

Key Technologies of Intelligent Control of Agricultural Greenhouse

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Abstract

With the network communication, automatic control, and software technology, the ecological environment factors should be simulate to meet the needs of different plant growing, such as temperature, humidity, light, air, solar ultraviolet radiation, soil temperature and humidity. According to the preset parameters, accurate measurement of greenhouse climate, soil parameters (control the film, wet curtain fan, biological light, irrigation and fertilization) and other environmental control equipment, automatic control system achieves the optimum range for plant growth, provides the best environment for plant growth.

Keywords

Internet Of Things, Greenhouse, Intelligent Technology.

1. Introduction

The environmental factors have great influence on crop production, such as temperature, humidity, light intensity etc. In recent years, people use the greenhouse planting method to improve people's living standards with more convenience, rapid promotion and application [1].

It is known that crop growth is closely related to environmental parameters in real-time acquisition, such as temperature, humidity, light, temperature, moisture and CO₂ concentration, etc [2]. According to the crop growth real-time requires, the agricultural greenhouse intelligent system automatically open or close the specified environmental control equipment to keep the the greenhouse running on economic energy state, to realize unmanned automatic operation, reduce energy consumption and cost, to provide an ideal environment for plants, to reduce the labor intensity, to improve the equipment utilization and the greenhouse climate, to reduce pests and increase crop yield [3].

The intelligent control of agricultural greenhouse system is shown in figure 1.

Using the technology of mobile phone, PDA, computers and other information terminal managers, the networking pushes a real-time monitoring information and alarm information to users, which realizes the greenhouse information and intelligent remote management [4]. Making full use of networking technology in the greenhouse environment to ensure the most suitable for the growth of crops with good conditions (high quality, high efficiency, ecological safety) and help customers to reduce cost and increase income. The intelligent control system mainly includes: the sensing terminal, the wireless sensor network, the communication terminal, the control terminal, the monitoring center and the application software platform [5].

2. Internet of things monitoring technology

Internet of things monitoring is the key technology of intelligent agricultural greenhouse control system. The monitoring includes temperature, humidity, soil moisture, CO₂ concentration, etc. These

monitorings are equivalent to the eyes of the entire control system, can monitor the real-time greenhouse conditions. The following are the various control parameters.

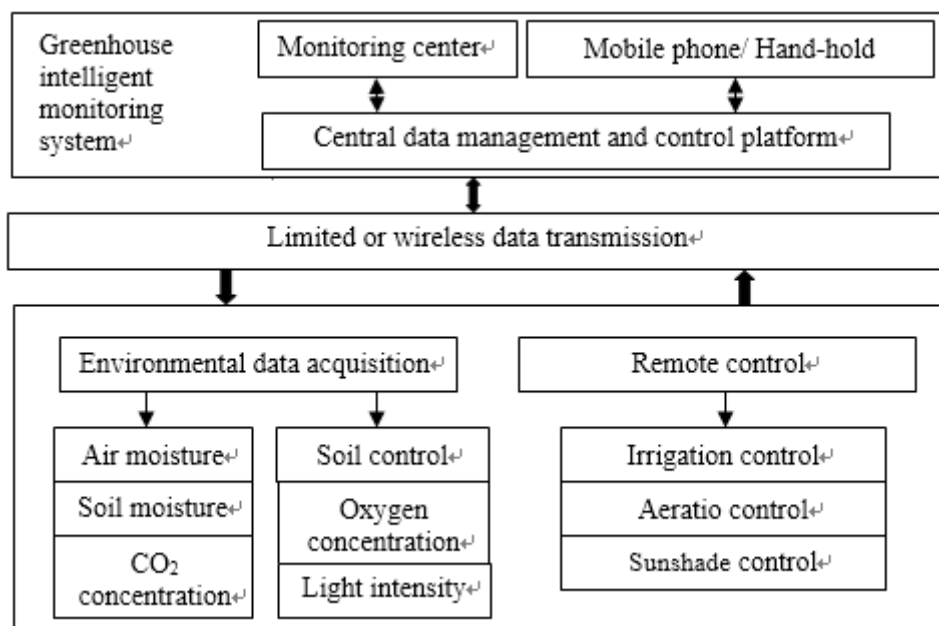


Fig 1. Intelligent agricultural greenhouse technology

2.1 Temperature control

Temperature control includes the cooling and warming systems. In summer, the temperature is high, and the air needs to cool down. We can use natural and forced ventilation cooling way to cool. According to the deviation of the target temperature and the actual temperature, the controller can calculate the change of temperature. The calculation is as follows: the top window is opened for natural ventilation to adjust the temperature in the greenhouse. After that, if the temperature value can not be reduced, then the side window is opened. If natural ventilation can not reduce the temperature value in the greenhouse, the wetcurtain pump start to opened, while the high temperature alarm are opened which can prompt the user to increase the cooling equipment.

The automatic heating system commonly is used in cold winter. The heating mode is calculated by the controller according to the deviation between the target temperature and the actual temperature. The temperature is controlled by adjusting the opening degree of heating thermostatic valve.

2.2 Ventilation control

The temperatures difference between the upper, middle and lower parts are collected by sensor, and calculated the difference in the room. If the difference is too large, the circulation fan will be opened automatically. The same as to the indoor humidity, if the humidity value deviation is too large, the circulation fan is also automatically open to balance the indoor humidity deviation value.

The ventilator can be operated automation by the computer or manual mode by operator.

2.3 Light control

Light control includes filling light and shading. The sensitivity computer system collect the outdoor meteorological illumination value, and set comparison with the target value. When the target value is higher than the computer, the system automatically start to pull screen to shade. When actual light lower than the target value, the machine automatically folded outside the curtain. The whole process can be controlled by the controller, or by the staff through the controller.

The filling light control is computed through the comparation value between the sensitivity light value and the target value. When higher than the target value, the lights are automatically shutted off. When lower the target value, the fill lights are opened by setting time.

2.4 Moisture control

The automatic water control is compared with the set target value and the soil moisture value by computers. When the target value is higher, the automatic valve is automatically closed. When lower than the set value, the valve opens to irrigation.

The water timing can be set by the wheel irrigation method, including a certain period of time and times per hour. Fully effective irrigation can not only protect the water pump, but also make the soil better absorb moisture.

2.5 Video monitoring

Video monitoring is an effective supplement to the data information, which is based on network technology and video signal transmission technology. The video monitoring system is composed of a network video server and a high resolution camera. The network video server mainly provides the conversion and transmission of the video signal, and remotes the network video service.

Through the Internet network and user permissions, the video monitoring can be used to remote image access, multi-point, online, convenient monitoring. Temperature detection in greenhouse is shown in Figure 2.

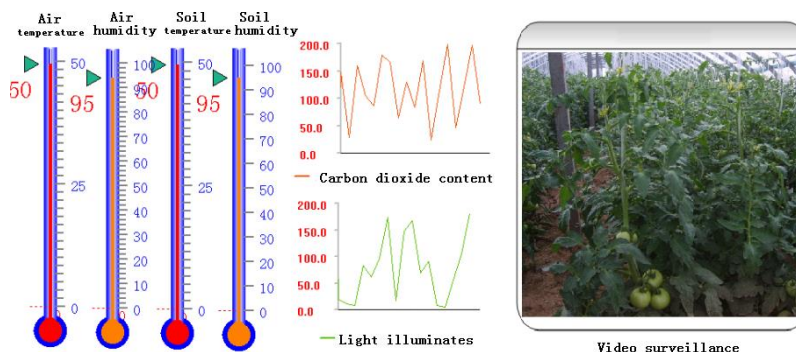


Fig 2. Greenhouse temperature detection

3. Network transmission

The LAN / Ethernet transmission technology is used to achieve real-time, stability, multi functionality (environmental monitoring, video surveillance) public network, and easy to manage, cost savings. The network transmission system is shown in Figure 3, including computer, switch, monitoring host, monitor, measurement extension, etc..

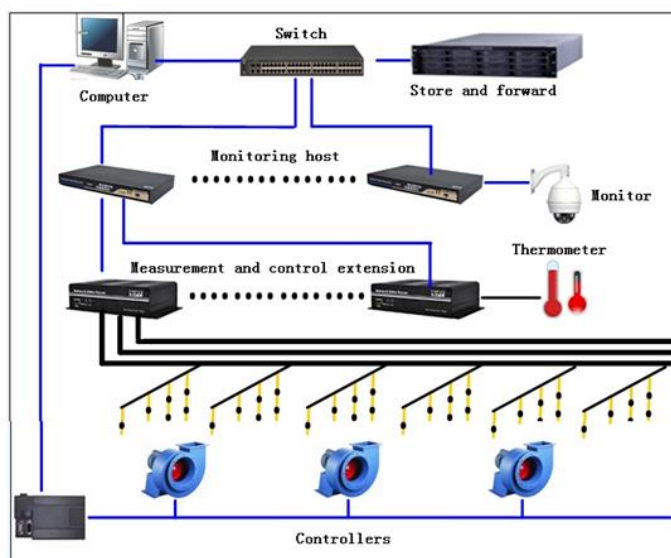


Fig 3. Schematic diagram of network system

4. Information transfer

The transmission of information through the two-dimensional code scanning. When scanning the two-dimensional code in planting link, we can get the information of watering, fertilizing, planting, planting, breeding, production management, etc.). When scanning the two-dimensional code in logistics links, we can get dealer information, logistics company information, and logistics process related information (storage time, transport time, out of time, etc.). When scanning the two-dimensional code in inspection report, we can get the quality inspection report information in other sectors, such as base information, product information, etc.. The information transfer schematic is shown as figure 3.

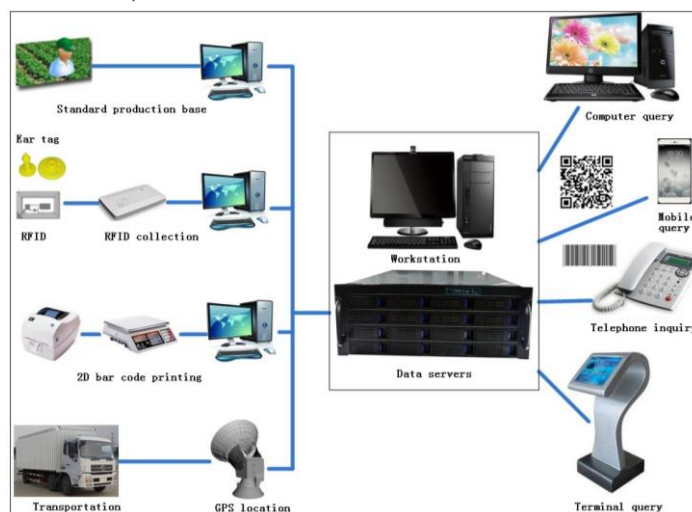


Fig 4. Schematic diagram of information transfer

5. Control system

Host control system likes the brain, implement a variety of control programs, according to different environments, crops and growth phase.

The system control monitoring equipment, light sensing equipment, meteorological sensing equipment, video sensing equipment and other equipment to unified storage, processing and mining. the central control software make the intelligent decision to form effective instruction and automatic control, such as wet curtain fan, spray drip irrigation, exterior shading, roof windows side windows, heating, lighting to directly control the microclimate, with excellent growth environment for the growth of crops.

6. Conclusion

According to the growth of crops requires real-time intelligent decision, the intelligent networking system automatically control agricultural greenhouse environmental parameters (air temperature, humidity, light, soil temperature, soil moisture etc.) under automatic monitoring, automatic control and intelligent management of facilities which provides the best environment for plant growth.

Acknowledgements

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