Based on Zigbee Technology Greenhouse Monitoring System

Mingtao Ma and Gang Feng

Jilin Agricultural Science and Technology College, Jilin, 132101 China
mmt800@126.com

Abstract. This paper account of the features of farmland greenhouse designs the corresponding monitor system.based on the self-designed test platform, the paper introduces the key issues of farmland greenhouse sensor network, analysis of the mechanic structure and network topology of wireless network protocol,designs the hardware structure of the system, and complete the software of the system.The experiment proved that the system is easy to use, stable and reliable,has a certain practical value.

Keywords: Zigbee, Network, Monitor.

1 Introduction

The weather is cold in winter in the northern part of China and it doesn't fit for the growth of various crops. However with the development of people's living standard and the need to enlarge the vegetable market in winter, the greenhouse provides a good artificial environment for the growing vegetables. While most of the current greenhouses are controled by artificial methods, it is difficult to collect and adjust various environmental parameters on time and accutately. Part of the greenhouses adopt the indicator parameters of the wired communication technology monitoring system, it still exists the shortcomings of the high cost of installation and maintenance, system power consumption , not flexibility. ZigBee is a low complexity, low power, low-cost, full-duplex wireless communication technology, this paper features this technology to the greenhouse environment monitoring.

2 The Introduction of Zigbee

ZigBee is a wireless personal area network technology, which fits for the occasion of small amount of data communication, the low rate of data transter but with a certain requirements for security and reliability of data. It develops the physical layer and data link layer standard according to IEEE 802.15.4 and ZigBee Alliance developed standards of the network layer and the application layer according to the wireless communication network . ZigBee supports three network topologies[1]: star-shaped network, the tree network and mesh , it is difficult to achieve high-density expansion with relatively poor flexibility and limitd coverage. Tree structure keeps the advantage

Z. Du (Ed.): Proceedings of the 2012 International Conference of MCSA, AISC 191, pp. 737–740.
springerlink.com

of simplicity of the star topology and needs only small upper routing information low memory requirements and low costs. Network structure has greater flexibility, scalability, reliability, but with complex structure and routing information , high cost and difficulty to maintain.

There are three logical network devices: coordinator, router and end devices. Coordinator: launching a new network, setting the network parameters, managing network nodes and storage nodes information in the network, network, only one coordinator, the other nodes as routers and; router: responsible for the routing information within the network; end devices: the node to achieve sense, among these coordinator and router have the functions to let devices join or leave the network.

3 System Components and the Working Process

The system uses a tree topology[2], and is composed of PC, coordinator, routers and end monitoring nodes ,and communicates with the monitoring computer with 485 interfaceof the structure of the system is shown in Figure 1.

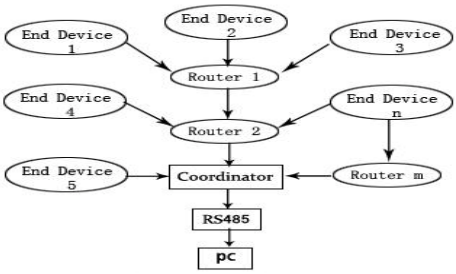

Fig. 1. System structure

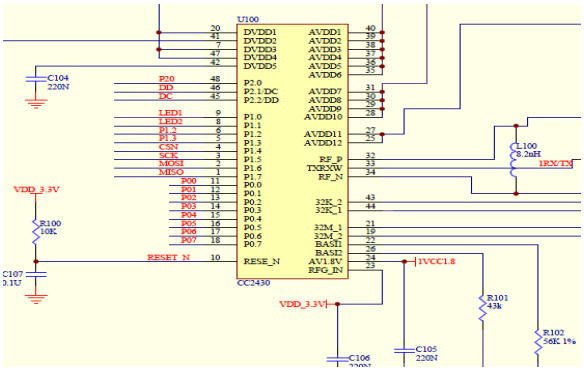

Fig. 2. Node of electric circuit

Coordinator starts the whole network, receives commands from PC and sends data or control commands from PC to the nodes directly or through router. Router is used as a transit point for data transmission, the node can communicate to the coordinator through multi-level routing; terminal nodes collect a variety of environmental information, send them to the coordinator through a router or directly and control temperature and humidity of the greenhouse through the intelligent control algorithm according to the instructions received from the coordinator.

4 System Hardware Design

System hardware includes the following parts: node design, power supply circuit, the serial circuit. Node circuit is shown in Figure 2, using TI's CC2430 as a core device.

In order to ensure system reliability and low power consumption, the coordinator is supplied by the main power directly. Routers and end monitoring nodes are supplied by using 3.3V battery-power. System power supplying circuit is shown in Figure 3.

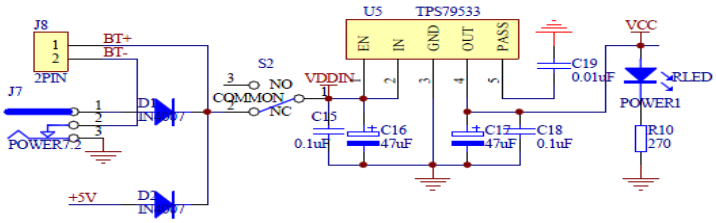

Fig. 3. System power supply circuit

5 Software Design of System

As the network coordinator, it can be divided into two parts according to the functions : network creation and management ; data transfer. The former is mainly responsible for the formation of a ZigBee network distribution network address and maintenance binding table. Coordinator creates a new network by scanning an empty channel to maintain a current list of connecting devices and support independent scanners to ensure that previously connection device can be able to rejoin the network. The latter is used as a gateway between Zigbee and RS485 and connect the two networks using different protocols together and converts the data with each other. Controller software flow is shown in Figure 4:

Coordinator is responsible for starting the network and initializing the hardware and the network, set up a ZigBee wireless sensor networks. Then the coordinator node is entering the wait state, waiting for a command sent by the PC or the information sent to the coordinator node .

6 Technical Difficulties

Ultra low power consumption can extend the life of the network nodes and the node energy consumption is in three areas: data acquisition of sensor components, data storage and data processing of micro-processing unit and wireless module receiver / transmitter. Among these the largest energy consumption is in the RF signal transmission process. Setting the node sleep and wake-up mechanism can minimize energy consumption. There is only 1.6μA current and 0dbm output power when the node is in deep sleep, the average current is about 250μA to wake up period of 1s.

ZigBee routing nodes[3] can participate in route discovery, data transmission, routing maintenance and expansion of the scope of the network, controlled by the ZigBee coordinator and it must be FFD. ZigBee end-nodes can only participate in routing mechanism through its parent node , which can be FFD or reduced functionality devices (RFD).

Fixed network nodes wireless sensor are the main carrier of connecting greenhouse wireless sensor nodes , with relative stability. In the process of setting up fixed network nodes , the connecting bandwidth of the nodes and the redundancy should be fully considered. Bandwidth of the network connecting decides the regional data load capacity, and redundant routing is the basic guarantee of adapting network. When a fixed node generates a fault, the junior nodes can automatically select other routes in order to maintain the network connection, that is adaptive nature of network failure.

7 Conclusion

Testing and actual operation proves that the use of the characteristics of ZigBee wireless technology realizes wireless automatic monitoring and controlling of the environment of greenhouses, and solve the problems of existing transmission such as the high cost, wiring complexity, maintenance problems, poor flexibility and scalability, save human resources and it is good for greenhouses's intelligent and unified management. At the same time, some minor changes to the system can be applied to other wireless sensor networks, which has great application value.

References

[1] Song, W., Wang, B., Zhou, Y.B.: Wireless Sensor Network Technology and Applications. Electronic Industry Press (March 2007)
[2] Li, W., Duan, C., Zig, B.: Wireless Networking Technology and Real Practice. Beijing Aviation and Aerospace University Press (April 2007)
[3] Lvzhi, A., Zig, B.: Networking Principles and Application Development. Beijing Aviation and Aerospace University Press, Beijing (February 2008)