

IoT-based Farm Production Monitoring System

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Abstract

This paper focuses on the design of an IoT-based farm production monitoring system, a technology that uses eight main modules to automate the monitoring and management of farmland. Users can access different modules through corresponding function buttons. This paper is divided into three chapters: firstly, it introduces the background of the topic and the significance of the research; then it describes in detail the project requirement analysis, feasibility demonstration and the overall architecture building process; finally, it discusses how to implement this system and the related parts of the content and other problem solving methods and the summary of the work done.

Keywords

Internet of Things; Agricultural Production; Monitoring System.

1. Introduction

1.1. Research Background and Current Status

In the process of China's increasing urbanization, most of the domestic rural areas are facing serious labor loss and abandonment of arable land, and a large number of rural laborers are working in the cities, so there is a lack of labor in agricultural production, and the cost required to monitor and manage farmland is too high, we should realize automated farmland monitoring and management as soon as possible. Although China's land area is vast, there are many hills and mountains, and the arable land only accounts for 12.5% of the land area, so we need an intelligent farmland monitoring system to make reasonable use of the limited farmland resources and make them more productive.

1.2. Problem Formulation

For a long time in the past, farmers' management of farmland only remained in their daily experience, lacking timeliness and scientificity for farmland management. At present, the domestic information technology and agricultural technology combined solution is to collect the environmental data of farmland and transmit it to the monitoring center for monitoring, but such a system is too large, costly, complicated equipment, difficult to promote, and not conducive to the fine management of farmland. Therefore an IOT farmland monitoring system with simple architecture, lower cost, and real-time efficient monitoring and management of farmland is necessary.

2. Overview of Related Technologies

2.1. Internet of Things Technology

IoT architecture is the top-level design of IoT development, which is related to the compatibility, scalability and interoperability between upstream and downstream products of IoT industry chain, and is still in the concept development stage.

The Internet of Things is characterized by an overlay of sensing, interconnection and intelligence. The main steps in the working of IoT are as follows.

- 1) Identification of IOT attributes, static attributes can be stored directly in the tag, dynamic attributes need to be detected by sensors in real time first.
- 2) The recognition device reads the object attributes and converts the information into a data format suitable for network transmission.
- 3) The attribute information of the object is transmitted to the information processing center through the network (the processing center may be distributed, such as a computer or a cell phone at home; it may also be centralized, such as the IDC of China Mobile), and the processing center completes the calculations related to object communication. IoT needs to have a unified architecture, clear layering, support interoperability of different systems, adapt to different types of physical networks, and adapt to the business characteristics of IoT.

2.2. Environmental Monitoring Module

Environmental health monitoring mainly takes the environment as the monitoring object, and uses biological, physical and chemical technical means to determine the value of factors affecting environmental quality, to conduct a comprehensive analysis of the composition of pollutants, to study the extent of the impact of their components on environmental quality, and finally to determine the trend of changes in environmental quality.

Environmental monitoring management system, also known as environmental monitoring information management system (EMIS), is a computer technology and database technology as the core, a large amount of environmental monitoring information and data obtained stored in the computer, the use of computer network-related technology, combined with its software and hardware systems to achieve the processing of environmental monitoring information data, mainly including data input and output, data modification and deletion, data It also combines and uses a variety of computer applications, such as Statistical Mathematics Software, Optimization of Management and Analysis Software, Prediction of Software Evaluation Model, and Software Programming Decision Model. It also combines and uses various computer applications, such as Statistical Mathematics Software, Optimization of Management and Analysis Software, Prediction of Software Evaluation Model, Software Programming Decision Model, Drawing Output Software, etc., to form a complex and orderly data information management system with various functions.

2.3. Pest Control Module

The pest measuring lamp is specially developed for agricultural and forestry pest measuring and reporting. The lamp uses photoelectric technology to realize the functions of automatic pest trapping, pest killing and distribution. It can be equipped with various sensor interfaces such as wind speed and direction, ambient temperature and humidity, light, etc. to monitor environmental parameters when needed and upload data through GPRS. to monitor the relationship between the environment and pests and diseases. There are multiple interfaces to provide support for visualization and online real-time monitoring of pest conditions. Widely used in agriculture, forestry, animal husbandry, tobacco, tea, herbs, orchards and other fields.

The insect measuring lamp is a simple, practical and new measuring tool, which provides more timely and accurate insect measuring service for the monitoring points set up in each township and village in the country.

The product is closer to plant measurement, multi-level measurement; in order to understand different meteorological environmental factors bring different biological characteristics, the special research and production of solar-powered insect measurement light, fundamentally change the environmental diversity brought about by the target measurement data and the differences brought about by the control. The lamp sets a multi-layer insect collection box,

insects fall automatically separated according to the size of the insects, the box needs to be equipped with a processing device for the processing of targets, simple operation, easy to use.

2.4. Temperature and Humidity Supplement Module

Temperature and humidity sensor is a kind of sensor device equipped with moisture-sensitive and heat-sensitive elements, which can be used to measure temperature and humidity, the temperature and humidity integrated sensor is a digital integrated sensor as a probe, with digital processing circuit, so that the temperature and relative humidity in the environment into the corresponding standard analog signal, 4-20mA, 0-5V or 0-10V. temperature and humidity integrated analog type It can simultaneously convert the temperature and humidity value changes into current/voltage value changes, and can be directly connected with various standard analog input secondary instruments.

3. System Requirements Analysis

3.1. Feasibility Study

(1) This design not only reduces the labor cost but also improves the productivity of farmland. In addition the system has features such as high security and reliability. Not only the cost is low, but also can realize the real-time monitoring of farmland. (2) Economic feasibility: This design realizes a variety of functions in one, which has a high practical value, while enabling users to quickly query the data they are interested in (3) Practical feasibility: The design and implementation of this system can meet the various data requirements for farmland monitoring in the daily, while also providing a simple and clear front-end page, where farmers can easily view the current condition of their farmland.

3.2. System Hardware Requirements

This system includes the greenhouse body, and the greenhouse body is equipped with nine modules, including environmental monitoring module, pest control module, photo module, power module, main control module, relay module, light supplement module, temperature and humidity supplement module, and communication module. Therefore, corresponding hardware is needed to implement the corresponding modules.

The environmental monitoring module uses a thermometer and an air monitor to detect temperature, humidity and gas changes within the greenhouse itself and transmits the detected information to the main control module.

The pest control module monitors the number of pests by using multiple pest measuring lights and sends a warning to the main control module when the number of pests reaches a certain threshold, reminding farmers to carry out pest control work.

The camera module uses the camera to take pictures at regular intervals and sends the pictures taken to the main control module to realize the picture monitoring of farmland.

The main control module uses a microcontroller, and the relay module is used to amplify the control circuit, receive the signals from the sensors of each other module, and feed back to the farmer.

The light supplement module is controlled by the main control module to supplement light to the greenhouse when the light intensity sensor detects insufficient light, allowing the crops to fully photosynthesize.

Temperature and humidity supplement module to control the temperature and humidity in the shed by the main control module.

The communication module sends the monitoring information transmitted to the main control module to the terminal.

The greenhouse body is hinged with a plurality of roofs, a plurality of roofs are adsorbed by electromagnets, and the roofs are fixedly connected to a rotating rod, and a motor is fixedly connected to one end of the rotating rod, and the roofs are provided with a motorized retractable sunshade, and a ventilating curtain is provided on one side, and the roofs are provided with a plurality of pressure sensors, and the pressure sensors feed the detected information into the main control module.

The environmental detection module is placed in the greenhouse body, and the environmental detection module includes a plurality of temperature and humidity sensors, a plurality of light intensity sensors and a gas analyzer, and the temperature and humidity sensors, the light intensity sensors and the gas analyzer send the acquired environmental information in the greenhouse to the main control module.

The light supplement module includes a plurality of plant supplement lamps, the height of the plant supplement lamps is 1.5 meters from the growing point, the plurality of plant supplement lamps are suspended in multiple rows, and the plurality of plant supplement lamps are electrically connected to the main control module.

The temperature and humidity supplement module includes a plurality of ground track heating tubes and a plurality of water mist nozzles, a plurality of ground track heating tubes evenly laid in the body of the greenhouse, a plurality of water mist nozzles connected to the water source, the use of solenoid valve to spray control, a plurality of ground track heating tubes and solenoid valve are electrically connected to the main control module.

3.3. System Software Requirements

Each farm production monitoring system will be bound to the corresponding user, the user can log in to the app to view the farm monitoring information in real time, and can connect to the main control of the system through the app to adjust the temperature and humidity of the farm and the light; the user can also view the data of the farm in the historical data, and analyze the environmental changes to make better adjustments. The photos generated by the photo module will also be saved in the app, so that users can view the situation in the farmland in real time.

4. Summary

Today, with the continuous development of the Internet of Things (IoT), the combination of IoT technology and various industries has become a hot spot in the current research field, and the development of IoT will inevitably drive the economy to take off, save more labor, and make everything in the world more intelligent. This project mainly designs an IoT-based farm monitoring system, using the integrated nine modules to monitor the temperature, humidity, gas changes in the greenhouse, and the use of microcontrollers and relays to achieve automatic control of farmland humidification, supplemental light, ventilation, etc. It is a low cost and can increase the efficiency of farm production IoT system.

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