

Design of Rolling Machine Intelligent Control System for Greenhouse Based on Internet of Things

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Abstract. This paper designs a new rolling machine intelligent control system for greenhouse based on Internet of things (IOT). This system consists of ZigBee module, light sensor, controlled circuit, remote control unit, mobile, computer, AC contactor, limit switch, display circuit and keyboard. According to the general information of the time, light intensity outside, temperature and vegetable kind in the greenhouse and so on, ZigBee module decide whether the rolling machine should be opened and how many angles for open. Users can also operate it manually or remotely. The system realizes the intellegent control of roll blind machine for greenhouse. After a long work verification, the system has the performances of safety and reliability, low cost and can be embedded into agricultural IOT.

Keywords: IOT; Greenhouse; Rolling machine; Intelligent control.

1. Introduction

In recent years, the IOT technology has been gradually playing an important role in the field of agriculture. To improve the production and quality of agricultural products, and save manpower and material resources, modern information technology is used to guide agricultural production, which is the agriculture development direction. China has made significant achievements in agricultural greenhouse engineering facilities, high-yield cultivation and quality safety production technology. Modern greenhouse technology mainly uses the automation equipment to adjust the crop growth environment according to the collected factors, such as temperature, humidity, and light intensity, etc.

In traditional agriculture, farmers can only rely on intuition to control the rolling machine. With the development of science and technology, modern agriculture is developing towards the intelligent direction [3]. Agricultural IOT can solve the problems, such as whether fruits and vegetables needs watering, fertilizing, spray insecticide, and how to ensure the temperature, moisture, light, CO₂ concentration of the greenhouse[4]. Modern intelligent monitoring and control system can improve the growth environment for the crops [5]. Of course, farmers can also manually operate the system via mobiles, computers, buttons and keyboard.

Rolling machine is used to keep the stable temperature and suitable humidity for the vegetables and fruits in the greenhouse. Introducing the new technology and advanced equipment is beneficial to improve the environment and save labour [6]. This paper presents a new rolling machine control system which can intelligently send the useful related data to the users and accept the control commands.

2. Overall System Framework

The intelligent control system uses ZigBee module as the core, which can communicate useful information with mobiles and computers, and send the commands to the controlled circuit of the rolling machine. The remote controller can realize the near distance wireless control of the machine. At the same time, manual switches can also change the working state of the machine. The overall system framework is shown in Fig. 1.

ZigBee module acquires the data from the light intensity, air temperature and humidity and sends them to the computer with Internet access via the gateway. The computer sends the data to intelligent mobile. The administrators can inquire the data from sensors and send control commands to the

rolling machine via the mobile or the computer. The computer can analyze the gathered information and prepare for agricultural big data. The farmers can modify the pre-set air temperature and humidity via the mobile, the computer or the keyboard. The displaying screen can show the current time and date, pre-set parameters and collecting sensor information of many nodes. Several important parts are introduced in the following.

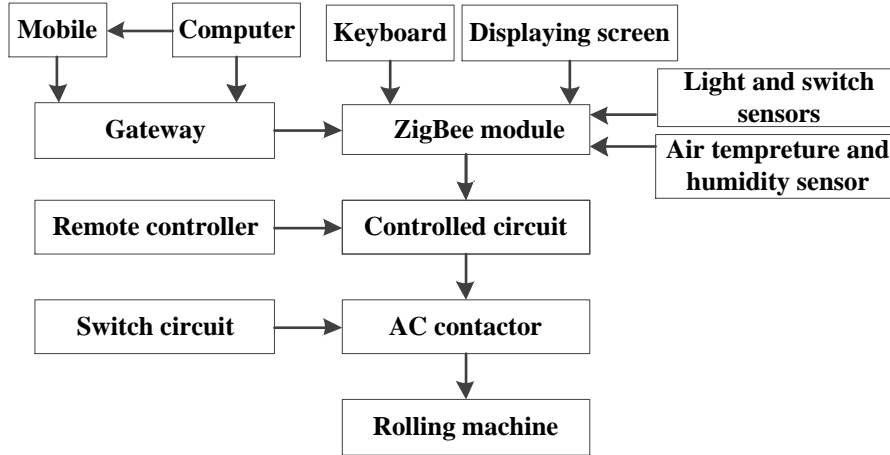


Fig. 1 The overall system framework

3. Zigbee Minimum System

The CC2530 is chosen as the control core. It is a true system-on-chip solution for IEEE 802.15.4, Zigbee and RF4CE applications. The CC2530 combines the excellent performance of a leading RF transceiver with an industry-standard enhanced 8051 MCU, in-system programmable flash memory, 8-KB RAM, and many other powerful features. This system adopts CC2530F256 with 256 KB of flash memory. The detailed minimum system diagram is shown in Fig .2.

This chip can collect the light intensity, air temperature and humidity, compare them with the pre-set values and consider time and date, decide whether the rolling machine should be opened and how many angles for open. Zigbee has ad-hoc network function, so the moisture data can be sent between nodes, and at last the related information can be accepted by the computer and mobile with the help of gateway.

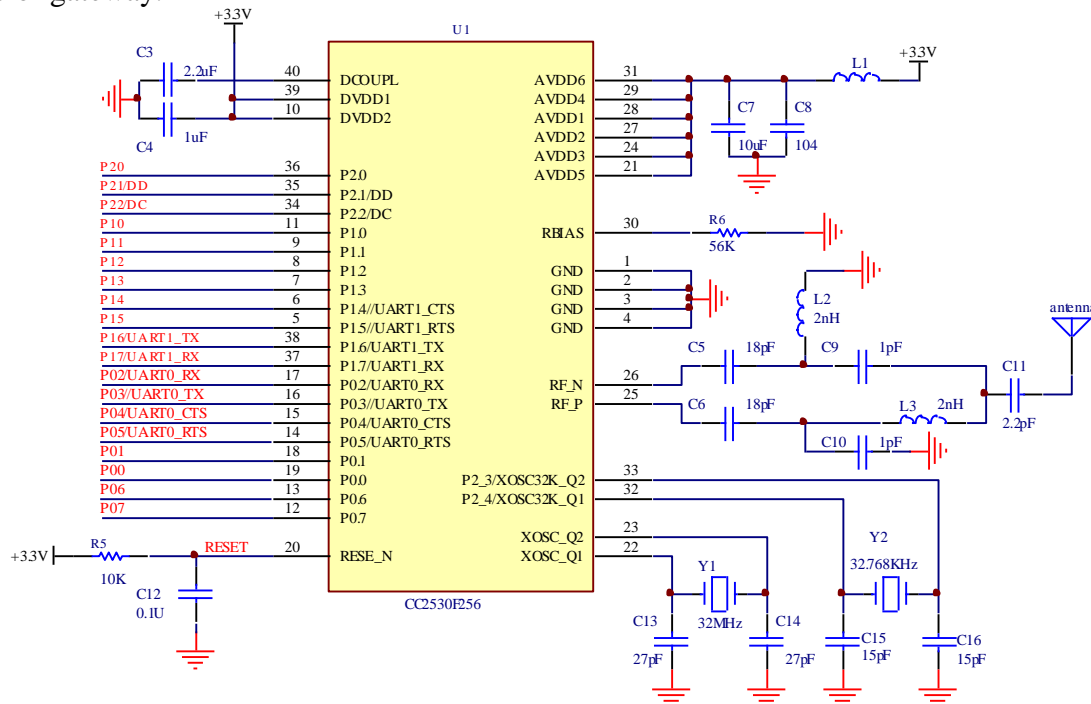


Fig. 2 CC2530 schematic diagram

4. Remote Control Unit

Remote control unit uses PT2262/HS2272 to design the wireless transmitting and receiving modules, respectively, and the products are shown in Fig. 3. The communication distance of the device with the operating voltage range 3-12V can reach above 1000 meters, which can satisfy the application in the greenhouse.

The transmitter has 3 keys representing for the commands ‘up/down/stop’. The receiver gains the corresponding information to operate the rolling machine. The users can control the machine at the entrance without entering the greenhouse.

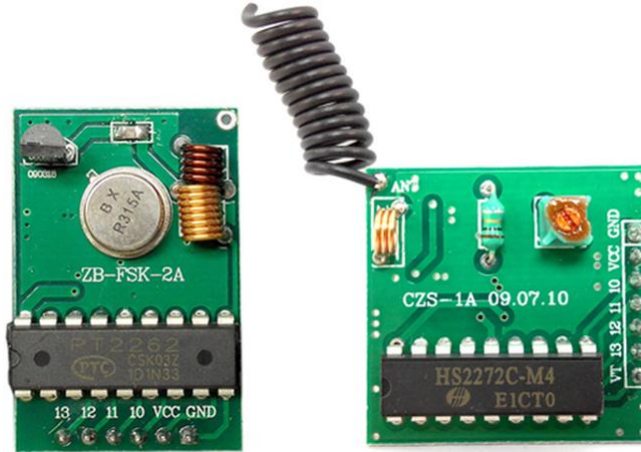


Fig. 3 Products of remote control unit

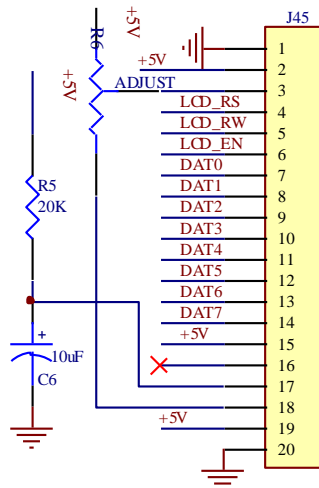
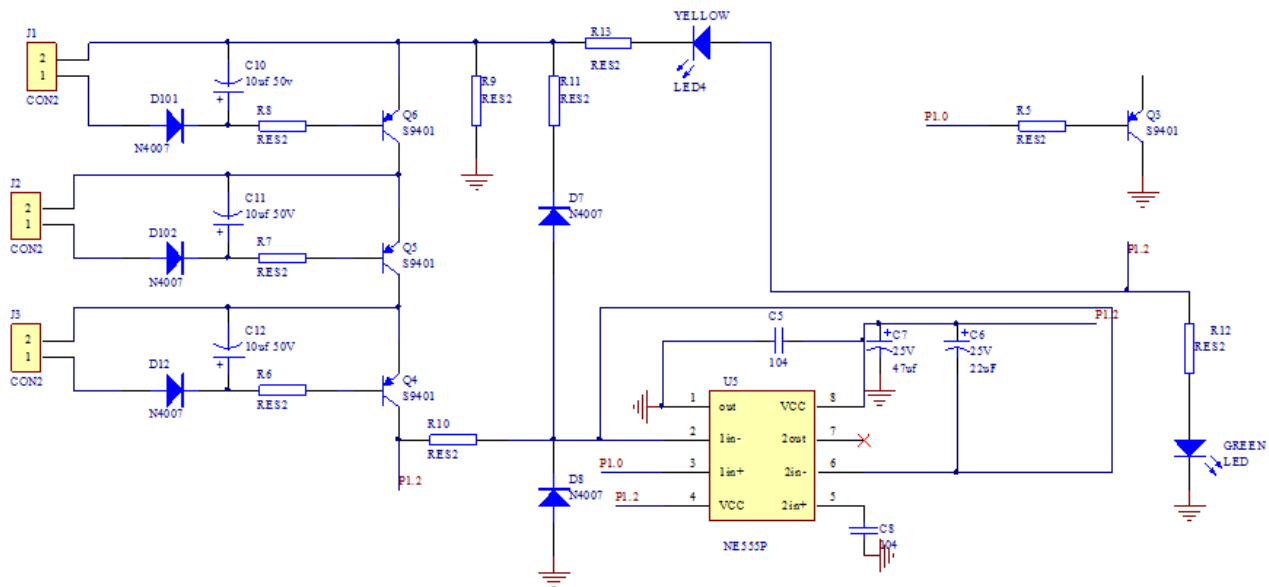


Fig. 4 Displaying circuit schematic diagram

5. Displaying Circuit Design

Displaying circuit adopts LCD12864 which can show the current time and date, light intensity, air temperature and humidity values of many nodes and the states of the rolling machine. As shown in Fig. 4, LCD12864 with 20 pins communicates with CC2530 by DAT0--DAT7, LCD_RS, LCD_RW, and LCD_EN. DAT0--DAT7 means transmitting data or commands. LCD_RS decides DAT0--DAT7 representing data or commands. LCD_RW means 'read' or 'write' operation. LCD_EN gets a pulse, and data or commands have been written in the LCD12864.



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