Intelligent Storage System based on RFID and ZigBee

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Abstract:- With the rapid rise of live broadcast e-commerce in recent years, a large number of fragmented orders have emerged. The traditional warehouse management and operation mode is difficult to cope with such a huge demand for goods in and out of the warehouse and warehouse security. Therefore, warehouse interconnection, IOT and visualization have become the direction and trend of warehouse development in the future. Intelligent warehouse is an Internet of things application scenario with great potential. Most goods have different environmental requirements for the warehouse. However, with the increasing demand for warehousing, it is difficult to manually input information in the traditional warehouse management system. According to the above analysis, this paper will use the relevant technologies of the Internet of things to realize the information, intelligent and integrated management of the traditional warehouse, improve the management efficiency of the warehouse, and then improve the efficiency of the enterprise.

Keywords:- Intelligent Warehouse; Internet of Things; Sensor; ZigBee；RFID.

I. INTRODUCTION

At present, the impact of the rapid development of the Internet, big data and the Internet of things has been integrated into the development of all walks of life. Under the social background of the rapid development of science and technology, the intelligent construction of warehousing has also been developed [1]. In particular, the emergence of live e-commerce has brought the scale of e-commerce into rapid development and poured out a large number of fragmented orders. The traditional warehouse management and operation mode is difficult to face such a huge demand for goods in and out of the warehouse and warehouse security.

At present, most small and medium-sized warehousing industries still use manual records for goods management. In the face of large warehousing and warehousing demand, this kind of record statistics method generally has some adverse conditions, such as difficult to update inventory information in time, difficult to find goods storage location, low level of warehousing information management, and it is difficult to ensure the timeliness and effectiveness of goods related data in warehousing, Greatly increase the management cost, and then affect the development of enterprises. This paper aims to solve the problems of complex data processing and lack of safety supervision in traditional warehouse management [2], and find a set of solutions for efficient out of warehouse data processing and multi-directional safety information monitoring for

traditional warehouse, so as to bring real benefits to relevant enterprises.

II. BACKGROUND KNOWLEDGE

A. Wireless sensor network technology

WSN consists of a large number of small sensor nodes arranged in a certain range. These nodes form a multi hop self-organizing network through wireless data transmission. WSN system is mainly composed of three parts, including sensor nodes, sensor networks and management users. Sensor nodes cover the nodes in a certain range in a certain way, and the whole range can meet the monitoring range according to certain requirements. Sensor nodes are generally micro embedded systems. The basic modules include: sensing unit, processing unit, communication unit and power supply. Wireless sensor networks have the characteristics of distributed self-organization, robustness, scalability, dynamic topology, application correlation, large scale, high redundancy, spatial location addressing and so on.

B. ZigBee Technology

ZigBee protocol is based on IEEE 802.15.4 standard. Since IEEE 802.15.4 standard only defines physical layer protocol and MAC layer protocol, ZigBee alliance is established, and ZigBee alliance standardizes its network layer protocol and API. And ZigBee protocol architecture divides it into four layers.

Physical layer (PHY): The physical layer defines the interface between physical wireless channel and MAC sublayer, and provides physical layer data service and physical layer management service.

Media access control layer (MAC): The MAC layer is responsible for single hop data communication between adjacent devices. The MAC sublayer controls the radio channel through CSMA / CA mechanism. His responsibilities may also include sending beacon frames, synchronizing and providing a reliable transmission mechanism.

Network layer (NWK): The network layer provides corresponding functions to ensure the correct operation of the MAC sublayer and provide appropriate service interfaces for the application layer.

Application Layer: The application layer is the top layer of the architecture, including application support sublayer (APS), ZigBee device object (ZDO) and application object defined by the manufacturer.

C. RFID Technology

A core technology of the Internet of things is identification technology. Bar code and QR code are one of identification technologies. They can record item information and inform the system, so that items without chips can also be connected to the network of the Internet of things. However, due to the replicability of bar code and QR code, there are some security vulnerabilities, so RFID technology is available.

Radio frequency identification (RFID) emits electromagnetic field from the identifier. Through the electromagnetic field adjusted to the frequency, the electronic tag attached to the article transmits the data. The electronic tag contains electronically stored information and can be identified within a few meters. In this paper, we use ZigBee technology and RFID technology to design the system [3], so as to realize intelligent storage and improve logistics efficiency.

III. ZIGBEE NETWORK OF INTELLIGENCE WAREHOUSE

A. Overall design of hardware structure

The hardware part of smart warehouse is composed of ZigBee terminal monitoring node, ZigBee coordinator, camera and computer. The smart warehouse collects a number of environmental information, collects the storage environmental information and goods in and out of the warehouse, and then wirelessly transmits it to the coordinator. After receiving the data, the coordinator transmits it to the intelligent warehouse management system of the upper computer through the serial port. The monitoring module transmits video to the intelligent warehouse management system of the host computer through the serial port. As the core unit of intelligent storage, the intelligent storage management system of upper computer is responsible for the processing, storage and display of storage information.

B. Hardware selection of ZigBee data acquisition terminal

In the design of the smart storage system in this paper, CC2530 is used as the chip developed by ZigBee Application. It has the main advantages of easy packaging, programmability, high output power and perfect TI official IAR development technology [4]. The functional block diagram is shown in Figure 1.
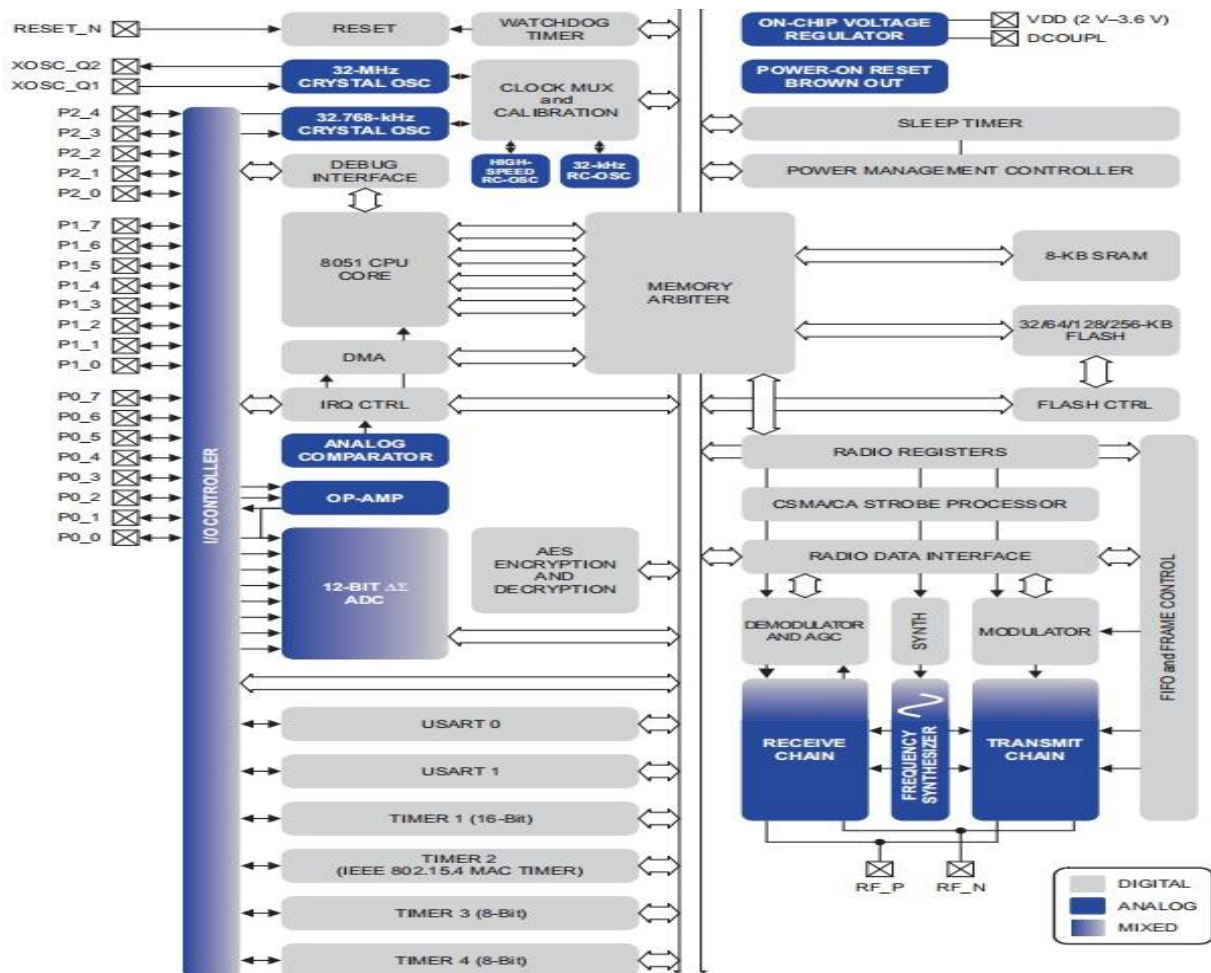

Fig. 1. CC2530 functional block diagram

C. ZigBee networking mechanism

ZigBee wireless sensor network is generally composed of coordinator, router and terminal node. ZigBee coordinator is responsible for components, maintenance and management of the network. It has strong information processing capacity and information transmission capacity. It can not only receive the data of the terminal or router for processing, but also send the data to each remote control terminal; The router node is the medium between the terminal node and the coordinator node, which is responsible for forwarding data packets, relaying the data communication between the terminal and the coordinator node, allowing the node to join the network and assisting its child nodes in data communication; The terminal node can be connected with the coordinator directly or through the router node, which is responsible for terminal data acquisition and control. ZigBee networking connection includes three connection modes: star connection, mesh connection and string connection [5].

Network initialization first determines the network coordinator, then scans the channel. After finding the appropriate channel, set the network ID. in a Zigbee network, there is only one coordinator. Active scanning searches for network information within the communication range of nodes, and selects the best and relatively quiet channel for recording according to these information. To join the network through the coordinator, the node needs to send association request command, wait for the coordinator to process, send data request command and reply in turn. The flow chart is shown in Figure 2.
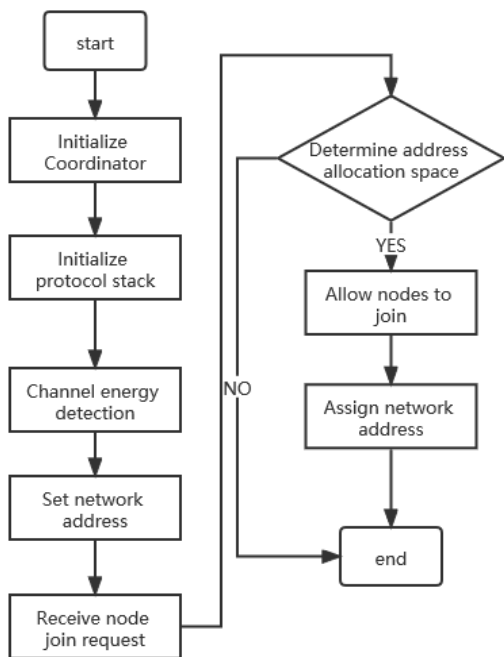

Fig. 2. ZigBee networking flow chart

D. Application of sensor in ZigBee

To build an application ZigBee network, first select a CC2530 node as the coordinator to compile and burn the CoordinattoEb-Pro program, and then use the other two CC2530 nodes as the terminal nodes to compile and burn the EndDeviceEb-Pro program. After power on, the data communication between the terminal and the coordinator in ZigBee network can be tested [6].

1) *Temperature and humidity sensor:* Cn Figure 3. Pin 1 is GND grounded, pin 2 is data serial data transmission, pin 3 is SCK suspended, pin 4 is VDD power positive, and the power supply voltage is 3.3 ~ 3.5V. After receiving the start information sent by MCU, the sensor changes from low-power mode to high-speed mode. After the start signal is completed, the sensor sends 40bit temperature and humidity acquisition data to MCU, Return to low speed mode after completing acquisition.
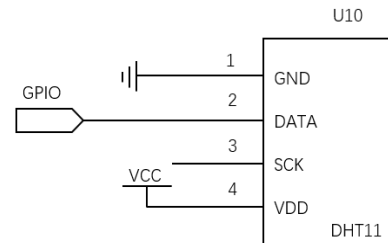

Fig. 3. DHT11 and CC interface circuit diagram

2) *Smoke sensor:* The development steps of mq-2 sensor on CC2530 single chip microcomputer are the same as those of DHT11 sensor. Mq-2 sensor needs a series of initialization work first, and then data processing and conversion. Its task flow chart is shown in Figure 4
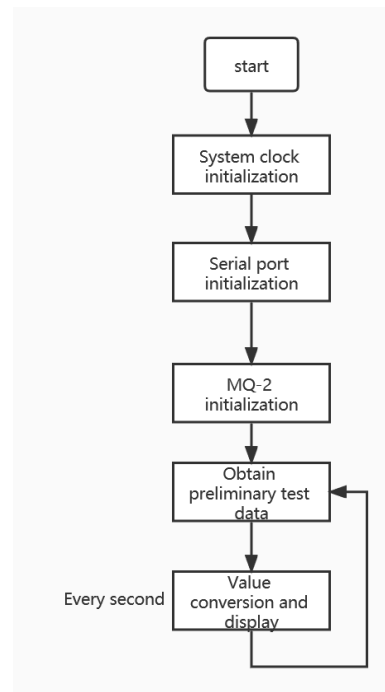

Fig. 4. Mq-2 task flow chart

1) *Working principle of RFID reader：* The reader / writer is composed of frequency emitting module and high flat magnetic field. It communicates with the chip through SPI (serial peripheral interface) serial port peripheral interface, and the communication speed is 10Mbps. The pin diagram of rfid-rc522 (RFID reader / writer) is shown in Figure 5.
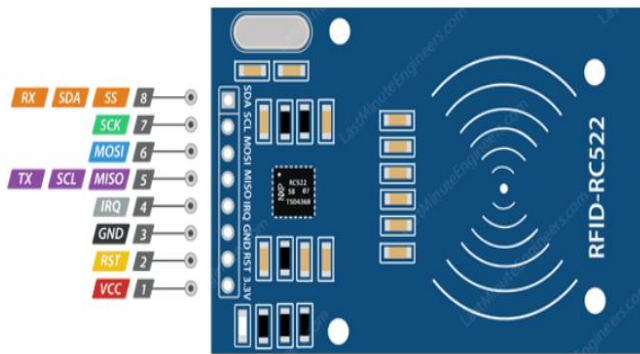
Fig. 5.   RFID reader pin diagram

Based on the ZigBee protocol of CC2530, this chapter uses DHT11 temperature and humidity sensor, mq-2 smoke sensor and rfid-rc522 to build a wireless sensor network, explains the working principle of each sensor, and realizes the functions of intelligent warehouse multi-point environmental monitoring, cargo information reading and wireless data transmission, which is ready for the next development of intelligent warehouse management system.

IV.   CONCLUSION

The intelligent warehouse management system based on RFID and ZigBee mainly takes the traditional warehouse as the research background [7]. Traditional warehousing mostly uses the management system with pure software function to manage the data information of warehousing, and the environmental information monitoring is separated, so the work efficiency is low. Therefore, the intelligent warehouse management system with highly integrated warehouse environment data monitoring and automatic processing of warehouse in and warehouse out data information will improve the plight of traditional warehousing and improve the efficiency of enterprises.

In the era of prosperity and development of the storage industry, the management efficiency of storage affects the development level and efficiency of enterprises. The intelligent storage system based on RFID and ZigBee adopts Internet of things, software and other technologies to improve the storage management mode, ensure the environmental safety of goods storage and improve the management efficiency of goods in and out of storage.

The smart storage system based on RFID and ZigBee is composed of CC2530 single chip microcomputer, various sensor hardware and smart storage management system software. After a series of rigorous system function tests, the hardware part realizes the functions of storage environment data collection, warehousing data collection and wireless data transmission; The software part realizes the functions of automatic processing and storage of storage data, visual display of data, generation of warehousing data report and so on. The goal of improving the efficiency of warehouse management has been realized.

Because of the lack of research conditions, the speed of goods in and out of warehouse detection can not meet the expected effect, and the functions of goods management are not rich enough. Therefore, there is a large room for progress in the later stage [8]. Therefore, the future development direction of the system is to further improve the speed and stability of goods in and out of warehouse detection, and improve the function and user experience of the system.

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