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Design and Implementation of Jingyue District Road Administration Lighting Management System

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Abstract: With the development needs of urban construction in the new era, urban lighting system symbolizes an important symbol of the image of a city. However, due to the extensive content and direction involved in lighting and the high maintenance cost, the city is inevitably faced with a series of safety problems such as power failure and leakage caused by the aging of system equipment. In this paper, an intelligent lighting system is proposed and designed. Through the optimization system of real-time supervision based on the bottom construction based on the Internet of Things, the intelligent lighting management mechanism as the foundation theory and real-time website data feedback, the integration and differentiation of the overall and specific lighting projects are carried out. Through real-time data, the supervision is more visible and controllable, and the modernization of urban lighting is promoted. And promote the development and construction of smart cities.

1. Introduction

With the increasing use of energy and increasingly scarce resources today, energy conservation and emission reduction have become the common goals of government departments and urban builders. Among them, how to reduce lighting energy consumption, real-time maintenance of lighting equipment, reduce energy waste and other issues are also the key to the construction of smart city lighting system[1].

At present, lighting system construction has been carried out in many places in China[2]. With the rapid development of urban scale and the gradual increase of construction scale and maintenance cost, the traditional construction system has become more and more inadequate[3]. The required management means and scientific and technological means are more complex, and relevant professionals are needed to cooperate and develop the practice, which is a long way to go[4]. In the process of urban lighting system construction, if the lack of relevant management technology means, it will cause a lot of disadvantages, even serious economic losses[5].

In recent years, European countries led by the United States have shown the modernization of information processing and management for the technical level of lighting system[6]. For information processing, the wireless improvement of traditional wired data transmission has greatly optimized the original transmission mode and construction and maintenance cost, and the application in related fields has gradually become more flexible and reliable with the process of technological development.

For the management mode, the integrated management system has been adopted, and the real-time control from construction optimization to supervision and maintenance can be achieved through the integrated platform. Problems can be dealt with in time; For the management mode, the remote control and real-time monitoring of street lamp data can be realized through the management control platform, and many fields can be automatically controlled by the computer. In the domestic to Shanghai think twice company and Xiaomi as representatives, respectively, the domestic street lamp system tends to improve.[7]

This paper mainly aimed at the current domestic lighting system of the street lamp state can not be accurate real-time synchronization state, resulting in the lack of intelligence lighting system, resulting in timely control of the problem of the experimental design. The system and technology are mainly divided into node monitoring module, through the single chip microcomputer equipped with brightness and infrared sensors to detect the data; Data transmission module through ZigBee, GPRS, cloud server to achieve data upload, platform management through front-end related language design interface, equipped with tomcat server and connected to mysql database to store data[8].

By studying the relationship between the dynamic state of the real-time lighting environment and the lighting intensity, and developing the smart city lighting management system, real-time monitoring faults, using the core intelligent control algorithm to achieve the accuracy of regulation, so as to achieve the ultimate goal of safety and energy saving[9].

2. Intelligent lighting System Hardware Architecture Design

In order to provide more safe and intelligent lighting services for life travel, this paper starts from the real needs of the actual city to analyze the practicability of the system. If the intelligent system is to be realized, it cannot do without the support of the underlying hardware platform and the construction of the upper software platform. The hardware and software and the interconnection between software and software are also the top priority of the system.

The main functions of this system are: data acquisition, ZigBee networking, data transmission, data analysis and processing, data display, intelligent dimming, real-time street lamp status monitoring [2]. The ZigBee networking structure is shown in Figure 1.

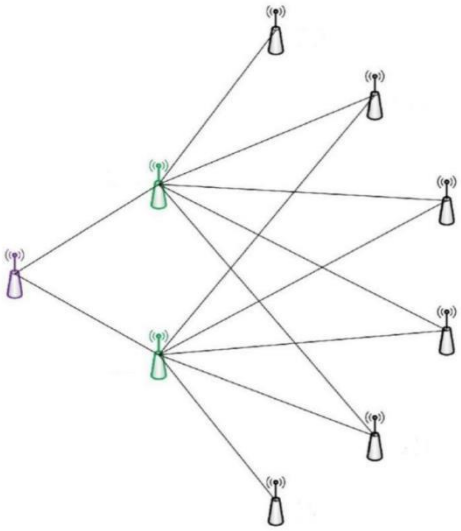

Figure 1: ZigBee network structure

As shown in Figure 2, the system installs a street lamp controller node at the bottom of the street lamp to realize data information acquisition of the node and intelligent regulation of the street lamp system. The street lamp node of the system consists of multiple control nodes and routing centralized

control nodes for AD hoc networking and data transmission through the ZigBee LAN topology[10].

The collected information is sent to the centralized control node, the information of the control node is sent to the cloud server through the GPRS WAN, the cloud server we can use the existing Ali cloud server for rent, the use of the cloud server for data storage processing, through the algorithm for data analysis, by the background management system to present the processed data, The data can be submitted to the administrator for real-time information monitoring and maintenance.

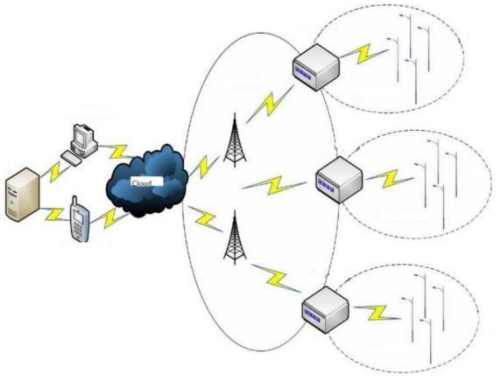

Figure 2: Node data transmission line

For a series of problems extended by the difficulty of real-time and security control of street lamp nodes in common street lamp management systems, the hardware circuit design of this system has functional modules to solve the above problems, including data collection module, node data transmission module and node real-time control module. The circuit framework is shown in Figure 3.

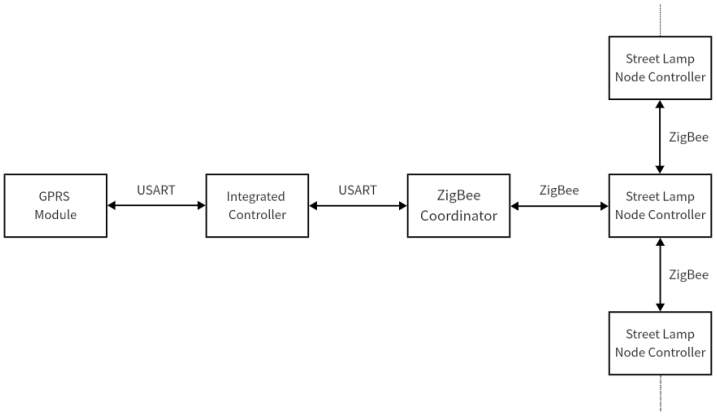

Figure 3: System hardwork circuit framework

The street lamp node control module is responsible for collecting the brightness and flow information of the environment where the street lamp is located, transmitting and uploading according to the data information, and conducting dynamic brightness control according to the instructions of the manager.

The CC2530 microprocessor is connected to the power acquisition circuit, light intensity acquisition circuit, street lamp brightness recognition circuit and vehicle induction recognition circuit to realize relevant control functions. Through this circuit, a node device based on CC2530 is constituted. The node is composed of power supply equipment, reset facilities and clock control circuit. The power consumption in normal operation is insignificant compared with the power consumption level of the street lamp. The function module is simple and stable, and the control program such as algorithm can be written into the device in advance, which is convenient for the subsequent unified control. The hardware framework of the street lamp node controller is shown in Figure 4.

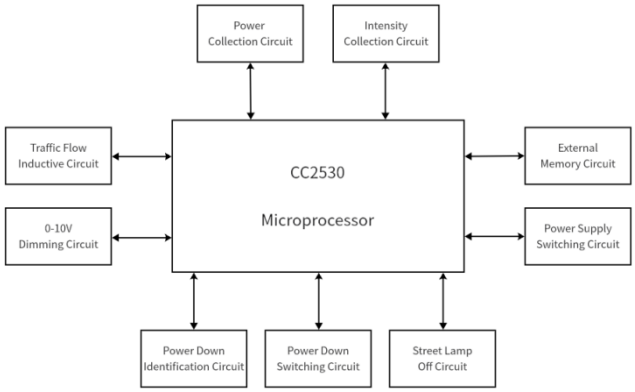

Figure 4: Street lamp node controller hardware framework

3. Intelligent Lighting Management System Design

The system is mainly composed of a large platform and three functional systems. It consists of city construction information, street lamp node equipment data and dynamic real-time data, underground facility information, equipment control management system based on the Internet of Things, infrastructure supervision system and production management system.

With monitoring data as the core, the smart city lighting system platform uses data processing, data calculation, data transmission and other technologies of the system to realize dynamic monitoring of urban real-time lighting status, so that managers can easily understand the latest status of urban lighting and regulate the relationship between the flow and brightness in the lighting system. In addition, while ensuring the lighting effect, taking into account the long-term goal of saving energy. Secondly, for lighting node failures in the system, the device status information can also be uploaded in real time through node monitoring. The source of node failures can be obtained through the real-time data information uploaded by the device, and the staff can deal with and maintain the node immediately afterwards to ensure the integrity of the node[11].

After the above information collection and processing, the intelligent lighting system management platform can realize data visualization, which is convenient for human analysis and management. The system can also manage data by task control and subsystem point use and other practical functions, so as to realize intelligent data real-time information management.

After entering the system through identity authentication, the system can customize the function call interface of the sub-system according to the identity of the user. The complete user function subsystem module includes three modules: lighting node management module, alarm maintenance module and maintenance dispatch module.

The main page shows the main functions and three options of the login interface, which are tourists, maintenance personnel and managers. They log in to different databases with different identities and use different functions. The administrator can view all the data in the background and modify it. The system constructed in this paper is for the purpose of saving resources, reducing the maintenance cost of urban lighting, ensuring people's normal lighting needs while saving energy, and ensuring the safety of urban residents.

In order to improve accurate management methods, we control lighting nodes remotely and carry out real-time high-intensity lighting for key sections, while we carry out energy-saving processing for non-key sections to ensure resource conservation and green lighting on the premise of ensuring light. The above interface of lighting node management, road section implementation alarm, maintenance dispatch management can only be accessed after entering the login interface.

After selecting the login identity, we log in to the management interface according to the account and password of the identity, and access different databases according to different identities. The user identity can be viewed and managed in the administrator interface, in real life, the management system staff and management identity often change, often appear similar to the maintenance staff change a class of problems, so the background identity management is equally important.

By setting the user name and user secret law, we can find out the identity category to which the user belongs. According to different identity categories, we set different databases for storage, and then deal with the problem of user data management. Secondly, in the process of database management, if there are problems such as data storage errors, we only need to maintain the data of the system personnel immediately and update the data information of the owning database to ensure the stability of the data. We will add the lighting information to the data content of the owning management personnel, and the management data will be processed by it. We can call different management measures for users with different functions, and they can also change the real-time information of the database through mutual sharing of data, so as to achieve unified management of manual and data, the user information stored in the database.

The interface for adding lighting nodes. The specific location of lighting nodes can be accurately located by adding data information such as street lamp number, street lamp area and street lamp node type improvement.

Because the change of lighting nodes is common in the actual use, we need to update the data information of these nodes in real time to facilitate subsequent adjustment and modification. We have added the street lamp number and its area to the functional interface as a table entry, and the management interface in its operation.

The lighting node management module [3] realizes two functions, namely the addition of lighting nodes and the management of added nodes. In order to manage the lighting node, it is necessary to input all the detailed information of the lighting node into the system and save it as backup. In order to make the data information be managed and saved immediately, we save the data in the database. In the management area of the database, we facilitate the subsequent further management, so that when the system has a problem, we can know the location of the problem node in the first time. If frequent faults occur in the area, follow-up management such as line maintenance or system maintenance can be considered.

For the added nodes, we can achieve node management through the lighting node management function module [4]. The functions that can be provided in the system can realize the basic data management functions of deleting, modifying and viewing nodes on demand.

The management function of the lighting node management module [5]. The street lamp number and specific node information log can be re-edited and saved, and the change time of the last problem can also be seen on the interface. You can also view the number of maintenance personnel in the area and contact them by hotline. After the modification is complete, modify the entry and rectify the fault. If you delete the entries, the problem is rectified. If you can view the saved historical node logs, you can view them.

Through the historical log information, we can know the location and region of the problem node, and through the real-time statistical historical information, we can easily find that if a specific region is found to have frequent failures in the management of the owning region, it is not difficult to show that the system facilities in the region have been seriously aging, and the efficiency level of the management system is too backward, which leads to this problem. As a result, the aging of nodes in some areas is relatively rapid, and the service life of nodes is very low, which wastes resources and costs. The road administration department can consider follow-up management such as updating and system maintenance for the lines in this area, so as to realize its management functions.

We can open the selection file to save the log file of the lighting node, and we can conduct

subsequent analysis based on the historical usage of statistical data.

The alarm maintenance module [6] realizes the functions of equipment maintenance and line maintenance. The functions of equipment maintenance realize the functions of line area, line section, line number, line type and management. The management realizes the deletion and modification of entries.

It is essential for the node management function. After updating the system log, we can record the maintenance of the lighting node in real time, and learn about its specific historical problems. When the fault is solved, we can also delete the entry, so that the management personnel can avoid worrying, and no longer send other maintenance staff to repeat maintenance work, which greatly saves the management cost. It accelerates the efficiency of control and truly realizes the intelligent management we expect.

The maintenance function of the line [7] is similar to the system maintenance. The alarm function enables the management personnel to control the real-time line, overhaul the line and update the line information. Its main functions include real-time display of the area, section and the road administration department to which the alarm problem belongs, checking the number of maintenance personnel in the area and making hotline contact. After the change is complete, modify the entry to remove the problem. After maintenance, the information in the database is synchronized by modifying and saving the entries.

The maintenance dispatch module [8] manages the existing maintenance personnel and alarm area through the administrator's view of alarm maintenance.

Finally, we can switch to log in at the upper right corner of the user interface and change their account information, etc. Users have the right to set their identity information just like the current common personal space management. This content is not updated by the administrator to help the system administrator to update their personal information, and the administrator only needs to manage the accessible functions.

4. Effect Analysis of Intelligent Lighting System

Establish a smart city lighting management system [9-11] through remote monitoring of each node in each lighting line, node data collection, node remote control, real-time dynamic node regulation and alarm are realized, so as to improve the intelligence of the lighting system as a whole, and effectively control the energy consumption and security issues generated by the lighting system through scientific node control.

Detailed planning needs to be carried out from specific locations, with Jingyue District of Changchun as the pilot area. We can cooperate with the road administration of Jingyue District to build pilot projects in small areas, divide Jingyue District such as Xincheng Street into different areas, number all kinds of lighting equipment on the road according to their types, make statistics and upload the relevant data to the management system. After the node is installed, we conduct test management on the platform by monitoring the feedback given by the node. Through horizontal and vertical comparison, we can find out whether the specific benefits of the management system can achieve the ideal state. In addition, we can immediately modify the feedback of the problems reflected in the process of the event, and gradually optimize the management mechanism more suitable for regional and local characteristics.

5. Conclusion

The system constructed in this paper is for the purpose of saving resources, reducing the maintenance cost of urban lighting, ensuring people's normal lighting needs while saving energy, and ensuring the safety of urban residents.

Aiming at the real-time illumination control of street lamps, we put forward the intelligent management method. The intelligent management of urban lighting realizes the transmission and upload of the data of street lamps, and displays the real-time information and data through the management platform. In the rapid development of the era, the construction of this platform has strengthened the modern management of the city and improved the management level. Targeted control of problem areas is obviously much safer and faster than aimless, periodic inspection.

In order to meet the requirements of smart city construction at the present stage and build smart lighting system, we rely on the existing Internet of Things technology to carry out channel transmission of real-time monitoring information. Through this technology, we can carry out multi-dimensional real-time supervision of environmental factors and realize the combination of integrated management and real-time customized management.

Acknowledgments

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