The Research and Design of Intelligent Control System for Greenhouse based on the Internet of Things

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Abstract: The intelligent monitoring and control system for greenhouses based on the Internet of Things uses gas sensors, temperature sensors, humidity sensors, illuminance sensors, infrared sensors, etc., to measure various parameters in agricultural production processes with high precision, and intelligently control temperature, humidity and ventilation in the greenhouse. It can automatically achieve insulation, moisturize and data recording, and monitor the internal environment of the greenhouse. The main content of this paper is to build a greenhouse environmental intelligent monitoring system, and design the overall technical architecture, main modules and main functions of the system.

1. Introduction

China is a big country with agriculture and population, and agricultural production plays a pivotal role in the development of the national economy. Under the macro background of the country's vigorous development of modern large-scale agriculture, the green environmental protection and precise intelligence of the agricultural production process are gradually becoming the mainstream development direction [1].

Using the Internet of Things(IoT) technology, real-time remote monitoring of soil moisture content and pH in greenhouses, lighting, temperature and humidity in the greenhouse, and even monitoring of pests and diseases can be realized. With the corresponding control system, remote control and automatic control of the shed environment can be realized, the most suiTable growth environment for crops can be created, the regulation and management of greenhouse crop production can be realized, crop yield can be improved, production level can be improved, and modern agricultural construction can be promoted.

2. IoT Overview

2.1 Concept.

In order to further understand the IoT, we need to analyze its concept through the following two aspects. First, the IoT is a device that connects wireless transmission technology to the Internet, and can understand the operation of the system [1]. When the device is connected with cloud computing technology. When connected, it can form a monitoring and management function with automation features. Second, the application of IoT technology in agricultural work mainly uses remote sensing monitoring technology to monitor the growth of crops in greenhouses and automate management, reducing the use of manpower and improving production efficiency and production quality.

2.2 Advantage.

In the analysis of the IoT, the advantages can be sorted out through the following two aspects. First, because the growth of greenhouse crops is affected by the environment, temperature, climate, etc., it is difficult for planters to pay attention to the growth quality of crops. The problem of negligence affects the output of greenhouses [2]. However, when applying the IoT to intelligent control of greenhouses, the system can monitor the growth of crops and automatically process crops to ensure

sTable growth of crops and improve crop yield and quality. Second, due to the influence of carbon dioxide and light intensity in the greenhouse on the growth quality of crops, the application of the IoT can rationally adjust the environment and increase crop yield. In addition, because the greenhouse intelligent control system can intelligently adjust the environment inside the greenhouse, ensure the sTable growth of crops, and timely identify the problems and improve them, can promote the development of agricultural production, improve production efficiency and quality.

3. Design strategy of intelligent control system for greenhouses in IoT

When applying the IoT technology to adjust the greenhouse greenhouse intelligent control system, it is necessary to properly construct the system technology, which can be understood through the following below two aspects.

3.1 The operation monitoring equipment setup.

When using the IoT technology to control the greenhouse greenhouse intelligently, it is necessary to set up the operation monitoring equipment. Specifically, it can be understood through the following two aspects [3]. First, because the greenhouse greenhouse intelligent control system can measure the temperature, humidity and light of the greenhouse. Strong data is intelligently monitored. In order to further improve the operational stability of the monitoring equipment, it is necessary to properly design the monitoring equipment, as shown in Fig. 1.

Fig.1 Monitoring module schematic

3.2 Build a data aggregation system.

When designing the greenhouse greenhouse intelligent control system, it is necessary to construct a data summary system, which can be understood through the following two aspects [3]. First, because the temperature and humidity data in the greenhouse will change in different periods, in order to understand the greenhouse greenhouse intelligent control system the operation situation needs to bring together relevant data to provide a basis for data analysis work, but in this process, there is a large amount of data information. Second, because the data can reflect the planting situation, and then the data needs to be compared when analyzing the planting situation, but because the greenhouse greenhouse intelligent control system does not have the ability to aggregate the data, the analysis efficiency is not high, in order to improve the status quo. It is necessary to construct a numerical comparison analysis system, which can automatically analyze and sort the data.

4. Design of intelligent monitoring and control system for IoT in greenhouse

4.1 System technology architecture.

The core of the IoT-based greenhouse intelligent monitoring system is the WiFi router and the embedded gateway, both of which transmit information through the WiFi coordinator. The user

interacts with the system through a GPRS module, a wireless router, and the like; the system acquires information of each sensor node through the WiFi router, and adjusts the agricultural environment by executing a node control relay. Combining the characteristics of crops and IoT technology, from the perspective of technical architecture (as shown in Fig. 2), it mainly consists of the sensing layer, the network layer, and the application layer [4].

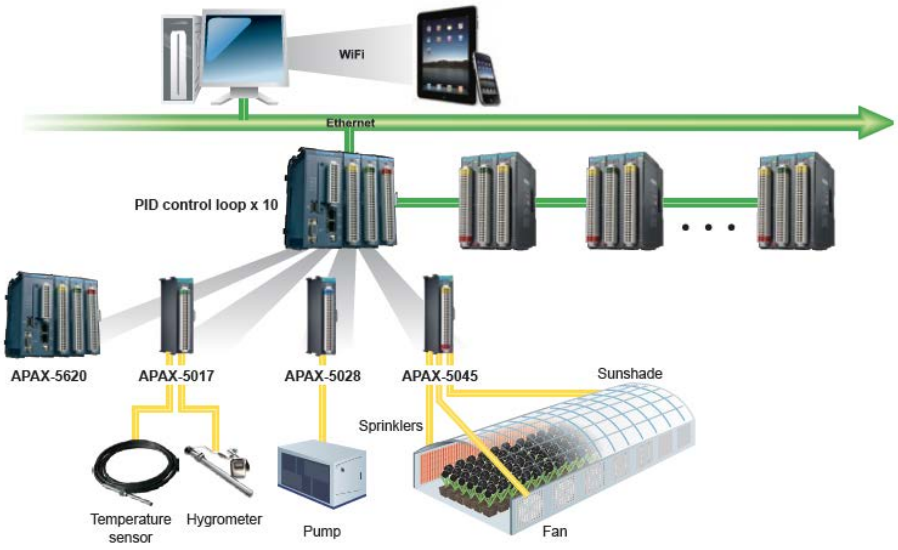

Fig.2 System architecture

The sensing layer is composed of various sensors and sensor gateways, including carbon dioxide concentration sensor, temperature sensor, humidity sensor, two-dimensional code label, RFID tag and reader, camera, GPS and other sensing terminals; it is mainly used to collect greenhouse agricultural planting sites. Important environmental parameters such as soil temperature and humidity, air temperature and humidity, light intensity, and soil pH. The network layer is composed of a network management system and a cloud computing platform.

The application layer is located at the highest level of the system, and mainly includes various management devices and display devices. It is an interface between the IoT and users (including people, organizations, and other systems) to realize intelligent applications of the IoT.

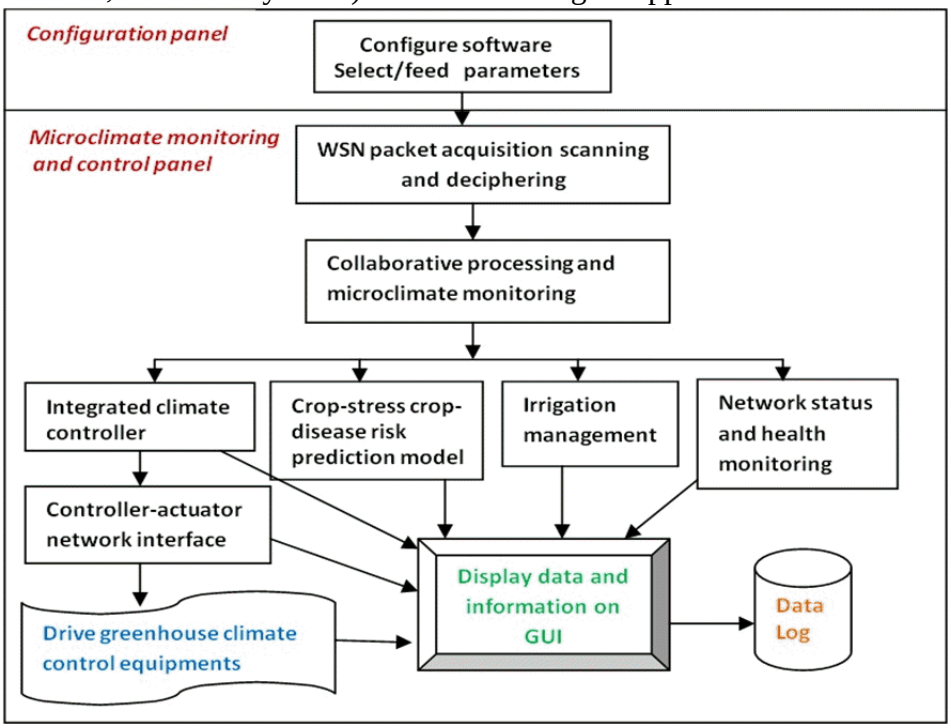

Fig.3 Design principle module

4.2 System design principle (in Fig.3).

Greenhouse greenhouse intelligent monitoring and control system deploys WiFi node-based wireless sensor network as sensing layer according to actual situation, real-time collection of greenhouse temperature, humidity, light intensity, soil temperature, soil Humidity, soil pH value, foliar temperature, dew point temperature and other important environmental parameters, and through the integration of WiFi and GPRS heterogeneous network as a network layer, the collected information parameters are effectively and reliably transmitted to the monitoring information center, monitoring information center as the top of the whole system, the system application layer is formed based on the configuration software, and the purpose of information sharing is achieved through database storage and network interaction. Users can access the monitoring system WEB interface through computers and mobile phones to master real-time dynamic information such as crop growth and environment [4].

4.3 The main application module of the system [5].

The system is designed to intelligently control the greenhouse. Its main functional modules include climate monitoring, soil pH detection, humidity temperature control, spray module and environmental water and atmospheric circulation, as shown in Fig. 4.

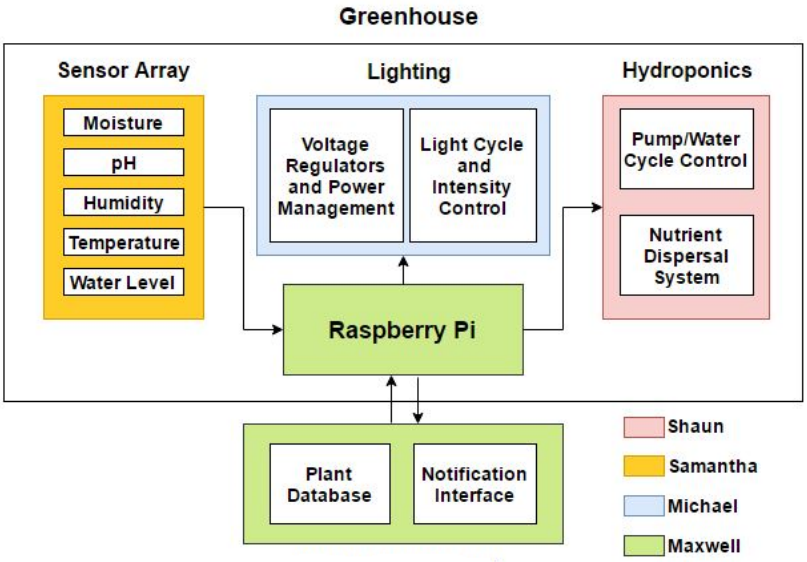

Fig.4 System function module design

1) Gas monitoring and management module. The gas monitoring and management module uses a resistive semiconductor gas sensor, which is the core of the gas monitoring and management module and is installed in the probe. The main gas sensors used are oxygen sensors, CO2 sensors, etc., through which the gas concentration is monitored in real time, and the data is sent to the user by the embedded gateway.

2) Temperature and humidity monitoring management module. The ambient temperature and humidity are detected by the temperature and humidity sensor. During the growth of crops, when the ambient temperature and humidity do not meet the requirements, the adjustment is made by a heater and a humidifier.

3) Illumination monitoring management module. Lighting is more important in the growth process of crops. The monitoring of light is of great significance to intelligent agriculture. The illuminance monitoring management module uses a photoresistor to collect illuminance information.

4) Infrared sensing management module. The infrared sensing management module uses a specially designed sensor to specifically detect infrared rays of a specific wavelength emitted by an ordinary human body. Once someone enters the detection area, when the human body infrared rays are irradiated to the sensor, the charge will be released outward due to the pyroelectric effect, and the subsequent circuit generates a control signal after being detected and processed.

4.4 Main functions of the system

1) Monitoring of planting environment data [6]. High-precision measurement of data parameters such as temperature, humidity, light intensity, soil temperature, soil moisture and soil water content in greenhouse greenhouse production process, through wired or wireless the network is passed to the data processing system to intelligently control the temperature, humidity and ventilation conditions in the greenhouse, automatically realize the insulation, moisturizing and historical data recording, and display it to the user in an intuitive chart and curve.

2) Error alarm. The system sets the alarm threshold such as temperature and humidity. When the monitored point data is abnormal, an alarm signal can be automatically issued. The alarm mode includes on-site multimedia sound and light alarm, network client alarm, mobile phone short message alarm and so on. Upload alarm information and perform local and remote monitoring, the system can notify different on-duty personnel at different times [6].

3) Planting video surveillance. In the nursery stage, users can view the video surveillance images inside the greenhouse through remote access of 4G mobile phones or PCs at any time and anywhere to remotely monitor the growth process of crops.

4) Equipment management. Users can view the operation status of all automation equipment in the room at any time and any place through mobile phone or computer, and can carry out remote automation control and management.

5) Data query. You can view the real-time planting data information of the greenhouse, including the greenhouse number, planting variety, air temperature and humidity, light intensity, soil temperature and humidity, and the number of sunshine. The data can be selected by selecting the name of the greenhouse and the variety of vegeTables grown [7].

6) Planting analysis. The system compares the collected values to compare the growth and growth of the same crops in each greenhouse (video image comparison, analysis of the influence of planting environmental factors on the growth and yield of vegeTables, forming a scientific and low cost Planting to increase the yield and quality of vegeTables [7].

7) Data analysis and summary. The system displays the collected values and spatial distribution status to users in an intuitive form, and provides historical reports such as daily reports and monthly reports.

8) Security monitoring. When someone around the greenhouse appears, the security information collection node sends a signal to the main control center and alarms at the same time.

5. Summary

In summary, in the process of production of Chinese agriculture, in order to further improve efficiency, it is necessary to rationally apply the IoT technology, analyze and design the greenhouse cultivation situation, and build a greenhouse greenhouse intelligent control system, but this equipment will be externally Environmental impact, reduce operational stability, in order to improve this situation, it is necessary to install a monitoring system in the greenhouse greenhouse intelligent control system, timely understand the operation of the greenhouse greenhouse intelligent control system, promote the development of agricultural intelligence, and ensure the sTable growth of agricultural products.

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