

# Design of Parking Intelligent Navigation System Based on Internet of Things NB-IoT Technology and ZigBee Wireless Network Technology

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**Keywords:** Internet of Things NB-IoT technology, ZigBee wireless network technology, Parking lot, Intelligent navigation, System design.

**Abstract:** The intelligent operation management of the parking lot by means of modern information technology can help users quickly find parking spaces, save parking time and effectively improve the user experience. However, the technology of the parking lot intelligent navigation system has achieved efficient operation and management of the parking lot, but there are certain problems to some extent, and the user service experience and demand satisfaction are poor. Based on this, based on the related research of the navigation function navigation system of the parking lot, based on the related theories of Internet of Things NB-IoT technology and ZigBee wireless network technology, this paper analyzes the two technologies in the design of parking lot intelligent navigation system. Apply strategy. The fingerprint positioning module, the parking space detection module and the navigation route planning module are designed by using two new technologies, in order to provide reference and reference for the efficient and intelligent management of the parking lot.

## 1. Research Background

### 1.1 Literature review

At present, domestic research on parking lot intelligent systems has formed a certain scale. In order to solve the problem of urban parking difficulties and irregular parking lot management, Yang Dengqiang and Wang Yujie proposed an intelligent parking lot management system based on ZigBee technology, which is used to realize the interaction between vehicles and control centers, and promote the management of barrier-free intelligent parking lots (Yang and Wang, 2012). Sheng Xiaoliang et al. used a two-dimensional code technology to propose an in-vehicle auxiliary system to help car owners use the mobile phone to automatically navigate to find the location of the car (Sheng et al, 2015). Qian Chengshan et al. combined the software and hardware technologies of the Internet of Things, including ZigBee module, RFIDRC522 module, US-100 ultrasonic ranging module, single-chip STC89C54RD+ chip and terminal detection node, etc., designed a positioning, initial timing, and empty Intelligent parking lot management system for functions such as parking space detection (Qian et al, 2016). Based on WiFi positioning technology, Zhou Changlong designed a smart parking system for fingerprint identification, and developed a mobile terminal application software and server-side software to effectively accelerate the operation efficiency of parking lots (Zhou, 2016). Based on Internet technology, Guo Yujun and others designed an Internet + smart parking lot with low-cost ultrasonic detector + infrared detection module to detect parking space information according to the needs of the yard and the owner. The parking lot that combines the parking lot hardware and the WeChat public number platform has functions such as lighting navigation, inquiries, and reserved parking spaces, which can help the owner quickly find parking spaces and reduce traffic congestion (Guo et al, 2017). Liu Feiqi and others used RFID technology to design a real-time voice navigation and control system for parking lots. The system design, hardware design and software design were studied. It was found that the system can identify and manage vehicles entering and leaving, and can realize parking space management ( Liu et al, 2018). Based on the research of Boolean model and Dijkstra algorithm, Zhao Yizhou proposed a smart parking navigation system (Zhao, 2018) which integrates information inquiry, scheduled parking

space, parking navigation and reverse car search. However, at this stage, no scholars have studied the application of the Internet of Things NB-IoT technology and ZigBee wireless network technology in the design of parking lot intelligent navigation system, so this paper makes a detailed analysis.

## **1.2 Purposes of research**

In recent years, with the improvement of residents' living standards and economic development levels, the number of private cars has gradually increased. In this context, the overall number of parking lots is increasing, and parking lot management has gradually entered people's attention. However, in recent years, in the operation and management process of large parking lots, there are widespread problems such as difficult parking spaces, complicated terrain and unclear lines. The parking lot is not efficient and greatly affects the user experience (Yu and Yu, 2018) . With the development of advanced Internet technologies, such as GPS navigation systems, RF sensing technology, full video technology, and diversified positioning technologies, parking lots in various regions have been designed with certain intelligent navigation systems, and have achieved certain results. However, these technologies have certain limitations in the application process. Therefore, the development of a simpler, more humane, systematic, and accurate parking management system has become a major trend in current and future development. Based on this, based on the theoretical basis and application advantages of Internet of Things NB-IoT technology and ZigBee wireless network technology, this paper designs the intelligent navigation system of parking lot, in order to design a more intelligent and practical parking management system. Moreover, at the theoretical level, it is hoped that this study will complement the relevant literature base for the design of parking lot intelligent navigation systems.

## **2. Theory of NB-IoT Technology and ZigBee Wireless Network Technology in Internet of Things**

### **2.1 NB-IoT Technical overview**

NB-IoT technology mainly refers to the wireless access technology of cellular network, which is based on the field of wireless communication. The radio frequency broadband of NB-IoT technology is 180 KHz, which mainly provides Internet of Things connection function for relevant institutions. NB-IoT technology is different from the traditional short-range technology of license-free spectrum, and has different application advantages in the actual application process.

First, NB-IoT technology has the characteristics of low power consumption. When using NB-IoT technology, relevant equipment can keep on-line in different time and space. By reducing some unnecessary instructions, the corresponding entry mechanism can be reduced, and then the power consumption of equipment can be reduced, which is conducive to delaying the life of equipment batteries.

Secondly, NB-IoT technology has the characteristics of low complexity. The main goal of NB-IoT technology is to realize batch application of related software on some complex equipment, which to a certain extent is conducive to reducing the cost of equipment operation.

Thirdly, NB-IoT technology has the characteristics of wide coverage. In traditional devices, the use of NB-IoT technology is mainly to expand the system memory, which is conducive to improving the efficiency of data conversion in the system and expanding data storage.

Therefore, when introducing NB-IoT technology, relevant enterprises can solve the requirements of low flow of related equipment. NB-IoT technology can be directly introduced into cellular networks, which can reduce the operating costs of enterprises. And NB-IoT technology is relatively widely applied, including intelligent transportation, home, power grid and some wireless sensor equipment. All these functions can be realized by NB-IoT technology.

### **2.2 Overview of ZigBee Wireless Network Technology**

After the Chinese translation of ZigBee wireless network technology, it is known as the purple

peak technology. It is a kind of Internet of things communication technology which has been developing in the near future. The name ZigBee originated from a dance method used by bees to convey relevant information. Its dynamic process image conveys the basic connotation of wireless communication technology. Since the 21st century, relevant enterprises have jointly initiated and established the ZigBee Alliance, which is dedicated to the research and development of ZigBee wireless network technology standards. At present, more than 200 designers and wireless network manufacturers have chosen to use ZigBee wireless network technology standards.

ZigBee wireless network technology is different from traditional Wi-Fi technology, mainly for different scenarios of data traffic. With the deepening of research on ZigBee wireless network technology in related fields, the function of ZigBee wireless network technology is gradually strengthened, which makes ZigBee wireless network technology have different application advantages in different fields. Firstly, ZigBee wireless network technology has the characteristics of low manufacturing cost. When introducing ZigBee wireless network technology into relevant equipment, it can minimize the cost, improve the performance of equipment, strengthen the technical use function and improve the efficiency of equipment use. Secondly, ZigBee wireless network technology has the characteristics of low power consumption. ZigBee wireless network technology can choose different communication channels, and graft technology on related equipment. Through the corresponding data conversion and equipment grafting, the energy consumption will be reduced to the lowest, which is conducive to improving the performance of related equipment. Finally, ZigBee wireless network technology has a wide range of applications. After adopting ZigBee wireless network technology, relevant organizations can transmit data indoors and outdoors by choosing channels with low frequency. With the expansion of power, the data transmission range can be further expanded, and the relevant enterprises can collect data in a wide range.

### **3. Application of NB-IoT technology and ZigBee wireless network technology in the design of intelligent navigation system in parking lots**

Under the background of Internet of Things, based on NB-IoT technology and ZigBee wireless network technology, intelligent parking intelligent navigation system is designed, which mainly includes fingerprint positioning module, parking detection module and navigation route planning module. Among them, the fingerprint positioning module mainly relies on the basic application features of NB-IoT technology and ZigBee wireless network technology, and takes the wireless signal characteristics of related technologies as the corresponding position fingerprint to form the position fingerprint database within the system, and then identifies the user's position through fingerprint matching. Parking detection module mainly uses the positioning technology of NB-IoT technology and ZigBee wireless network technology to monitor the vehicle's route and correction trajectory in real time, and to calculate the speed of vehicles in and out of the parking lot to determine the location of the vehicle. Navigation route planning system is mainly based on the position information of the vehicle provided by the user to identify the short-term, and then carry out the corresponding route planning, which is conducive to improving the parking speed of the vehicle.

#### **3.1 Fingerprint Location Module**

Based on the NB-IoT technology and ZigBee wireless network technology of the Internet of things, the fingerprint location method of the intelligent parking guidance system is designed to collect and process the relevant data in real time. The corresponding fingerprint database is set up in advance, and the corresponding vehicle test and training are carried out accordingly. In the actual application process, the location fingerprint positioning module is the basis of indoor positioning technology. It has the characteristics of higher accuracy than fast response, and can effectively realize the accurate positioning of different vehicles.

### **3.2 Parking space detection module**

In the off-line state, that is, in the training phase, the parking lot location design is carried out in advance without the collection and preprocessing of parking data, and then the parking detection module can be entered. In the parking detection module, with the help of NB-IoT technology and ZigBee wireless network technology, some position data can be monitored in real time in corresponding time, and the vehicle data can be accurately positioned and the vehicle trajectory can be corrected. Then, the system uses the positioned vehicle information data to identify the vehicle status. If the speed of the vehicle entering the parking lot is greater than that from the parking lot, the corresponding position mark will disappear and the vehicle will be stopped. If the speed of the vehicle entering the parking lot is less than the speed away from the parking lot, the vehicle takes the vehicle status. If the parking and picking-up state of the vehicle does not follow the normal state or the planned route, there will be vehicle deviation. Therefore, when entering or leaving the parking lot, the vehicle must strictly follow the systematic planning route and drive according to the established driving route.

### **3.3 Navigation Route Planning Module**

Navigation route planning module uses NB-IoT technology and ZigBee wireless network technology to identify parking space information on the corresponding equipment. In this module, users can freely choose parking spaces and pick up parking spaces. When the manager receives the relevant information from the user, he will provide the real-time data information for the user according to the specific analysis, and plan the route pertinently. At the same time, the system will push relevant information to users in real time. After users have basic needs, they can also provide users with the best path choice in the shortest time, and improve the parking efficiency of users.

## **4. Conclusion**

In summary, with the gradual improvement of residents' living and consumption levels and service demand, people's requirements for the number of parking lots and overall service quality are also increasing. With the help of advanced Internet technology, the intelligent management system of the parking lot is designed to quickly identify the complex parking lot terrain, clear the line in the shortest time, and find the empty parking space is the focus of the current parking lot needs to be improved. In order to truly design an efficient parking management system, it is necessary to further upgrade and optimize the technology used in existing parking lots. The Internet of Things NB-IoT technology features low power consumption, low complexity and wide coverage. ZigBee wireless network technology can improve device performance and efficiency through the lowest manufacturing cost and technology grafting function. Therefore, the parking lot needs to introduce the Internet of Things NB-IoT technology and ZigBee wireless network technology to design the intelligent navigation management system. Specifically, the specific design and application can be carried out from the three aspects of the fingerprint positioning module, the parking space detection module and the navigation route planning module. In the future, smarter navigation, which is more concise, humanized, systematic and accurate, has become a trend. It is hoped that by using the advanced advantages of the Internet of Things NB-IoT technology and ZigBee wireless network technology, the design of the parking lot intelligent navigation system can effectively solve the user's Problems, improve the service experience, and promote the efficient operation of parking lots.

## **References**

- [1] Yang D.Q., Wang Y.J.. (2012). Research on Intelligent Parking System Based on ZigBee Technology, *Internet of Things Technology*, 2(8), 44-47.
- [2] Sheng X.L., Liu Z.J., Liu K., et al. (2015). Design and implementation of a parking lot navigation system based on two-dimensional code recognition, *Digital Communication World*, 11(7),17-18.

- [3] Qian C.S., Jiang Q.F., Mao Y.Y., et al. (2016). Design of intelligent parking system based on Internet of Things technology, *Internet of Things technology*, 6(7), 26-27.
- [4] Zhou C.L.. (2016). Design and implementation of intelligent parking system based on WiFi, *Electronic World*, 28(23) ,70-71.
- [5] Guo Yujun, Ding Xueyong, Zhang Lin. (2017). Low-cost Internet + Intelligent Parking System Design and Implementation--Taking Sanya City as an Example, *Science and technology*, 17(7), 67-67.
- [6] Liu F.B., Ma X.K., Liu M.H., et al. (2018). Real-time voice navigation and control system design for parking lot, *Electronic World*, 30(13), 127-128.
- [7] Zhao Y.Z.. (2018). Research on intelligent parking navigation system for large and medium-sized parking lots, *Software*, 39(10), 124-128.
- [8] Yu B., Yu H.Z.. (2018). Design and Implementation of Mobile Intelligent Parking Query System Based on Cloud Data Platform, *Software Guide*, 26 (3), 111-113.
- [9] Zhou Z.Y., Cai Y.. (2017). Underground parking garage energy-saving lighting system based on NB-IoT and Internet of Things technology, *Electronic product world*, 25(10), 72-76.