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Research on Power Monitoring System of Campus Intelligent Network based on Wireless Sensor Network

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Abstract. Aiming at the poor connection and overload of electrical lines on campus, it is easy to generate fires, and then propose a wireless monitoring system to build a campus electricity monitoring system. The solution can dynamically set the threshold of the smart socket to avoid overload and affect the circuit. At the same time, it conducts intensive management for the power consumption of various types of electrical equipment on campus, and briefly summarizes the hardware and software components of the wireless sensor network of the system. The experimental research shows that the system is easy to install and debug, guarantee the safety of electricity consumption, achieve the purpose of energy saving on campus, and has high application value.

Keywords: Wireless sensor network; Intelligent campus; Power monitoring system; Intelligent power saving.

1. Introduction

The intelligent power monitoring platform is based on high-tech such as control technology, communication technology, network technology and sensor technology, and uses various power electronic devices to form an intelligent system to complete the corresponding intelligent control functions. It includes communication systems, power consumption monitoring, remote on/off control of equipment, overload protection and energy management. This paper introduces a WSN-based campus intelligent energy-saving system, which uses wireless sensor network, Ethernet, and GPRS and Internet technologies to realize real-time remote monitoring of the power consumption status of campus electrical equipment, through various electricity in the campus. The power consumption status of the equipment is centrally managed and optimized by the power mode, thereby achieving the purpose of energy saving in the campus.

2. System Overall Structure Analysis

The intelligent power monitoring system based on ZigBee consists of three parts: intelligent node, aggregation node and campus monitoring center (as shown in Figure 1). The networking mode of the ZigBee node is a star structure, and the electrical parameter values are obtained by polling between the protection node of the aggregation node and the intelligent node [1]. In this system, the intelligent node monitors the current and power consumption of the socket by measuring current and voltage, and transmits the data to the aggregation node via ZigBee [2]. The sink node calculates the total current of the branch circuit according to the data transmitted by the intelligent node, and compares with the rated current to obtain the remaining safe current value, which is used as the threshold of the intelligent node overload protection. When the electrical equipment of a certain node of the branch circuit is overloaded, the intelligent node will cut off the power supply in time to prevent overload and more serious accidents.

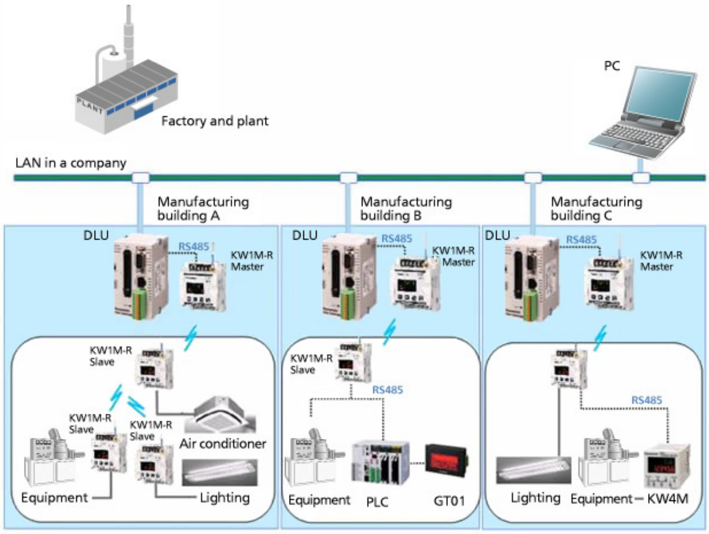

Fig. 1 Power monitoring system overall structure

3. Smart Power Saving Design

3.1 Hardware Design

The wireless sensor network is composed of a large number of micro sensor nodes deployed in the monitoring area, and forms a multi-hop self-organizing network system through wireless communication [4]. The purpose is to cooperatively perceive, collect and process the information of the sensing objects in the network coverage area. And send it to the observer. Wireless sensor network technology is listed as one of the 21 most influential technologies in the 21st century and one of the top 10 technologies that change the world in the US Business Weekly and MIT Technology Review's Forecasting Future Technology Development Report.

Sensor nodes are the basic building blocks of wireless sensor networks. It consists of four parts: sensor module, processor module, wireless communication module and energy supply module. Since the sensor node is usually a tiny embedded system, its processing power, storage capacity, and communication capabilities are relatively weak and are powered by batteries that carry limited energy. Based on these characteristics of sensor nodes, this paper designs a wireless sensor network node based on chip CC2430 for campus power monitoring system. Figure 2 shows the CC2430 basic circuit design [3].

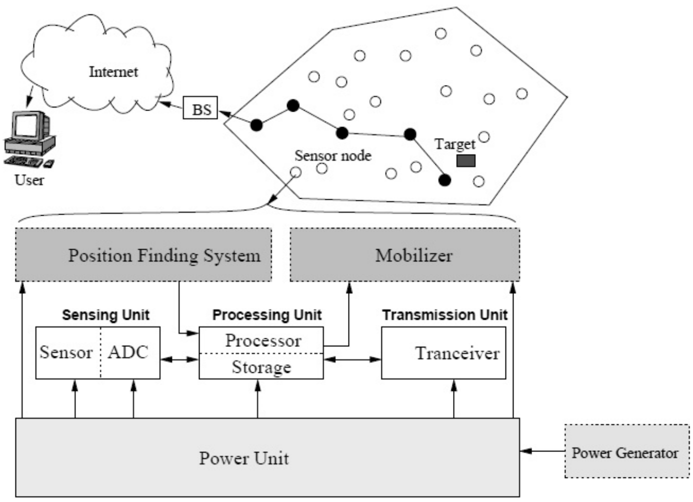

Fig.2 Wireless Sensor Node Architecture

The microprocessor adopts MSP430 series ultra-low power processor M SP430F169, which has low power consumption and high performance, and fully meets the requirements of wireless sensor networks for low power consumption of communication nodes. The wireless communication module uses N R F905 produced by NORDIC. The chip can work in three communication frequency bands of 433/868/915M Hz, and can realize low-power design during communication through software setting method. In this system, the wireless sensor network adopts the 433M Hz communication frequency band and the switch output control interface are used to control the on/off control of the power equipment. It can be implemented by using relay or thyristor; the controlled load of the controlled terminal node can be selected as Single or multiple [5]. The power detection unit is used to monitor the real-time power consumption of the powered device.

3.2 Software Design

Firstly, the system is initialized, the power parameters are read from the integrated circuit, and then the overvoltage is judged. If the voltage is overvoltage, the relay is turned off, otherwise the LED light is set and the power is continuously read. After the relay is disconnected from the overvoltage, the LED is set to transmit the information to the sink node, and then the fault is cleared [6]. If it is cleared, the relay is closed. Otherwise, the information is transmitted to the sink node, as shown in the figure below.

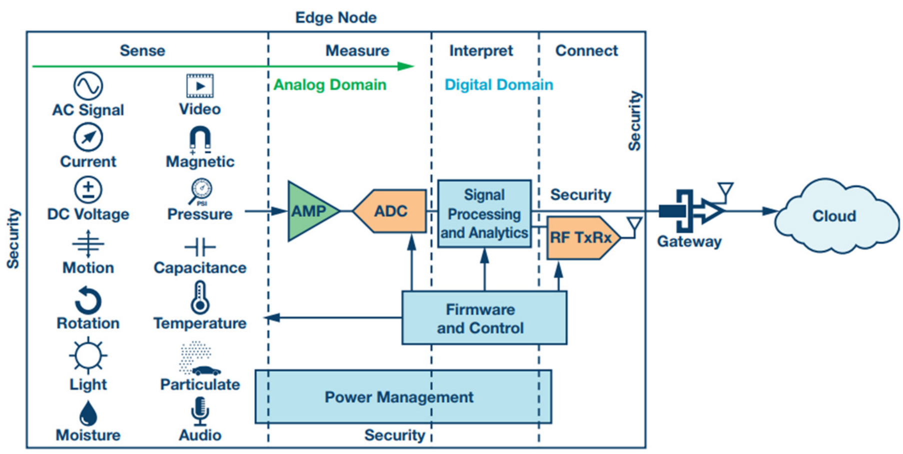

Fig.3 Node flow chart

After the initialization of the controlled terminal node is completed, the system enters a loop waiting state to query and analyze whether a complete data packet enters the data buffer in real time. Once the data is entered, the node immediately performs the data analysis and data processing stages, and then performs the power state control and power consumption monitoring of the powered device, and the software flow is as shown in Fig. 3.

3.3 Establishment of Wireless Network Communication

ZigBee wireless transmission has three modes, unicast, multicast and broadcast. In this design, the data transmission of each node is sent in unicast mode and transmitted to the coordinator; the coordinator sends the command by broadcast, and the instruction sent by the coordinator is transmitted by the host computer through the serial port.

3.3.1 ZigBee Protocol Stack

Z-Stack is the protocol stack of ZigBee. It is a series of communication standards. When any two devices communicate, both parties need to send and receive data according to this standard. This design has the following characteristics for Z-Stack development: (1) Users do not need to have a very in-depth study of Z-Stack, only need to be familiar with the initialization and calling process, most of the development can be carried out at the application layer. As in the operation of the data acquisition part of the design, the main content is to add a read function to the sensor at the application layer, and then call the send function. (2) When triggering a function in the protocol stack, there are two main types: interrupt trigger and timing trigger. Considering the energy saving and efficiency, the terminal node can be awakened by the timing trigger method, thereby automatically collecting and analyzing the temperature and humidity data and the power consumption status of the university. In the protocol stack, the calling procedure of the task program in Zstack is: main () ---> osal init system () ---> osalInit Tasks () ---> Serial App Init (). Where osal_init_system( ) initializes the operating system and does not return once executed; osalInit Tasks( ) is task initialization, in which this allocates storage for each task of the system and assigns task IDs to each task, ie each task Unique serial number; Serial App Init( ) Initializes the application and configures the IO on the development board in this function [7].

3.3.2 Triggering of Node Task Events

Event triggering at the application layer is primarily done in the function Serial App Process Event (). In this function, it is first retrieved whether a system event has occurred, and no NULL is returned. If a system event occurs, the function further subdivides the event through the case function. For example, when AF_INCOMING_MSG_CMD is set to 1, the device receives the signal from the air, and then calls the Serial App_Process MSGC md () function message processing function to receive and analyze the received information. In this design, programming is set: when a system event occurs, if the state of the device in the network occurs, the SerialApp Device Connect () function is first called to establish a connection between the terminal node and the router to the coordinator; secondly, on the terminal node device. A timer is used to trigger a periodic function to send an event, so that the function SampleApp_Send_P2P_Message () can be called. In the SampleApp_ Send_P2P_Message () function, the reading of the temperature and humidity sensor, the flame sensor, etc. is implemented, and the message is sent after integration [8]. The data send function is defined as: AF Data Request (afAddrType_t * dstAddr, end Point Desc_t * srcEP, uint16 cID, uint16 len, uint8 * buf, uint8 * trans ID, uint8 options, uint8 radius).

Where *dstAddr defines the destination address, endpoint address, and transmission mode, *srcEP defines the description of the terminal, cID refers to the cluster number, Len refers to the length of the transmitted data, *buf points to the buffer for sending data, and *transID is the task ID. No., Options is the transmission option of the valid bit mask, and Radius is the number of transmission hops.

3.3.3 Serial Transmission of Instructions

In order to realize the wireless control of the host computer to the node, serial port transparent transmission is used in the design, so that the coordinator reads the command sent by the host computer in the serial port, and then sends the command to each node through the broadcast; after the node 3 receives the signal in the air, Call the Serial App_Process MSGC md() function to control the opening and closing of the relay circuit with the judgment command content.

4. Monitoring Platform Design

The monitoring center management platform is a set of power management software based on PC. The software includes five functional modules: electrical equipment control, power equipment information management, power equipment mode setting, power equipment status display and related information query printing.

The power equipment control module will directly perform the control operation of the administrator to turn off the power of the power equipment. The administrator selects the use by using the software function button. The electrical equipment information management module will record information such as the type, model, power, location, mode, and usage period of all devices controlled by the system, which is convenient for administrators to manage and operate. The power device mode setting module will set the power mode of the device controlled by the system. The power mode of the device can be arranged according to the specific requirements of the user. Settings. The power device status display module monitors the working state of the device through the power control terminal. Related Information The query print module can be used for powering device information. Query and data printing using information such as the real-time working status of the electrical equipment. As shown below.

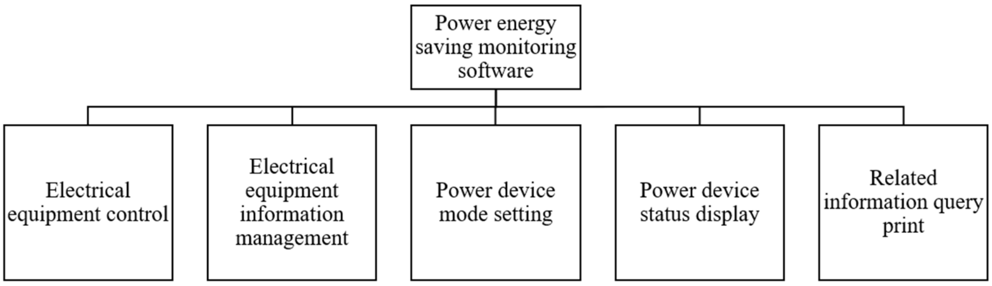

Fig.4 Power saving control software module

5. System Debugging

In order to verify the feasibility of the system, a test was conducted in a university. The system has a sink node and manages two branch circuits, one of which contains three intelligent nodes and the two of which contains two intelligent nodes. The standard voltage of each branch circuit is 220V, the current protection value is set to 10A, and the corresponding rated power is 2200W. The object-oriented Qt Creator remote display results the second intelligent node current of one road is zero, the relay has automatically cut off the power, the other two relays are closed, but the total power does not exceed the rated power; two intelligent nodes of the two branches The relays are all closed and also do not exceed the rated power.

6. Conclusion

This paper proposes a ZigBee-based management and monitoring system for campus electricity use in colleges and universities. It can realize real-time power detection, update power threshold and automatic power-off, power classification management, power monitoring and other functions of intelligent buildings in the university monitoring center. Deepen the improvement of the power-saving capacity of colleges and universities, and provide the basis and plan for the energy-saving and emission reduction work of colleges and universities. Through the actual test in colleges and universities, the system runs stably, and can realize the open circuit treatment of the overloaded line in time, which makes up for the defects of the traditional power distribution system and effectively protects the electricity safety of colleges and universities.

Acknowledgments

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