Research and implementation of Smart Classroom Management technology based on NB-IoT

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Abstract

With the development and progress of social science and technology, in the process of information teaching, the requirements for the construction of smart classroom are gradually increased, especially the real-time monitoring of the classroom has a high demand. Since the classrooms are distributed in different teaching buildings and the number is large, and it is difficult to realize real-time monitoring in the monitoring and management of teaching resources and students, a remote real-time monitoring system is designed to monitor the management and configuration of the classroom, so as to improve the efficiency of classroom management and promote the development of smart classroom.

Keywords

NB - IoT; Wisdom classroom; Data acquisition; Monitoring system.

1. Introduction

Based on the Internet of Things environment, Web system, big data and cloud computing related technologies, this paper aims to create a remote real-time monitoring system scheme to monitor, manage and configure the classroom so as to improve the efficiency of classroom management. In the process of project development, a smart classroom management system based on NB-IoT technology was realized through the design of hardware terminal module and the development of monitoring platform. The monitoring terminal of the system is responsible for the collection of students' campus card information, the location of monitoring terminals, terminal equipment parameters and other information data, and the NB-IoT technology is used to transport the data to the monitoring platform. The monitoring platform receives the data, analyzes it and sends it to the manager in the form of a page. After the implementation of this project, through the statistical analysis of abnormal information and abnormal situations in the classroom, the managers can find the problems in the classroom in time and improve the teaching quality.

2. Current situation at home and abroad

As an emerging wireless access technology, NB-IoT is designed specifically for the Internet of Things and can support a large number of device access. It provides scalable coverage, high capacity, reduced device processing complexity and long battery life, and strong stability in network connection, which can provide reliable data connection for iot devices. The purpose of this technology is to meet the needs of the development of the Internet of Things, so that a large number of Internet of Things terminals can be connected to the network. Through the network optimization and upgrading of the operator, the power consumption problem caused by the technology can be reduced. Since its emergence, NB-IoT technology has been applied in all aspects of people's lives, such as remote meter reading and crop temperature monitoring, which has changed people's lifestyle and promoted the development of the Internet of Things.

Besides, it has the characteristics of long distance, low power consumption and low cost, and also has its own frequency band authorization. Compared with LoRa technology and Sigfox technology, it is more secure and reliable, so operators are more inclined to deploy NB-IoT network. At present, it is being promoted by major companies, such as Huawei, which has made great achievements in this field.

In foreign countries, the research on smart classroom at the beginning mainly focuses on what kind of technology and equipment to adopt. For example, Kumara believes that the main way to build smart classroom is to adopt electronic technology. From the recent research, more attention is paid to what functions smart classrooms should have, such as convenient storage of generated information, timely teaching feedback, automatic equipment control and other functions.Since the concept of smart classroom was proposed, no unified standard has been formed. Scholars at home and abroad have made different degrees of research on the construction of smart classroom from various aspects. From the perspective of Internet of Things and education development, its technology has not been applied to smart classroom much, so it is necessary to deeply integrate the Internet of Things technology into the classroom.

3. Overall design and key technologies of the system

3.1.   Overall design of the system

The smart classroom management system design based on NB-IoT communication technology is mainly composed of two parts: classroom monitoring terminal and monitoring system. In the classroom, the collected data is sent to the monitoring system through the NB-IoT communication module through the information acquisition module, and the system analyzes the data for managers to check. The system is mainly designed from two aspects: the first is the hardware design, that is, the monitoring terminal is designed, and various Internet of things modules are used to expand the Arduino development board to meet the monitoring needs; The second is the design of the monitoring system, which mainly processes the data uploaded by the monitoring terminal and displays the processing results to the manager in the form of text or graphics. Figure 2.1 shows the structure diagram of the system. The monitoring terminal transmits the collected data to the platform server through the core network through the NB-IoT communication base station. The administrator can see the processed data in the system and the collected data will be displayed on the system page at any time, which is convenient for the administrator to manage the classroom.
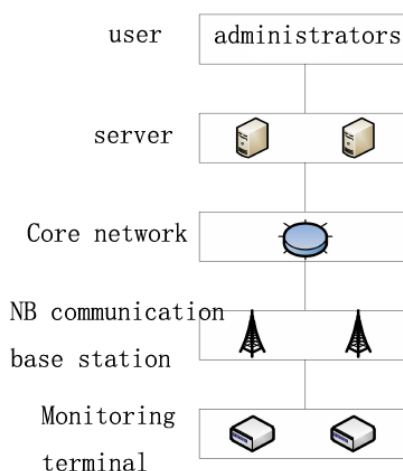

Figure 1 System structure diagram

3.2. Design of monitoring terminal

The design of the monitoring terminal relies on the Internet of Things platform and adopts the modules related to the Internet of Things. The data collected by the terminal will be uploaded to the monitoring platform through the Internet of Things communication module. The monitoring platform will process the data in real time and display it on the page. The monitoring terminal designed in this project mainly collects campus card information of students in class, the location of the classroom and the state of equipment, then codes the collected data, transmits the collected information to the monitoring platform through NB-IoT network and processes the data in real time.

Figure 2 Application field of monitoring terminal

3.3. Design of monitoring platform

The reasonable design of the monitoring platform can fully explore the internal relationship between data. The function of the monitoring platform is mainly to analyze and display the data uploaded by the monitoring terminal, so that the manager can easily monitor the collected data. In order to facilitate the management of the monitoring terminal and the reporting of the classroom location, the system will configure the monitoring terminal so that the terminal can report the location to the monitoring platform in real time, as shown in Figure 2.4.

The monitoring platform can not only analyze and process the uploaded data, but also set parameters of the monitoring equipment by the managers with corresponding management rights, such as the collection range and data collection cycle of the monitoring equipment. After the managers complete the configuration of relevant parameters, the monitoring platform will give the configuration instructions, and the communication module will transmit the received data to the main control module. The main control module executes the command to configure

the terminal. After the terminal updates its configuration, it automatically communicates with the monitoring platform.

4. Key technologies

4.1. NB-IoT

NB-IoT is a wireless access technology that is standardized in 3 GPP and has excellent performance to support iot devices. Iot technology has promising applications in many areas, such as security, asset tracking, remote monitoring, metering (gas, water, electricity, etc.) and smart grids. This reflects the advantages of the Internet of Things. Features such as large connectivity and low cost will support the communication in these fields, while the current widely used 2G/3G/4G/SG communication technologies cannot fully meet this demand. The structure design of wisdom classroom can be divided into the following three levels.

The structure of smart classroom is designed according to the fourth design pattern of the Internet of Things: the bottom layer is responsible for perceiving external information, such as the collection of external information by various sensors; The network layer in the middle is responsible for information transmission; The topmost application layer processes the data transmitted from the network layer. These three layers work together to make the Internet of Things stable.

NB-IoT technology is developed from 4G LTE/ evolution packet core network (EPC),NB-IoT technology Other communication technologies do not have advantages, such as high coverage, low power consumption and so on. The technology for 4G Acertain optimization, there are the following two transmission optimization schemes:

First,Control plane optimized transmission scheme: The signaling bearer mechanism is used in the transmission of IP data between the terminal and LVIIVIE C Mobility Management Entity, in which the non-access bearer provides the security mechanism.

Second,User plane optimization transmission scheme: This scheme mainly optimizes the signaling transmission process, so that the terminal can store and access the loaded context information network in idle state, and can quickly rebuild the wireless connection and core network connection for data transmission in idle state.The following describes the functions of each part:

First,Terminal: all kinds of electronic devices are connected to the base station through wireless network for communication.

Second, Wireless network: provides wireless network access functions for terminals, including the existing mobile cellular network and other communication networks. The wireless network will connect terminals and send data to high-rise units.

third,4G core network: perform the function of data interaction with terminals, and forward the IoT data to the Internet of Things platform for processing through the function of data forwarding.

Fourth,Platform: Integrate audio, video, short message and other data. Currently, the platform used is mainly based on communication platform.

Fifth,Application server: It can communicate with the platform through network communication protocols and can call the platform interface and issue instructions to control the operation of the platform. In addition, the application server will also process the data transmitted by the platform.

To sum up, choosing NB-IoT technology as the communication mode of smart classroom can meet the requirements of this system design.

4.2. Design of intelligent classroom monitoring terminal

Using RC522 radio frequency read and write module to collect students' campus card information, and the data statistics to realize the real-time monitoring of students' attendance in class, can effectively manage students, reduce the workload of teacher attendance in class, teachers' work efficiency has been improved; NEO-M8N high-precision positioning module is used to realize real-time positioning of acquisition equipment. Even in the indoor environment of classroom, the positioning error is very small. In addition, the positioning module is small in size and low in energy consumption, which is very suitable for the design requirements of the acquisition equipment of this topic, and convenient for managers to manage the equipment. BC95 communication module is adopted, which integrates NB-IoT communication technology and has the characteristics of low cost, low power consumption and small size. The BC95 communication module is used in this design to send the coded data to the monitoring platform, which will display the data in real time on the system page after splitting and processing. At the same time, managers can also remotely configure the monitoring terminal on the system page to achieve the purpose of remote control of the terminal.

4.3. Design of monitoring platform

The overall design of the platform is a Web system designed with B/S architecture, which mainly includes the design of user management module, the design of data processing module, the design of database and the design of electronic map.

The user management module can facilitate the administrator to maintain the user account and ensure the security of data between different users. The design of the data processing module is mainly to process the data transmitted by the acquisition equipment and display it intuitively on the system page, so that the management personnel can directly see the result of data processing, convenient to make corresponding processing. In order to make storage call to a large number of data uploaded by the collection terminal, I choose My SQL database, and design the database table. Finally, it is convenient to analyze the location of the equipment. The monitoring platform calls Baidu Map to display the location of each acquisition equipment and the location of the classroom on the map. The platform draws data analysis charts and student attendance tables according to the collected data.

5. Development prospect

This system is mainly divided into two parts: monitoring terminal and monitoring platform. Nowadays, the rapid development of Internet of Things technology, in the design Both parts are indispensable when monitoring systems, and there are good tables in many fields for designing such monitoring system models Now (For example, for monitoring the tilting of buildings, acceleration sensors can be used as data in the design of monitoring terminals The acquisition module is transmitted to the monitoring platform through the network, and the platform can monitor the tilt data of the building in the first time, thus Reduce the occurrence of safety accidents). In view of my limited ability and knowledge level, the current implementation of the system still needs to be improved Local, mainly including the following aspects:

 First, Add the collection module to diversify the system functions. The information collection device can add the temperature and humidity collection module, which can be used. To real-time monitoring of the temperature and humidity in the classroom, easy to air conditioning and other equipment switch setting, but also according to the temperature reference to move.

State regulation is suitable for students to learn the best air conditioning temperature;

Second, Due to the large number of collection equipment, the richness of collection information increases. In order to facilitate the maintenance of the equipment in the future, Need to further reduce the monitoring terminal energy consumption;

third, The basic functions of the smart classroom management system have been realized in this paper, but after long-term use, the system will appear Due to the high concurrency, the server runs slowly, so the overall performance of the system needs to be further optimized.

Acknowledgments

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