

# Design of Greenhouse Environment Wireless Monitoring System Based on ZigBee

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**Abstract.** In the greenhouse environmental monitoring, the wired sensor networks have some problems, for example, complex wiring, inflexible sensor location, cable aging and corrosion and so on. To solve the above problems, we use ZigBee technology to build a wireless sensor network for monitoring temperature, humidity, light intensity, carbon dioxide concentration. And each node is low-power design. Based on the Modbus protocol, we built RS-485 bus to achieve the communication between a number of greenhouse sensor networks and upper computer (PC). The system has advantages such as flexible sensors placement, low power consumption, easy installation maintenance and expansion, low cost, strong practicability.

**Keywords:** ZigBee, wireless sensor networks, RS485 bus, Visual Basic 6.0.

## 1 Introduction

Greenhouse cultivation techniques let agriculture break down geographical, natural environment and other factors' constraints; it has great significance for agricultural production. Greenhouse cultivation environment such as temperature, humidity, carbon dioxide concentration, light intensity is an important factor influencing crop, so a good environmental monitoring and control of greenhouse is an important measure to ensure that greenhouse production[1]. The wired sensor networks have some problems, for example, complex wiring, inflexible sensor location, cable aging and corrosion and so on. And maintenance is difficult[2-3]. The greenhouse environment wireless monitoring network was designed based on ZigBee technology. Sensor nodes and the network coordinator node are low-power design. The network coordinators communicate with the host computer in the monitoring center via RS485 bus.

## 2 Overall System Design

Wireless monitoring system of the greenhouse environment consists of wireless sensor nodes and the network coordinator nodes located in the greenhouse.

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The network coordinator nodes of greenhouses connect to the host computer in the control room by the RS-485 bus. Managers can view real-time environmental parameters of greenhouses by the PC. Taking into account the size of the greenhouse within the communication range of wireless sensor nodes, this wireless network system only sets up a network coordinator node (FFD) and several sensor nodes (RFD), no router nodes. Considering the wireless network coverage, power and reliability, choose a star topology[4].

According to the characteristics and requests of the greenhouse environmental monitoring, we build a wireless sensor network includes a coordinator node and six wireless sensor nodes. The network coordinator nodes and wireless sensor nodes are built based on the CC2430, and the network coordinator placed among the top of greenhouse. Coordinator node is responsible for establishing and managing the network, and communicating with the host computer through RS485 bus. Sensor node is responsible for data acquisition and data transmission to the coordinator node, and receiving command of the host computer coming through the coordinator node.

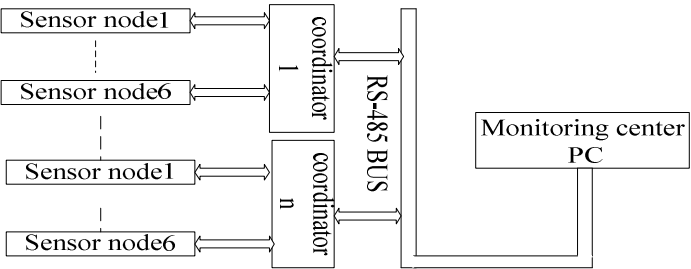


Fig. 1. Overall system plan

### 3 System Hardware Design

#### 3.1 Sensor Node Hardware Design

Sensor nodes of wireless sensor networks typically contain the sensor unit, processor unit, the wireless communication unit and power unit[5]. CC2430 ,the chip Chipcon Introduces, is used to implement the embedded ZigBee applications, uses an enhanced 8051 MCU, 32/64/128 KB flash memory, 8KB SRAM and other high-performance modules, and contains the ZigBee protocol stack, integrated RF transceiver which support 2.4GHz IEEE 802.15.4/ZigBee protocol. The chip also includes analog-digital converter, 3 timers, AES128 coprocessor, watchdog timer, the sleep mode timer of 32 kHz crystal oscillator, power-on reset circuit, power failure detection circuit, and 21 programmable I/O pins.