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Design of Intelligent Greenhouse Management and Control System

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Abstract

In order to achieve real-time monitoring of the temperature environment and adapt to the current trend of agricultural intelligent development, the traditional greenhouse design has weak functions and many restrictions. For this reason, a greenhouse model was made and the system based on a single-chip microcomputer was developed through sensors. Monitor and adjust the greenhouse environment so that it has the functions of temperature control, watering and irrigation, and light adjustment to promote the growth of crops. The system realizes the scientific and efficient management of the greenhouse.

Keywords

Smart Greenhouse, Single Chip Microcomputer, Sensor.

1. Introduction

In agricultural production, many environmental factors such as temperature and humidity, soil pH, water content, and inorganic salts are very important, and they all directly affect the growth quality of agricultural products. In the greenhouse management system, the temperature, humidity, carbon dioxide content, light intensity, and soil conditions inside the greenhouse must be grasped in real time, which can effectively ensure the growth of internal crops in a good environment [1]. At present, many greenhouses use different equipment to ensure the growth of crops, but these equipment require manual and uninterrupted real-time monitoring operations, which has many inconveniences. At present, in order to improve the growth environment of crops and monitor and adjust the environment in the greenhouse, an intelligent greenhouse management and control system has been gradually established to implement effective intelligent adjustment of various parameters and perform automated management.

2. Overall system plan

The system consists of three parts: a test system, a control system, and a control system. The test system uses temperature sensors, humidity sensors, carbon dioxide concentration sensors, light intensity sensors, etc., through environmental testing, and feedback the obtained environmental sampling information to The control system, the control system adopts STM32 single-chip microcomputer, which is relatively powerful in function. Through the control system, the control system is turned on and the system is adjusted.

3. Subsystem design

3.1 Temperature control system

The temperature sensor selected is the DS18B20 digital temperature sensor, which is small in size and has a large temperature measurement range. It is between -55°C and +125°C. It has high measurement accuracy and low use cost. Its external state can correspond to changes in use conditions.

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The change [2]. The system needs to collect multiple points of temperature to ensure the accuracy of the collected data. This is in line with the characteristics of the sensor. The sensor does not require an external circuit. Each sensor has an independent serial number, enabling multiple sensors to be hung on one. Detect the temperature of multiple points on the data line [3].

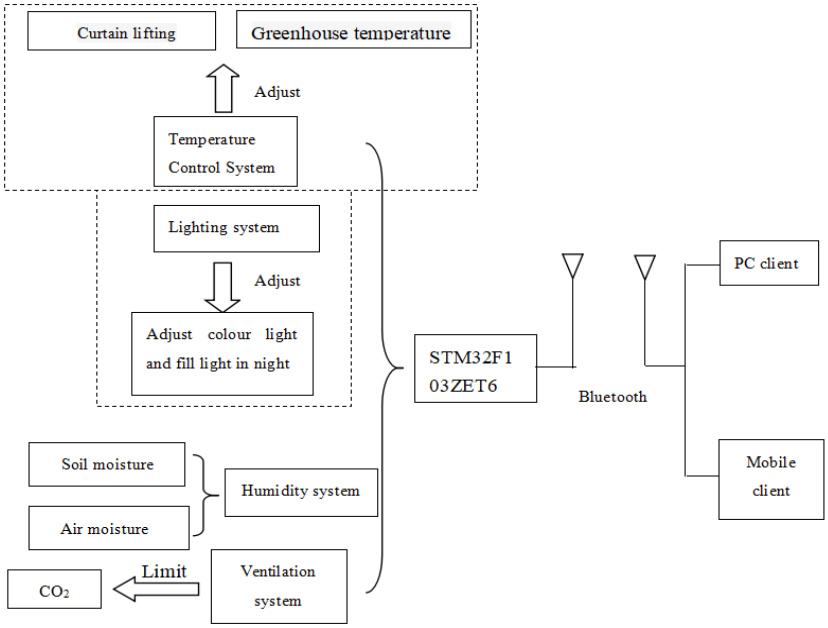

Figure 1. Control system diagram

The system mainly collects temperature data in the greenhouse through the DS 18B20 temperature sensor, and transmits the collected data to the control system, and displays the temperature value on the 12864 LCD display. The single-chip microcomputer compares the collected temperature data with the preset temperature The range is compared, and the processed adjustment behavior is input into the indoor temperature adjustment system so that the temperature in the greenhouse is always maintained in the range suitable for the growth of crops, and the volume is autonomously controlled by the range of light intensity set at the beginning (judging day or night) The lifting of the curtain.

3.2 Humidity control system

The sensor is arranged on the root of the plant, and in order to ensure the accurate nature of the measured data, it is advisable to adopt multi-point arrangement and multi-point measurement to prevent accidental measurement data. The sensor feedbacks the humidity status to the control system through the detection circuit and displays it on the 12864 LCD display. From the measurement data, the control system determines the current state of the sensor, and then controls whether the water mist system sprays water to adjust the air humidity. If the soil moisture is higher than the preset threshold, the irrigation will be stopped; if the soil humidity is lower than the preset threshold, water will be supplied through the solenoid valve connected to the water source.

3.3 Ventilation system

The system adopts the MG111 carbon dioxide sensor and uses the principle of solid electrolyte. The sensor has a high sensitivity to carbon dioxide in the air to collect the CO2 concentration in the air. After processing the data through a single-chip microcomputer, the ventilation system is intelligently controlled to turn on according to the established data, and the response to 12864 LCD display On the screen. Crops are more sensitive to the concentration of carbon dioxide, too high or too low concentrations are not conducive to crop growth. Through the intelligent adjustment of the ventilation system, the carbon dioxide concentration is limited to the most reasonable range, which is beneficial to the increase of crop production.

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3.4 Lighting system

The illumination system consists of a single-chip microcomputer, adjustable light quality LED, and light intensity sensor. The main part of this part is to fill in the light at night and adjust different colors of light.

(1) Night supplement light: The system monitors the data through the light intensity sensor and transmits the collected data to the control system. The control system compares the collected data with the set value, and then adjusts the intensity of the light emitted by the light source to compensate Light reduces the respiration of crops in the greenhouse and ensures photosynthesis to achieve the ultimate goal of a reasonable increase in crop production [4].

(2) Adjust the color light: This part is mainly based on the different color light absorption for different plants in different periods. According to the current scientific research, the demand value of different color light in different periods is set for the crops grown, and the single-chip microcomputer will be set according to the preset The value adjusts the color light emitted by the adjustable light quality LED light source, so that plants can make better use of light energy.

4. System hardware design

The system mainly uses the STM32F103ZET6 series chip as the core of the data processing single-chip microcomputer. STM32F103ZET6 is an embedded-microcontroller integrated circuit (IC), which is one of the STM32F1 series developed by ST. The core size It is 32-bit, the speed is 72MHz, the program memory capacity is 256KB, the program memory type is FLASH, and the RAM capacity is 48K. This series of chips has the advantages of small size, low cost, and high performance. Its development freedom is high, and its processing performance is strong. It can stably realize data processing and system control. At the same time, the system plans to use Bluetooth modules to connect to mobile phones and other terminals for real-time detection and control. The Bluetooth module HC-06 slave module can be directly connected to various single-chip computers. The Bluetooth is a slave device. The slave device can pair with various smart terminals with Bluetooth function. The slave devices cannot be paired. The data processed by the single-chip microcomputer is transmitted to the terminal app via Bluetooth, and the operation of the system can be manually controlled in real time through the app.

5. Conclusion

The design uses a greenhouse control system based on STM32 to monitor the environment in the greenhouse in real time and make corresponding adjustments to achieve the most suitable environment for crop growth and increase crop yields. This design is close to the current concept of agricultural intelligence advocated in China. Promote the development of agriculture on the basis of this, and reduce the burden of working people.

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