Design of shared parking system based on Internet of Things technology

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Abstract: In order to maximize the use of parking resources and realize the sharing of parking Spaces with staggered peak, users' idle parking Spaces are published on the APP in their spare time, so as to solve the problem of difficult parking. The key lies in the visualization of parking information and the sharing of parking Spaces with parking locks and online APP by using the Internet of Things technology. Remote booking and unlocking of parking lock can be realized through mobile APP, so as to bring convenience to people's travel and improve the utilization rate of urban parking space.

1. Introduction

With the rapid development of China's economy, the contradiction between the increase of the number of motor vehicles and the shortage of parking Spaces is becoming more and more prominent. According to the traffic management bureau of the Ministry of Public Security, the number of motor vehicles in China reached 372 million in 2020, including 281 million cars, and the number is still growing rapidly. The government has also invested a lot of resources to alleviate the urban congestion problem, such as building parking lots and planning more roadside parking Spaces, but the urban congestion problem has not been solved.

In order to alleviate urban congestion and improve the utilization rate of parking Spaces, it is very necessary to share parking space information. The concept of parking space sharing is to use the technology of the Internet of Things to input all the parking space information into the background of the system, and publish and share the parking space information through the background. This paper proposes a Narrow Band Internet of Things (NB-IoT) communication module based on Internet of Things (IoT) mode, and OneNet, an open PaaS IoT platform created by China Mobile, is used to send instructions. The real-time feedback data of the parking lock will be sent to the background, and the background will conduct centralized management and publish the parking status information on the mobile APP, so as to facilitate the user to choose the appropriate parking space and avoid the owner driving detour distance because of looking for a parking space, which will waste time and cause road congestion.

2. The existing problems of the parking space

With the rapid increase of car ownership, the contradiction between urban cars and parking Spaces has become increasingly prominent. In cities with a lot of land, underground parking lots and ground multi-storey parking lots, which occupy less land and have a large capacity, have become more and more important means to relieve the urban parking pressure. However, at present, many domestic parking lots are still in the primitive manual management stage, which has caused great troubles to both the car owners who need to park and the operators of the parking lots.

At present, the common problems in the parking lot are:

1. The manager knows nothing about how many parking Spaces are available in the venue, so he has to rely on manual investigation.

2. After entering the parking lot, the car owner cannot find the parking space quickly and conveniently. Instead, he can only search for the empty parking space in the field disorderly, which

not only occupies the resources of the main lane from the yard, causes traffic congestion, but also wastes a lot of time and energy of the car owner.

3. After the car owner parks in a strange parking lot, finding a car becomes another big problem for the car owner.

4. A large number of full-time managers must be equipped to guide vehicles to park in the parking lot, increasing the cost of parking lot management;

5. The manager cannot timely count the traffic flow of different periods every day, and cannot timely optimize the allocation of parking resources, resulting in low utilization rate of parking lot.

3. Necessity of intelligent parking system in the sharing economy

The emergence of cars greatly facilitates people's life and brings people a comfortable experience, but the increasing number of cars has brought no small test to urban traffic, parking difficulties, parking disorder, traffic congestion and other problems.

The traditional parking lot still uses the manual charge, greatly increases the labor cost, basically causes the parking space can not leave the person, greatly increases the cost of the parking place owner. For example, when office workers leave the community to go to work, the parking Spaces in the community are vacant, and others can not stop, which results in a waste of resources. Generally, people have to park on the roadside without parking Spaces, which leads to urban traffic congestion. Therefore, it is very necessary to carry out systematic management of these parking Spaces, which can not only alleviate urban traffic, but also bring some benefits to the owners and make contributions to the rationalization of urban resources.

4. Hardware parking lock design

4.1 Principle of Parking Lock

The intelligent parking lock structure based on the shared concept is mainly composed of the main control unit single chip microcomputer, Bluetooth module, GPRS communication module, infrared limit switch, ultrasonic detection module, intelligent voice chip, relay, DC motor, transmission gearbox, vehicle lock arm, step-down voltage regulator module, Bluetooth or GPRS communication module, etc. When the user arrives at the parking space, the user can unlock the parking space through the mobile APP. At the end of the parking and after the user leaves, if the ultrasonic detection module of the parking lock does not sense the vehicle, it will automatically recover, or the user can recover by himself at the APP end.

4.2 Shared parking space lock modeling analysis

Product modeling design needs to be responsible for our society, not just to design a product with a high level of appearance, good-looking is only the most basic stage of our design, which also includes materials and colors, which is also the primary stage of design -- instinct level of a very important factor. At the same time, we also need to consider whether the product is easy to use, to consider the function of the product, visibility and a user's feeling when using it. Only when we pay attention to rationality and sensibility at the same time, can we design a product that is praised by people. The use of both beautiful and durable aluminum alloy material, so that the product has a longer service life, but also can adapt to different indoor and outdoor scenes. The product adopts a yellow and black color scheme for color. Yellow mainly plays a striking role. Even in bad weather, users can quickly notice this product. At the same time, the other parts of the black color can play a dirty role.

4.3 Structure design of shared parking lock

In parking lock rocker arm used in the structural design of the parking lock, so the design of the first is the simplest and the most cost savings, at the same time he is the best, only need a simple built-in rotating device can work normally, materials with high die casting aluminum alloy ADC12 materials, high die casting molding, product structure is more stable, more strong. At the same time, it

can also take into account the problem that the user accidentally hits, when it is hit, it can automatically fall down along the force direction, and give an alarm to prevent damage to the vehicle.

5. Design Concept and Functional Analysis of Parking Sharing APP

APP is an important link in the intelligent parking system, and it is an important bridge to communicate the parking owners and car owners. The convenience of his use process is particularly important. The users of park-sharing apps fall into two categories: car owners looking for a parking space, and owners renting out their spare Spaces. According to the different needs of these two types of users, there will be different functional design.

5.1 Fast screening of appropriate parking Spaces

According to user interviews, price and distance are still the first considerations of users. The built-in price filter can quickly filter the price range that users do not consider. The price screening function is placed on the top of the card, which makes it easy for users to adjust the screening range again, and reduces the number of parking lots displayed, reducing the time cost for users to screen parking places.

After selecting the drop-down menu, it will display information such as the evaluation of a parking space, the distance, and the deadline for sharing time. Users can make choices according to the length of sharing and their own parking arrangements. According to Sigg's law, the drop-down menu only shows the details of the three parking Spaces that have been shared for the longest time, so that users can make a choice and judgment.

5.2 Parking reservation

After determining the target parking space, it can be reserved for 10 minutes. The parking space is reserved for the user within 10 minutes, and the user can arrive at the specified location to park within a specified time. If the parking space can not be found, there is also the function of parking lock voice honking, which can help the user determine the location of the parking space faster. Users can cancel at any time on the app if their plans change.

5.3 Parking navigation

After booking the parking space, the user can directly navigate to the target parking space in the APP, which avoids the user having to cut out other interfaces to navigate after booking the parking space, and simplifies the user's operation steps. The APP will automatically plan out the most convenient route for different complex terrains in the community.

5.4 Parking status query

The APP can visually display the parking status for users, and users can see their vehicle information, parking time, parking amount and other information. And when it is difficult for users to find their own car in the parking lot, it also has the function of honking for parking space and navigation, so as to avoid bringing trouble to users.

5.5 Inquiry of income details

Owners can intuitively view their income details in the APP end, and show their monthly income through the way of graph, so that users can have a clear comparison; At the same time, you can also view the basic information of each parking user in their own parking space. In addition, different scenes can be set in the card bar. For example, users may have two parking Spaces at home and in the company to share, and different parking information can be switched through the APP.

6. Technical innovation of shared parking Spaces

6.1 Innovation of unlock method of shared parking space

Different from the traditional Bluetooth connection unlocking method, this parking lock adopts the Narrow Band Internet of Things (NB-IoT) technology. Relies on the open platform of China Mobile Internet of Things to send instructions, the parking lock will send data back to the cloud platform, so as to realize the centralized management of data. Compared with the traditional Bluetooth connected parking lock, the parking lock based on IoT technology has higher fault tolerance, shorter unlocking time and more convenient use. In the whole process of parking, and then time charging, the lock using acoustic positioning and light sensing device double positioning equipment, once sensing the car left the parking space after 10 seconds will automatically lock, and automatic settlement, to avoid the user after leaving also need to open the mobile phone for settlement. When the owner leaves the shared parking space and stops using it, the parking lock will automatically lock again after paying the corresponding parking fee on the phone. In the whole process, the innovative design of parking unlocking method greatly improves the user's efficiency.

6.2 Function innovation of parking space sharing APP

Parking space sharing APP can display the status of parking space, the status of parking lock, the exact position of free parking space, booking parking space, navigation and other rich functions in real time. Only by visualizing the information that users are most concerned about on the mobile APP can car owners have a good user experience. At the same time, the parking lock has low power consumption, long standby time, and can be used for several months after a charge, which brings convenience to the follow-up maintenance.

7. Conclusion

In the city car ownership surge, parking lot construction is difficult environment, the problem of parking space shortage has not been solved, so reasonable use of resources is the key, only to improve the utilization of parking space to solve the problem of parking difficulty. Based on the concept of "sharing economy" and Internet of Things technology, this paper proposes a plan to realize parking information visualization based on mobile terminal APP development technology, so that the functions of parking space information acquisition, reservation, unlocking and checkout can be realized on the mobile terminal. Automatic unlock way and the method of payment is greatly improve the efficiency of parking, at the same time, let users to share of spot, not only can bring benefits to users, at the same time also can raise the utilization rate of parking Spaces in the largest extent, alleviate the problem of city "parking", in line with the green and the concept of sustainable development, to promote the wisdom of the city construction to provide a set of feasible solutions.

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