

Application of zigBee technology in intelligent building information system

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Abstract. According to the intelligent building needs to build multi layer, high coverage, large amount of massive data acquisition requirements, it is necessary to build a wireless sensor transmission network with high scalability, simple node increase and decrease, and multi node topology network. This paper adopts the low power local area network protocol based on IEEE802.15.4 standard, namely: ZigBee technology to achieve. The technology is widely used in wireless sensor transmission network. This paper first analyzes the equipment composition of ZigBee technology, and on this basis, completes the design of network structure. The sensor nodes, router nodes, coordinator nodes and other hardware components and the program design scheme of gathering node, router and coordinator are mainly discussed, and the monitoring software of the host computer and the slave computer is designed on this basis.

Key words. Intelligent building, zigbee, network design.

Intelligent building refers to optimize the combination of the structure, system, service and management of the building according to the needs of users, so as to provide users with an efficient, comfortable and convenient humanized building environment. The premise of intelligent is massive data perception and intelligent information processing. The maturity of big data technology makes it possible to store and process massive data. But an important work in smart building is to establish a multi-level, high coverage, large amount of data acquisition point, and the data collected by these acquisition points are transmitted layer by layer to the information management platform by wireless sensor network. Wireless sensor networks accomplish as much as possible small environmental constraints, high scalability, simple increase or decrease nodes or data points, multi topology network node.

1. Introduction

The main function of wireless sensor network is: After collect the corresponding data by sensor, the data is transmitted by the wireless network system effectively.

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According to the requirements of large coverage acquisition and effective data transmission, the network topology structure is adopted in the park information system. In order to ensure the power consumption and load balance of each node in the network, the internal network is divided into several star topology. Each star network is effectively managed through the router. Each star network is effectively managed through the router. The network topology is shown in Figure 1.

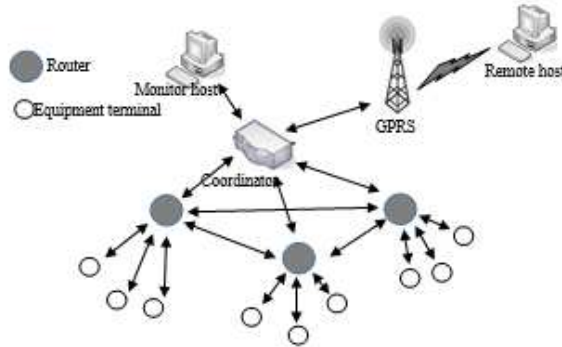


Fig. 1. network system structure

2. Hardware design of system

2.1. Sensor nodes

Scientific and reasonable deployment of a certain number of sensors can obtain data in a wide range, multi angle and multi levels, and improve the accuracy and representativeness of data acquisition specimens. The functions of terminal wireless data acquisition node are: The physical data such as temperature, humidity, light perception, harmful gas concentration and smoke concentration are collected on the monitored site, and transmitted after simple processing.

It is necessary to choose a chip with good stability, high cost performance and low energy consumption for wireless data acquisition system. Therefore, the TI CC2530 wireless chip produced by American companies Texas Instruments is adopted in the intelligent building information platform. The chip can be compatible with the physical layer and hardware layer of the ZigBee 802.15.4 protocol, and adopts the enhanced 8051 core CPU, 8kB SPAM, AES Security Co processing unit and 21 FB2530RF_ACC2530 RF development board of universal IO pins. Through the definition of each special function register in the CC2530.h header file that comes with IAR, it is easy to program this kind of pin. It is configured as connection modulus/ digital to analog conversion unit, counting unit or peripheral component unit I/O of serial port components.

This system adopts SHT15 protection type temperature and humidity sensor with high performance price ratio, MS5611-01BA air pressure sensor, CX-441 photoelectric sensor, smoke sensor module and so on, to collect temperature, humidity,

smoke concentration and other information in monitoring area. And wireless transmission is carried out by ZigBee technology, so as to finally enter the big data layer for effective information analysis.

SHT15 chip is a single chip fully calibrated intelligent sensor with multiple sensors. With high reliability and strong anti-interference ability, it can not only collect temperature in real time, but also collect humidity. The internal has a 14 bit A/D converter that does not require an external conversion circuit, and transmits data through the I2C bus, thus reducing the interface circuit, so as to reduce the cost. The circuit diagram of the platform is shown in figure 2.

MS5611-01BA pressure sensor is a high resolution air pressure sensor based on SPI and I2C bus interface launched by MEAS company, which can provide 24 bit numeric pressure values. The hardware circuit diagram of the platform is shown in figure 3.

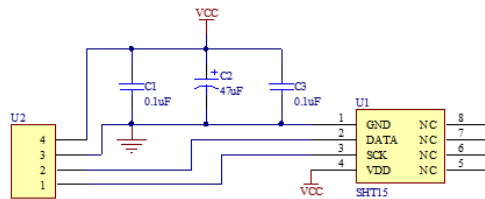


Fig. 2. hardware circuit connection diagram of temperature and humidity sensor

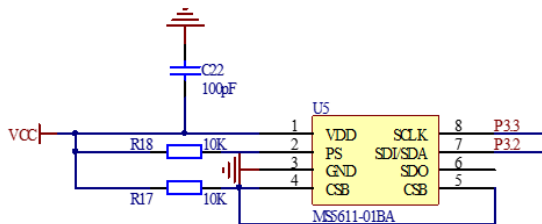


Fig. 3. hardware circuit connection diagram of pressure sensor

The smoke sensor module is mainly composed of smoke sensor MQ-2 and voltage comparator LM393. The circuit structure diagram of the platform is shown in figure 6. The working voltage of the smoke sensor is 5V, and the corresponding analog voltage is output according to the different smoke concentration, the range is between 0-5V. LM393 compares the analog voltage output from smoke sensor with the output without fire. If the output voltage is greater than the threshold voltage, it shows that the smoke concentration is higher, and there is a fire; If the output voltage is less than the threshold voltage, it shows that the smoke concentration is low and no fire occurs.

The external of CC2530 chip is also connected to crystal oscillator (32MHz), power supply module and so on. In order to improve the intensity of RF signal, the

necessary impedance network matching is used in the design, at the same time it can also prevent the influence of high frequency signal leakage on various transmit signals.

In the sensor nodes, the system adopts the technology of idle sleep, that is to say, only when the data is transmitted can the sensor node start to work. The technology has low energy consumption, which can be used dry batteries or silver oxide battery.

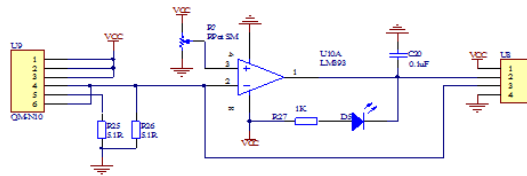


Fig. 4. hardware circuit connection diagram of smoke sensor

2.2. Router

Because the router's function is to automatically select the path, it can effectively exchange data for any device in the network through the router. If a link can not be effectively communicated, other routing routes can be selected, thus ensuring stable data transmission and wide range of network data sharing. In the ZigBee protocol, there are detailed routing protocols specification, so the system can choose the corresponding protocol according to the actual environment, thus greatly enhance the adaptive ability of the network.

The function of routing nodes is to be responsible for selecting data forwarding paths in the network and design and development of network structure, and it receives network access request from sensor nodes. A network can use multiple routers, and through the function of the router can make the ZigBee network has a good organization, which greatly expands the coverage and enlarges the dispersion and denseness of terminal acquisition nodes.

2.3. Coordinator

Coordinator is the central node of the ZigBee network, and also the core device, as shown in figure 7. Each network should have a coordinator, which is responsible for the formation and maintenance of the entire network, and allows new routing nodes and sensor nodes to join the network, which is the organizer of the entire network. It collects data from each router node and each sensor node, and transfers it to big data layer through GPRS.

3. Software design of system

After the intelligent building ZigBee network hardware is composed and connected, the software will be designed. Software is the most important part of driving hardware efficiently and scientifically. The system is written in a structured process, and the flow chart is shown in figure 5.

3.1. Program design of acquisition nodes

The function of terminal collection nodes software is: Node data acquisition, receiving, sending, etc., the device belongs to the RFD, the terminal collection node can not forward data, also can not allow other nodes to join. The basic process of the software is: firstly, the initialization is needed, then the router or coordinator is applied to enter the network, and then enter the network after approval. In order to reduce energy consumption and prolong the service life of the battery, the data acquisition node adopts the sleep wake mechanism. It is dormant in the default state and is awakened only after the clock command is received, and carry out the data acquisition after start, then wake up the ZigBee module, the data is packaged and transmitted, and it continues to hibernate after the task is completed. The program flow chart of the terminal collection node is shown in figure 6.

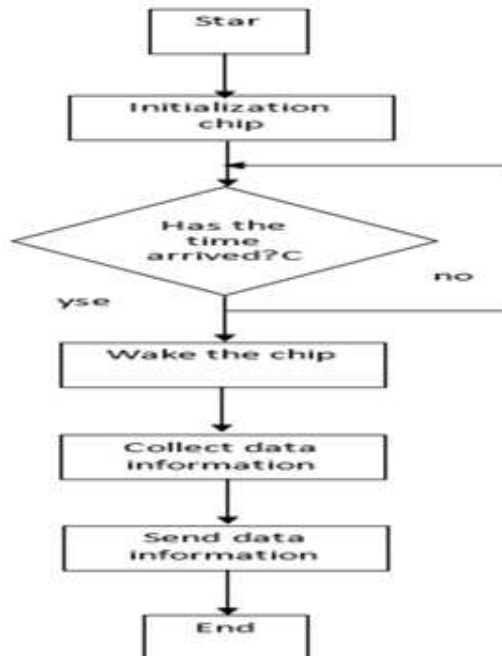


Fig. 5. flow chart of system

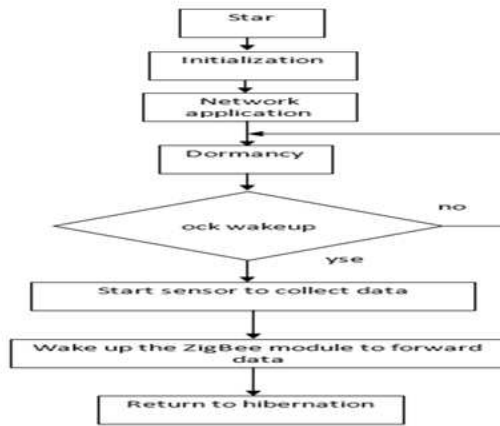


Fig. 6. program flow chart of terminal collection nodes

3.2. Program design of router

The router node must be initialized after power-up, such as the initialization of the peripheral part and the ZigBee protocol stack. But it just needs to rejoin or join the network without having to build a new network. If it is the first time to join the new network, it needs the necessary channel scanning first, and then select a suitable network, complete the join after get approval of the agreement; if the network is re entered, the parent device in the network structure is searched through the channel scan. After joining the network and entering the working state, the router's work is: data forwarding and approval of other new devices to join the network. The router program flow chart is shown in figure 7.

3.3. Program design of coordinator

The coordinator must first perform a power-on initialization before the operation, and then scan the channel, select a suitable channel and network sign. After the initialization is successful, the coordinator node automatically establishes the network and waits for the nodes of router and the terminal processor to join. Equipment to access the network first makes a request, after the information is correct, the node is allowed to enter the network, and assign it a 16 bit network address and some related parameters, finally, the relevant information of the new node is added to the neighbor list and the relation mapping table of the IEEE address and the network address. The purpose of constructing relational mapping table is to improve efficiency and reduce data transmission. When the terminal successfully joined the network, the coordinator node began to receive data from the terminal acquisition node, and this part of the data is stored in the data cache, then check the data to see if it is over standard or receive remote query commands, there is one to send

data to the remote, and then new data is received. The program flow diagram of the coordinator is shown in figure 8.

4. Design of system software

4.1. Host computer monitoring software

The host computer software refers to the data management function of real-time monitoring of remote monitoring data, intelligent analysis of data, high-speed access of data after processing by big data technology in the cloud, mainly include: Database management system module It is composed of database server and database. The database is responsible for storing data and managing data, the database server is responsible for data calls, analysis and access between the database and each module; System management module: responsible for the completion of the user's instructions; Data processing module: It is responsible for interactively process between the stored data and the received data in the database using data model, and the processing result is transferred to the management module. The host computer uses the Socket mechanism oriented to the TCP/IP protocol, while the programming language uses Visual C#. The structure of the monitoring system is shown in figure 7.

4.2. Lower computer monitoring software

The main function of lower computer monitoring software is to realize the establishment of ZigBee network, the acquisition and sending of sensor node data, the communication between coordinator and GPRS module, and the sending and receiving of GPRS module data, etc.. This part of the program uses the Z_Stack protocol stack (developed by TI), and uses the C# language in the IAR compiler environment. The requirements of intelligent building for the underlying data are: wide coverage, large amount of data, simply adding of network node, low energy consumption and so on. According to this request, the park information platform adopts the wireless network transmission technology of ZigBee protocol. The sensor nodes, router nodes, coordinator nodes and other hardware components are designed, and the corresponding program flow is designed according to this composition. In the aspect of system software, the coordination method of host computer monitoring software and lower computer monitoring software are designed.

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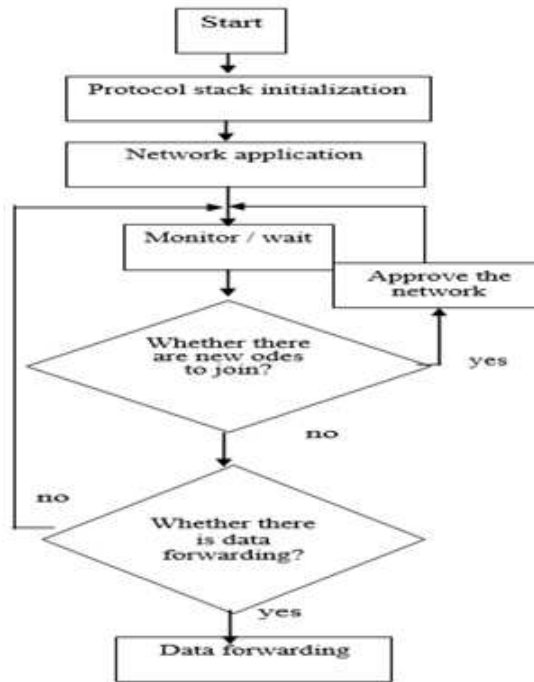


Fig. 7. program flow of the router

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