

Discussion On Intelligent Parking System Based On NB-IoT Technology

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Abstract

Narrowband Internet of Things (NB-IoT) has the characteristics of low power consumption, wide coverage, low cost and large capacity, and has become a research hotspot in the field of Internet of Things. For intelligent parking systems, NB-IoT can cover indoor or underground parking lots that cannot be covered by traditional wireless technology, and the data transmission is good, which is more in line with the rapid development trend of social development. This article studies the intelligent parking system based on NB-IoT, which utilizes NB-IoT technology, cloud storage, and big data technology to achieve functions such as online parking space search, parking space reservation, and reverse parking search, contributing to the development of smart cities and smart lifestyles.

Keywords

Intelligent Parking System, NB-IoT.

1. Introduction

With the development of cities, the number of motor vehicles continues to grow, but the growth of parking spaces is far from keeping up with the growth rate of cars, with a huge gap. The car owners are suffering from the problem of parking difficulties. According to research, the average time required to find a parking spot in a city is 4-12 minutes, which is longer in first tier or mega cities in China. When entering and leaving a parking lot with tight parking spaces, it is necessary to wait in long queues, which is a waste of time. When the waiting queue is too long, it will hinder normal traffic flow, leading to chaos such as lane changing, congestion and illegal parking, which brings difficulties to the construction of a civilized city or urban management and affects the healthy and harmonious development of the city. At the same time, vehicles parked and changing lanes indiscriminately will increase the probability of traffic accidents. The exhaust emissions from queuing vehicles idling for a long time can seriously affect environmental hygiene. Moreover, due to the non-public nature of parking space information, a large number of parking spaces are idle without guidance. On one hand, there is a high demand for parking spaces, and on the other hand, there is an idle parking space. There is an urgent need to utilize modern new technologies to solve this problem, achieve intelligent parking, and contribute to the development of smart cities.

With the progress of science and technology, the Internet of Things technology has begun to go deep into all walks of life. For the parking system, there are currently a few systems that use Internet of Things technology to achieve intelligent parking, but most of them use semi-intelligent + semi-artificial management, and the technology realization is combined with RFID, GIS, GPRS, ZIGBEE and other technologies. Due to the limitation of urban land use, a large number of parking lots are now underground or indoor. When these technologies are used underground or indoors, their signal coverage and penetration capabilities will be greatly

reduced due to the shielding of buildings. The degree of intelligence and real-time can not keep up with the development of society and cannot meet people's needs.

NB-IoT (Narrow Band-Internet of Things) is a narrow-band Internet of Things technology based on cellular network defined by 3 GPP, with the characteristics of low power consumption, wide coverage, low cost and large capacity. In terms of low power consumption, the battery standby time of NB-IoT terminal modules can be up to 10 years; In terms of wide coverage, NB-IoT gains 20dB over existing networks in the same frequency band, expanding its coverage area by 100 times. It is expected to cover areas where signals are difficult to reach, such as underground garages, basements, and underground pipelines; In terms of low cost, the cost of NB IoT modules is lower than that of 2G modules, and it is expected to be within 10 yuan after large-scale application; In terms of large capacity, NB-IoT single sector supports 10 0,000 connections, which is 50 to 100 times of traditional connections. Due to its unique advantages, NB-IoT has begun to be tested in various industries, especially in vertical industries. So applying NB-IoT technology to intelligent parking system is of great research significance. Combining the advantages of NB-IoT technology to realize intelligent parking can greatly facilitate car owners to drive out, save time, reduce economic losses caused by illegal parking, at the same time can improve the utilization rate of parking spaces, reduce the management cost and benefit parking operators. This article applies NB IoT technology to parking systems and explores intelligent parking systems based on NB IoT.

2. Intelligent parking system architecture based on NB-IoT

In the intelligent parking system architecture based on NB-IoT, the lowest level is composed of data collection and equipment control. The data collection collects the core business data from devices, such as the status information of the parking space, which is an event-driven passive acquisition mode. Equipment control refers to business operations such as configuration modifications and control commands initiated by the upper layer application to the equipment. The core business framework mainly abstracts the core business parts such as parking status (whether there is parking), timing / billing, event management, and event / notification push based on message push. In order to support business applications in different upper layer application scenarios. The top-level business directly interacts with users (including natural persons and third-party systems). Including display system, the occupation of parking space, and real-time display of distribution of idle parking spaces ; PDA parking charging system; Third-party payment can include a variety of payment types, such as WeChat, Alipay, etc., which are internally mapped to the core business of charging; The credit investigation system / traffic police system mainly links the information of illegal and irregular vehicles with the owner's credit through the credit investigation system, and reports the information required to be reported to the traffic police system through the traffic police system; The APP self-service parking system can be divided into two categories: car owners and charge inspection, achieving services such as parking space search, parking space reservation, automatic car finding, mobile payment, and user registration. The cloud computing center realizes the cloud storage of massive data, and uses big data technology, data mining, deep learning and other technologies to make statistics and analyze the stored data, so as to provide support for the upper-level business and application.

3. Intelligent parking system function based on NB-IoT

The intelligent parking system based on NB-IoT can realize the following functions:

3.1. Real-time release of parking space status

Using detection technology for real-time monitoring of parking space in the area, and transmitting the detection results to the cloud computing center through NB-IoT network. The cloud computing center stores the received huge amounts of data in the cloud, at the same time uses big data analysis, data mining, deep learning and other technologies to analyze and statistically analyze the stored data. Finally, the results, such as the availability of parking spaces, are published in real-time through apps, web pages, induction systems and other means, making it convenient for car owners to obtain the status of parking spaces, reduce the time for parking, and achieve convenient parking.

3.2. There are various ways of payment

It can adopt various payment methods, such as on-site manual payment, on-site self-service machine payment, mobile APP self-service payment, advance payment deduction, etc. At the same time, it can provide an interface with third-party payment to support various payment methods, such as UnionPay cards, Alipay, WeChat, etc., so as to facilitate car owners to flexibly choose payment methods. Confirm the payment status of the vehicles leaving the parking lot, and vehicles that have already paid their fees on their own will automatically lift the bar for passage; For the advance payment customers, the system automatically calculates the total parking fee based on the entry and exit time and billing method, deducts the fees, and lifts the pole for clearance; Vehicles with insufficient prepaid balance that have not been paid will be manually charged for parking and cleared by lifting the pole. In the early stage, measures can be taken to encourage car owners to pay for self-service, develop the habit of self-service payments, reduce the departure time of car owners, and reduce labor costs.

3.3. Diversified ways of information release

The status of parking spaces and charging information can be released through APP, web page, operation management system, induction system and other ways. APP can be divided into two kinds: charging inspection APP and car owner APP. The charging inspection APP is mainly provided for toll collectors or inspectors to use, which can realize functions such as license plate scanning, incoming car reminders, and QR code charging; The car owner APP is mainly provided for car owners to use, which can realize parking space reservation, idle parking space query, parking navigation, parking (pre-paid) payment and other functions. The web page can achieve the same functions as those of the APP, and the display mode use web page display. The operation management system provides real-time parking space leisure and occupation, supports user registration, quick recharge, overdue payment, violation inquiry, charge reconciliation, operation rate analysis and other columns, mainly provided for the parking lot management personnel to use. The parking lot management personnel can publish real-time information on parking space availability, billing, etc. through other means such as Weibo, Twitter and induction systems according to the real-time operation of the parking lot, facilitating car owners to understand the status of the parking space through multiple ways and freely choose whether to park or not.

3.4. Parking guidance

The real-time occupancy of parking spaces is guided by various information guidance such as guide screens, car owner apps, websites, etc., to release traffic information to the public in real time, enabling car owners to quickly find parking spaces, greatly improving the efficiency of parking, saving time for car owners, reducing traffic congestion, effectively improving the condition of parking difficulties, and improving the parking space utilization. The published information content includes: empty parking space information, location information, charging standard of each parking lot, etc., such as: XXX parking lot, XX spare parking spaces, charging standards: 2 yuan/hour, XXX meters away from you. The guidance system adopts a multi-stage

guidance screen for guidance, gradually guiding vehicles from the periphery of the area to a specific parking lot from far to near, from outside to inside. At the same time, GIS and other technologies can be integrated with various map systems to directly display the parking space information and navigation on the map. The display of parking spaces from far to near can be updated in real-time. After entering the parking lot, the specific idle parking space can be displayed and guided in combination with the indoor navigation system.

3.5. Equipment control and management

Feel the occupation and idle state of the parking space, the capacity of the equipment collect battery in the real time, and alarm the abnormal state in advance, timely inform the parking lot management personnel for maintenance when the abnormal occurs. In addition to the above functions, this system also supports car owners to perform the functions such as parking space inquiry, parking space reservation, and reverse car search. Before arriving at the destination, car owners can use the mobile parking app, mobile map, website, or the parking guidance display screen on the main line to understand the availability and pricing of parking spaces near the destination in advance, make a reasonable choice in a timely manner, save car owners time, alleviate traffic congestion, and reduce exhaust emissions. At the same time, it supports reverse car search services. For large parking lots, there are many spaces, and when car owners are preparing to leave, they spend a lot of time on search for cars. This system can combine the parking distribution, owner vehicle information, and indoor and outdoor navigation systems to achieve reverse car search services, saving car owners time and improving the utilization rate of parking spaces. The intelligent parking system can also give users different rights to provide parking space reservation services for car owners with good credit investigation or VIP customers in parking lots when parking spaces are tight. These car owners can book parking spaces in advance to improve their user experience. At the same time, due to the interface with the credit investigation system and the traffic police system, the bad behaviors of malicious illegal users can be associated with the credit investigation system. The bad behaviors include irregular parking, uncivilized parking, malicious arrears, and other behaviors; Timely report the vehicle situation or event that needs to be reported to the traffic police for handing or knowledge to the traffic police system.

4. Advantages of the intelligent parking system based on NB-IoT

The intelligent parking system based on NB-IoT has the following advantages:

4.1. High real-time performance

Due to the low frequency of NB-IoT technology, the low frequency signal has stronger penetration ability, so in the indoor or underground parking environment, this system has better coverage, shorter data transmission delay, and real-time update display of parking space status.

4.2. High accuracy

This system adopts cloud storage technology, which can store massive amounts of data. When the amount of data is large, big data technology can be used to analyze and statistics the stored data, analyze user's behavior habits, analyze the operation of parking lots, etc., which is convenient for the parking operation department to manage and improve the accuracy of messages, advertisements, and other push notifications. Using data mining and deep learning techniques based on massive amounts of data for analysis can result in more accurate results compared to small data analysis.

4.3. Easy to use

This system facilitates car owners to query and book parking spaces,reverse car search online through various means,and support a variety of charge management means.It can greatly improve user satisfaction and bring convenience to car owners while driving.

4.4. Easy operation and maintenance

This system adopts a fully wireless structure,with simple installation and real-time monitoring of equipment status.In case of abnormal equipment status,it can actively report to the operation and maintenance center,as well as monitor non-standard and uncivilized parking phenomenon. At the same time it can report to the operation and maintenance center or credit reporting system and the traffic police system for intelligent management,saving operation and maintenance costs.

4.5. Efficient management

Effective integration of massive parking data support the management department to realize the unified planning and management of parking resources, especially after the large-scale use of the system, this advantage is more clear.

5. Conclusion

By exploring the intelligent parking system based on NB-IoT,using the advantages of NB-IoT technology, combined with emerging technologies such as cloud storage and big data,this system can be applied to indoor or underground parking lots that traditional technologies cannot cover.The real-time data transmission is better,and the status of parking spaces can be displayed accurately in real time.It also supports car owners to query parking spaces,book parking spaces and search for cars in reverse through a variety of ways,saving car owners time,alleviating traffic congestion,reducing exhaust emissions,and contributing to the development of intelligent traffic and smart cities.

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