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Intelligent agricultural greenhouse system

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Abstract

What is changing is the era, and what is progressing is technology. Of course, the improved technology also includes agricultural farming methods. In the traditional extensive planting methods, crops are too much affected by factors such as seasons and weather, so changing to agricultural greenhouse technology improves the development of agriculture. It is impossible to measure real-time environmental parameters in the traditional mode of agricultural greenhouses. Therefore, people cannot know the best growth environment of those crops, and the unilateralism and disadvantages in actual planting. For today's agricultural greenhouse technology, our smart agricultural greenhouse technology is based on the websocket protocol to view the real-time parameters of the environment in the greenhouse. Users can set the growth stages and types of different crops in different agricultural greenhouses through a small program. Our system will use the experience of relevant professionals to judge the growth of crops in the greenhouse. So that crops can grow in the most suitable environment, thereby improving the quality and yield of crops and reducing human resources.

Keywords

Production efficiency, websocket; Wireless sensor network technology, Remote, agricultural greenhouse.

1. Introduction

To the people foodstuff is all-important,and there are many farmers in the world. It is these farmers who sell food for a living that feed people all over the world. However, the grain harvest is seriously affected by the weather, and even there is no grain harvest in the year of drought and flood. It is urgent to study an intelligent agricultural system to remedy this shortcoming.

2. Related research

Yanhui Cheng[1] integration and differentiation (PID) was taken as the research subject, and the greenhouse temperature model was constructed by mathematical expression, the simulation effect charts under the simple fuzzy control and PID control were obtained, and the results were compared.

Anuradha MR, Apoorva Raghunandan the greenhouse by actuating a cooler, foggier, dripper and light respectively in accordance with the necessary conditions for the plants[2].

Temperature and humidity control in agricultural greenhouses is very important to the growth of crops. Now most greenhouses have not entered intelligent control, and basically they rely on farmers' own feelings to adjust the temperature and moderately. Jamel Riahi a fuzzy controller was designed to manage a greenhouse indoor climate by means of an asynchronous motor for ventilation, heating, humidificat[3].

At present, the greenhouse area in China has exceeded 480,000 hm2, and most greenhouses are still controlled manually[4]. This requires not only a lot of people to help but also a lot of material resources. In order to increase crop yield and reduce labor force, Liu Lan designed an

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intelligent greenhouse control system based on Internet of Things,compared with the traditional greenhouse, the newly designed greenhouse has more perfect and guaranteed control over the living environment of crops[5].

3. Functional design

Intelligent agricultural greenhouse system consists of the following functions, as Figure 1 :

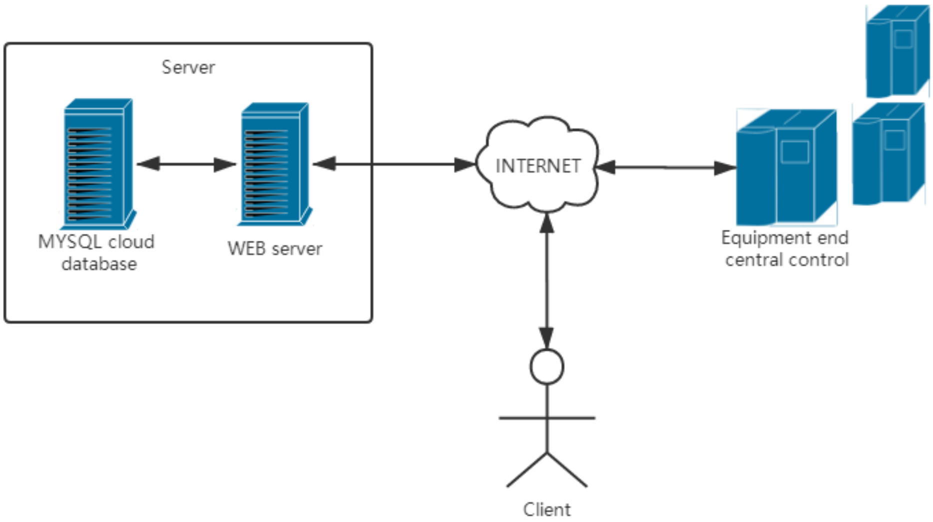

Figure 1: System Model Diagram

3.1. The client side

user login and registration
real-time data
disease identification
equipment management
abnormal warning
system settings
data statistics

3.2. The equipment side

sensor management
data acquisition
abnormal report
sensor distribution network
image acquisition
data processing

Server Function Module as Figure 2:

4. Detailed design and implementation

4.1. Design ideas

This system is an intelligent agricultural greenhouse developed on the basis of the current advanced computer intelligent system for farmers to use. In order to ensure the stability of farmers' grain harvest, users enter a small program to inquire whether the local cache has cache id and key. If so, request the dynamic key from the server, mix and encrypt the dynamic key and the static key, and carry real-time data: the server receives the real-time data sent by the device and sends it to the user through web socket.

The applet will detect whether the sensor is offline or not through the received data, and display offline or update to the page according to the data.

In the intelligent agricultural greenhouse system based on Internet of Things technology, Han Dong can store greenhouse detection data and data set by monitoring personnel through the parameter setting module through bidirectional electrical connection with the processor, and the monitoring personnel can extract the data in the storage module through the USB module through electrical connection with the input end of the USB module, which is convenient for data summarization and research[6].

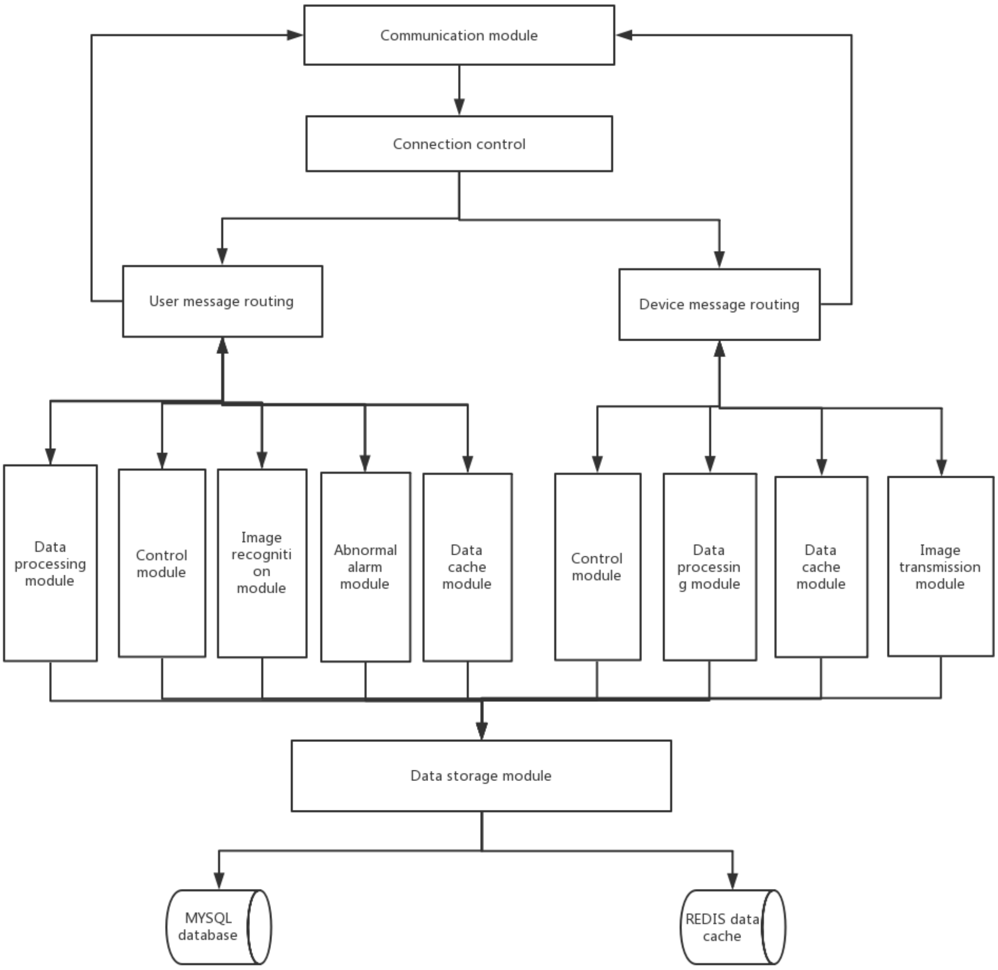

Figure2 Server Function Module

Disease identification: After the server receives real-time image information from the equipment, it processes the image to make the features of the image more obvious. Then, the image is recognized by the pre-trained convolutional neural network model, and the prediction result and the image are sent to the user. After receiving the real-time image sent by the server, the user can judge whether there is a disease according to the abnormal field. If so, the application interface will pop up a prompt to remind the user that the image is suspected of disease, and update the image to the page. If not, judge whether the current page is in abnormal disease state, and if so, update the page to normal page.

Equipment management: the user can view the current equipment list, bind and unbind equipment through the equipment management page. Update the device list on the page after receiving the device list from the server. Temperature and humidity acquisition module. DHT11 is connected with a single chip microcomputer to form a temperature and humidity acquisition module [7]. A module for collecting carbon dioxide concentration. This system uses MH-Z14A carbon dioxide sensor to measure carbon dioxide, and communicates with MCU through serial communication [8].

4.2. Hardware requirements

The development of this intelligent agricultural greenhouse system needs 89C51 single chip microcomputer, A/D conversion circuit, temperature detection circuit, humidity detection circuit, control system, computer and domain name.

Light intensity acquisition module. The microcontroller measures the current flowing through the resistor through a PCF8591A/D converter module, and then substitutes the value into a specific formula to determine the illumination intensity. Circuit diagram of photoresistor and A/D converter [9].

4.3. Function realization

The client side

1) user login and registration

The user login registration function module includes user registration and verification code generation. User login authentication, user connection authentication. The connection between users and servers is realized through web socket. When using the system for the first time, users need to register and log in. After the user successfully logs in, the user id and static key are saved locally, and then the web socket connection is established. When establishing web socket connection, it is necessary to obtain a dynamic key, encrypt the dynamic key and the static key, and generate a connection key, which can be used by users to send connection requests to the server. If the authentication passes, the connection is successfully established, and if the authentication fails, the connection is disconnected.

2) Real-time data

The server actively forwards the sensor data reported by the device to the user through the web socket connection between the server and the user.

3) Disease identification

In advance, the system trains healthy plant leaves and diseased leaves to generate recognition models. The server recognizes the plant leaf images through the pre-built deep learning model, and judges whether the plants are infected. After the recognition is completed, the identified pictures and recognition results are actively sent to the user side.

4) Equipment management

The server verifies the binding status of the equipment by querying the database, and completes the binding or unbinding of the equipment. When the equipment end sends the current equipment list, the server checks whether the equipment status is normal, and forwards it to the user if it is normal; if the equipment binding fails, it notifies the equipment end to release the binding status between the central control equipment and the equipment.

5) Abnormal warning

Call the SMS notification interface to send SMS notification to the mobile phone number bound by the user and send abnormal reminder to the user.

6) System settings

Save the user's system settings to the cloud server and synchronize the settings to the device.

7) Data statistics

Filter the user's environmental data in the database, calculate the average value of environmental data per hour and send it to the user.

Equipment side

1) sensor management

Manage the sensors and actuators connected to the central control equipment, monitor the online status of the sensors, and adjust the data acquisition interval of the sensors.

2) Data collection

Obtain sensor data through MQTT, and report real-time data to the server.

3) Exception reporting

If the monitoring data exceeds the range set by the user, an alarm will be given.

4) Sensor distribution network

The central control equipment sends the network configuration package to the sensor through UDP broadcast packet. After the sensor grabs the configuration package, it connects to the local area network through the acquired configuration information, and reports the sensor information to the central control equipment, and then the central control registers the sensor with the server.

5) Image acquisition

Collect the crop images in the greenhouse regularly through the camera and report them to the server.

6) Data processing

Convert the parameters displayed in the sensor into practical values and present them.

5. Conclusion

Most of the existing greenhouses are equipped with various devices, but most of them need human operation to detect the environmental data in the greenhouse, and then compare the data with the specified data range, and then use the devices to regulate and control various values in the greenhouse. There are many greenhouses that need to be managed, so an intelligent agricultural greenhouse system based on Internet of Things technology is urgently needed, Aiming at the shortcomings of the prior art, this study provides an intelligent agricultural greenhouse system based on Internet of Things technology, which solves the problem of artificially controlling the environment in the greenhouse. Based on the combination of computer and intelligence, an intelligent agricultural greenhouse system is developed, which effectively guarantees the production and life of farmers. So that farmers don't have to look at the sky to eat, but also to ensure the food and clothing of compatriots around the world.

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References

[1] Xianzhong Liu: Research Status and Design Principles of Intelligent Greenhouse, Jilin agriculture, Vol. 16 (2019), p. 89-93.

[2] Tang K , Yuan H and Lv J: Developing an Intelligent Monitoring Technology for Airport Stone Column Machines, Sensors, Vol. 20(2020), No. 11, p. 42-50.

[3] Tadili R , Dahman A S : Effects of a solar heating and climatisation system on agricultural greenhouse microclimate, Renewable Energy, Vol.10(1997), No.4, p. 569–576.

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[4] Xianwei Cui:*RESEARCH ON INTELLIGNET GREENHOUSE MONITORING SYSTEM BASED ON INTERNET OF THINGS*. (B.S., Qingdao university of science and technology, China 2018), p.28.

[5] Lan Liu,Penggang Li,Chunlin Liu,Yuyao Zhao,Yilong Tan: Design of Intelligent Greenhouse Control System Based on Internet of Things, South agricultural, Vol. 50(2019), No.16, p.70-75.

[6] Dong Han:Research on Intelligent Agricultural Greenhouse System Based on Internet of Things Technology, Electroacoustic technology, Vol. 43(2019), No.10, p.24-25+31.

[7] Shouyan Zhang:*Research on Intelligent Greenhouse Control System Based on ZigBee*.(B.S.,Qufu normal university, China 2014), p.32.

[8] Linlin Tang: *Design and Implementation of Intelligent Monitoring System for Vegetable Greenhouse*, (B.S.,Shandong University, China 2010), p.35.