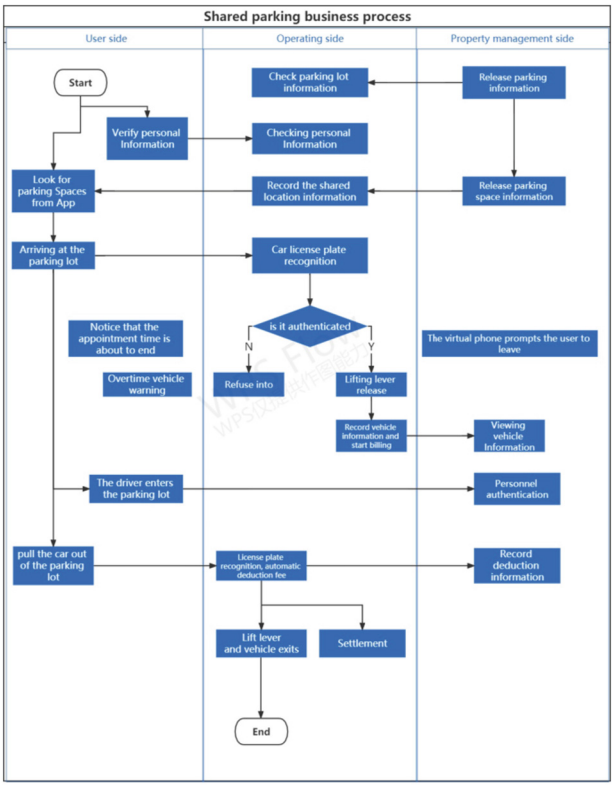

Fig. 3. Shared parking business process

3.3 Design of Main Business Functions

As shown in the figure, the urban shared parking system is divided into six subsystems and eight functional modules. Among them, the core subsystems used in the shared parking scenario based on the parking lot of enterprises and institutions are parking sharing network operation system, public service system, big data analysis system, and the core functional modules are resource management, user service, etc. (Fig. 4).

Parking Sharing Network Operation System

The system manages shared parking services, including management of shared parking Spaces and shared time, shared parking management and records, shared parking statistics and analysis, etc.

Fig. 4. Structure of Parking Management Platform

Public Service System

The system includes user APP and Wechat public account, which provides parking public information service and value-added service for parking owners and the general public through road guidance system, mobile APP and Wechat public account. Car owners can use the public service system for registration, real-name authentication, shared parking, online payment, route navigation and other related services.

Big Data Analysis System

Parking big data analysis system is business data storage and processing results, data mining, refining, analysis of the main body, according to the size of the data, the accuracy, completeness, value factors such as the hierarchy of all data logically from coarse to fine is divided into three levels, namely the basis of data layer, business layer, data analysis and mining. Among them, the basic data layer mainly saves all kinds of basic data in different formats. These basic data come from the public basic data of roadside parking services, such as car owners, vehicles, berths, accounts, members and other data systems, which are summarized and stored through the cloud as the bottom support data of parking business. The business data layer mainly manages the operation and maintenance process and platform configuration data, such as parking records, payment records and recharge records generated in the parking process. After data association analysis of basic data and business data, part of the result data will be stored in the data analysis and mining layer, so as to form operational indicator data, and further calculation and processing of report data.

Resource Management System

Intelligent transformation of parking lot, the combination of license plate video recognition technology and high-speed video image shooting, storage and comparison, to achieve accurate real-time management and monitoring of every parking space based on intelligent image recognition. It is of precise management and authorization of parking behavior of vehicles with different identities. For example, for the firefighting truck, police car and other special vehicles to be managed as the white list, so that they can enter all the shared parking lot; For licensed vehicles, conduct behavior analysis through big data, and directly send alarms when encountering vehicles suspected of licensed vehicles, and confirm through manual analysis; For the control of vehicles, the strategy

of "allowing in and not allowing out" is adopted. As long as the car is detected by the system, the system will send alarms and notify the public security, traffic management and other relevant units.

Fully integrate all the berths, including in-road berths, parking berths and social berths, realize the management of all the berths and provide various parking services for the whole city.

User Service System

User service system includes vehicle information management, user authentication, and financial management, including user credit system and user point system. There are three modules, specific functions as follows:

- Vehicle & user management: data statistical analysis, user management, vehicle management, financial management, complaint management, system management;
- User credit system: user behavior analysis, credit index setting, connection with credit investigation system, user credit details;
- User point system: point index configuration, point system design, point details.

3.4 Shared Parking Safety Design

Parking sharing platform needs to share the original private parking resources of business circles, communities and enterprises and institutions. The internal safety of parking lots and the safety of owners and vehicles is an issue that we have to consider carefully. In view of safety problems, it is suggested to adopt high-level and strict safety audit scheme in the early stage of shared parking operation to improve the public's awareness of the safety of shared parking.

For parking lots connected to the parking sharing platform, related management units can choose the number of shared parking resources based on their own actual situation and management system, and participate in the parking resource sharing service to the maximum extent on the premise of ensuring safety and not affecting their daily operation.

We solve security problems through the integrated management of user authentication, integral system and credit management. After the operation of shared parking has been gradually accepted by the public for a period of time, it can be considered to shorten the audit time for some high-quality users and improve efficiency. Wait for conditions to mature, and then fully open.

Commercial Area Parking Lot Safety Design

As a public place, the management of vehicles in and out of the business area is relatively loose. The commercial demand should also attract passenger flow and improve the convenience of car owners. The monitoring equipment construction of commercial area is relatively complete, and the management personnel are specially equipped. Therefore, the certification requirements for car owners are low. Register with a valid mobile phone number in APP or Wechat public account to obtain verification code for login. Register by mobile phone number, also can contact users in time.

Community Parking Lot Safety Design
The community is generally only open to owners, and for safety and management reasons, outside vehicles need to be strictly controlled. Therefore, for car owners who need to share parking, real-name authentication must be required, and the correct license plate number must be bound to ensure that the user's vehicle information is true. Car owners need to upload information on the mobile APP, pass the platform's review and complete the "human-vehicle certification", and become certified users before they can use the parking sharing function. Discredited car owners and blacklisted vehicles will be restricted from sharing parking services.

Government, Enterprises and Institutions Parking Lot Safety Design
As is known, for government, enterprises and institutions, With the exception of external departments, these areas, having the highest safety requirements, usually only allow internal vehicles to enter and are not open to the outside world. Therefore, only advanced users who have completed real-name authentication can obtain the shared parking resources. This strategy limits the number of people entering and leaving from the source and reduces the difficulty of management. In addition, need to increase the two-dimensional code scanning equipment in the duty room or pedestrian passage, car owners in and out of the parking lots need to show the mobile phone two-dimensional code scanning code verification, and reserve to increase face recognition function. Dishonest car owners and blacklisted vehicles are not allowed to use shared parking in government, enterprises and public institutions.

4 Conclusions

Through the design of credit system based on shared parking behavior, the daily parking behavior of shared parking users is standardized, the efficiency of parking resources is improved, the parking cost of citizens is reduced, and the social harmony is promoted. However, the credit system only considers the sharing of parking this small scene, the overall limitation is very large. In the future, other daily behaviors of citizens can be included in the credit system, expand the scope of application of the credit system, and urge everyone to abide by the convention and norms of daily behavior.

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