
Design of Greenhouse Monitoring System based on Internet of Things Technology

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Abstract

Internet of things technology is a new technology, applied in agricultural greenhouse. It includes information collection, automatic control of equipment, information release and intelligent processing. This technology can improve the production management efficiency and save labor. At the same time, it is very convenient for all agricultural research and other areas by providing a strong theoretical support with a scientific data.

Keywords

Internet of Things, Greenhouse, Monitoring.

1. Introduction

At present, traditional production method is still dominated in agricultural production in many developing countries. The farming was irrigated by experience, not only waste a lot of manpower and material resources, but also pose a serious harm to environmental protection and water and soil conservation, and set a serious challenges to the sustainable development of agriculture[1].

Internet of things technology (IOT) is a new technology, connecting all kinds of sensors and the existing Internet with mutual perception. In future, every grain of sand on the earth may be assigned to a certain address, and its various states and parameters can be perceived with this technology[2, 3]. How to combine IOT and modern agricultural greenhouse to accurate management of large-scale cultivation under the guidance of real time information technology is a urgent task of the scientific research[4, 5].

2. Greenhouse control system design

Some key points are resolved in control system design with advanced software design conception, advanced software and hardware equipment, Compliance with international standards and industrial standards, a high degree of openness and the provision of equipment in the technical compatibility and full escalation and expansion possibilities.

2.1 System functional characteristics

(1) Energy conservation and environmental protection.

Low power design, using solar power to supply for most equipment in the region of power is not convenient.

(2) Wireless technology

Using Zigbee, 3G and other wireless technology. The installation and the carrying are convenient. The installation and the carrying are convenient, the cost is reduced, and the fire hidden trouble caused by wiring is avoided. Users can break through the time and geographical constraints, the situation at any time to understand the production site.

(3) diversity show

Using many different display modes like LED display, LCD TV, computers, mobile phones, etc. Fully combination the integration of modern agriculture and modern optoelectronic information technology.

(4) Automation

Using the automated technical to collect regular data of the large scale agricultural production enterprises, improve the accuracy and reliability of data acquisition, so that workers can focus on the analysis and collation of data.

2.2 System components

In view of the modern agricultural demand and the development of the automation system with the overall solution, the system mainly includes three parts: information collection, automatic control, information release and intelligent processing.

Information collection includes greenhouse air temperature and humidity information monitoring, soil information monitoring, video information collection, etc. Equipment control includes irrigation controlling, shutter and sun shade board control, etc.

Information release and data processing includes LED information release system, the the management platform of central control and mobile phone alarm processing, etc. The whole automation system solution is shown in Figure 1.

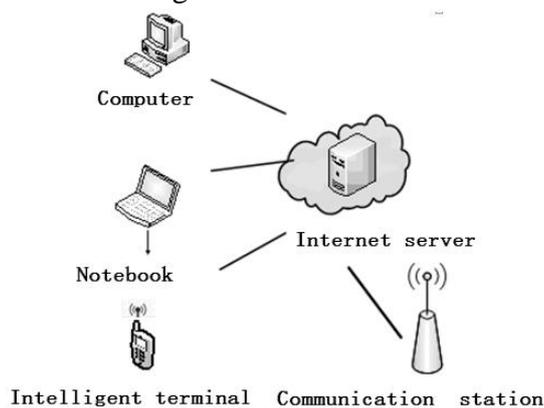


Fig1. The whole automation system solution

2.3 Greenhouse control system

The information collected by sensor, data acquisition equipment and other hardware, combined with the vegetable growth environment information monitoring and management system software, to achieve the online management and control of agricultural environmental information. The whole process of management and control is on line.

The environmental temperature and humidity sensor are installed outdoor in the monitoring point, to monitor the region's environmental information, including air temperature, air humidity, temperature, soil moisture, light intensity, carbon dioxide concentration, wind speed, wind direction, rainfall and other parameters, which displayed to the management staff. At the same time, the data is also transmitted through the wireless to the monitoring center management system, which provides accurate monitoring and scientific research for crop growth management. Greenhouse control system is shown in Figure 2.

2.4 Video surveillance system

In the management of agricultural production, video and image monitoring provides a more intuitive way. For example, Which land is short of water, single data can only see in the Internet of things, but not know the size of the real data. It can not mechanically make decisions according the data.

Because agricultural production environment is not uniformity, and it is difficult to make a breakthrough from pure technical means. Video surveillance directly reflects the real-time status of crop production. Video image and image processing can not only directly reflect the growth of some crops, but also can reflect the overall status of crop growth and nutrition level.

High definition network cameras were installed at the monitoring point, and the high-definition video information were transferred to the monitoring center. The management staff would monitor real-time information of fruit size, vegetable crop pest and color in the monitoring center. The monitoring system is shown in Figure 2 and Figure 3.

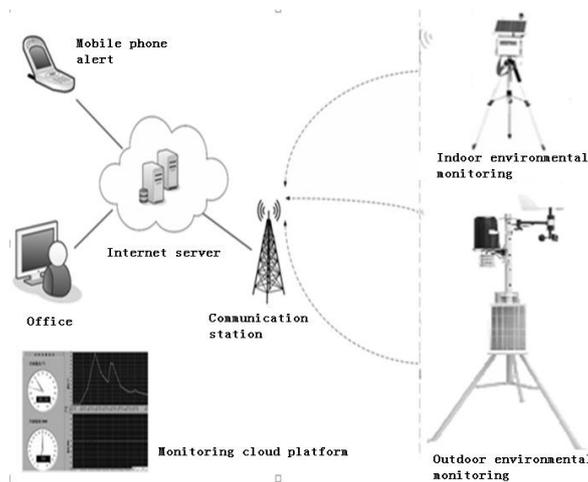


Fig 2 Greenhouse control system

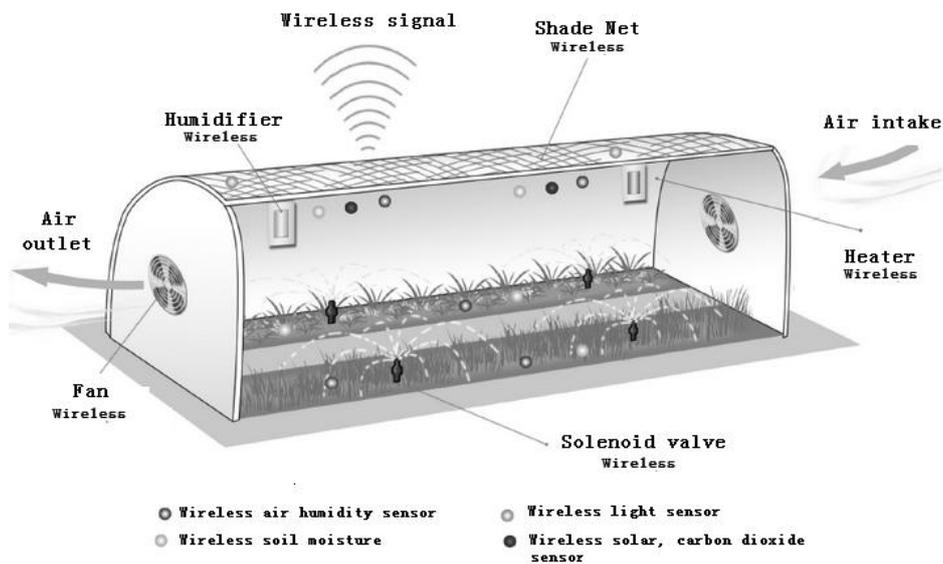


Fig 3 video surveillance content system diagram

2.5 Intelligent control system

According to the data obtained by the environmental parameter acquisition system, and the suitable environment parameters of various crops, all kinds of monitor and irrigation system, wet curtain cooling system, ventilation system was driven.

The specific contents include remote control automatic (manual) irrigation, remote automatic (manual) exhaust, remote automatic (manual) humidification, remote automatic (manual) temperature control, greenhouse, street lights and other lighting remote control etc..

2.6 Information display system

Information display system, which is composed of the display terminal and its supporting software, is released and query window. One way is through the common LCD TV or monitor, of which cost is lower, but the effect is generally; Another way is through the large liquid crystal splicing screen system, which is composed of a mosaic unit wall, a graphic controller, a large screen control management software, an interface device, a special cable and other units. The cost of second way is higher, but the display effect is better.

LED display system includes a LED dot matrix display, intelligent control board and supporting. It can display the various environmental parameters of the greenhouse with synchronous, such as air temperature, air humidity, carbon dioxide concentration, light intensity, soil temperature and soil moisture and other parameters, and help the staffs to understand the scene more directly.

3. Management platform solutions

The functional modules needed by the management platform are as follows:

- (1) Environmental monitoring platform requires the overall operation interface and environment.
- (2) In real-time monitoring, customers can view the latest environmental parameters and can control the adjustment in the current page, greatly facilitate operation.
- (3) The user can set the upper and lower limits of the indoor environment, and choose the response, and view all kinds of alarm data in the platform.
- (4) Video surveillance integrated in management and control system with the Internet of things, can be provide real-time video monitoring and used for demonstration (Figure 4).



Fig 4 Site monitoring picture

4. Conclusion

According to the modern agriculture, overall solution automation system development was design, use information technology for agricultural greenhouse by automation management, and fully reflect the integration of modern agriculture and modern optoelectronic information technology. The following conclusions are obtained by actual production data.

- (1) Increase production and income.

Greenhouse experiment showed that tomato yield reached 30kg~50kg, cucumber yield reached 40kg, more than 10 times in common planting per square which in the automatic control of temperature, humidity, irrigation, ventilation, carbon dioxide concentration and light in greenhouse. Other types of crops have a similar situation.

- (2) Energy saving.

Greenhouse control system can collect the temperature, humidity, soil moisture, illumination, weather, wind speed and other parameters, coordinated the indoor temperature, light, water, and

many other factors to the best state. According to the data, it can effectively save water and fertilizer, and the overall energy consumption reduced to 15%~50%.

Greenhouse control system improves the production environment at room temperature, and makes some difficult crops to grow, provides good conditions for new crops cultivation. It is high conducive to promote value-added economic crops, upgrade economic output, and promote farmers to increase production and income.

Acknowledgements

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