The Technology and Realization of Platform System of Tropical Agricultural Environmental Remote Monitoring Based on Internet of Things

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***Abstract*—This paper is under the theoretical support of the Internet of things, mainly using the RS-485 bus technology, wireless mobile networks (GPRS) technology, the Internet technology and database technology to achieve long-range tropical agriculture environmental data collection and remote monitoring. Back-office systems on the environment through data mining, analysis and reasoning, and forecast the occurrence of pests and diseases of tropical crops and adverse environmental impact from real-time database about pests and diseases, for China's tropical agricultural policy-making, production management and pests and diseases control providing a simple and effective way.**

***Index Terms*—internet of things, agricultural environmental, remote monitoring, wireless sensor networks**

I. Introduction

The concept of Internet of things (Internet of Things, IOT) is first put forward by the United States. at the Massachusetts institute of technology in 1999, which refers to various information sensing equipments, such as radio frequency identification (RFID) devices, infrared sensors, global positioning system (GPS), laser scanners and other information sensing devices, through use of modern communication technology, the unknown objects connected to the Internet, so as to realize the object recognition, location, tracking and monitoring and management [1]-[3]. With the continuous development of Internet of things and the wireless network technology and the widespread application, in the traditional agriculture, Artificial measurement methods of obtaining information of crop growth environment will be effectively solved. Through the use of wireless sensors, reduce human consumption and impact on farmland environment, obtain accurate crop environment and crop information [4].

Tropical agriculture occupies an important place in the national economy in our country, has great potential for development of production. In the tropical area in China, due to the high temperature and high humidity and suitable ecological conditions, to disease, insect renewal and new physiological races turnover speed, chemical drug and prevention means are difficult to keep up with disease, insect turnover speed, tropical crops by the harm of plant diseases and insect pests are very serious, caused huge economic losses. In this paper, according to the idea of the Internet of things, digital sensor connecting embedded acquisition equipment by the RS-485 bus, composition of the remote monitoring system of tropical agricultural environment, through the wireless mobile network and Internet docking, some environmental data will be collected, mainly including atmospheric temperature and humidity, light, CO_2, and soil temperature, humidity and so on plant diseases and insect pests Relying on the environmental data of the survival, and real-time transmission to a remote database server. The background system through mining, analysis and reasoning of environmental data, and then from the backend database of the plant diseases and insect pests, real-time intelligent retrieval and predicted the possibility of plant diseases and insect pests in the near future, prevention expert analysis of prediction results and field survey, formulate scientific and rational preventive measures. Finally, through the platform to publish to the society recently prone plant diseases and insect pests of news and preventive measures, ensure that the tropical agriculture from the effects of bad environment and harmful organisms, improve the level of tropical crops diseases and insect pests diagnosis accuracy and the level of prevention, promote tropical agriculture industrial competitiveness, make China's tropical agriculture efficient, sustainable development.

II. Key Technologies of the Platform System

A. Wireless Sensor Network

The sensor node is a very small computer, generally consists of the following parts:

- Processor and memory (general ability is limited).
- All kinds of sensors (temperature, humidity, sound, acceleration, GPS, etc.).

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- Communication equipment (usually a radio transceiver or optical communications equipment).
- Battery (typically dry cell, also have use solar cells).
- Other equipment, including various kinds of special-purpose chip, serial parallel interface (USB, RS232), etc.

The role of each base station in wireless sensor network is to collect data from each sensor node, centralized treatment and then submitted to the user. Therefore, the base station generally has the ability of data processing and communication skills, and more lasting power.

A typical wireless sensor network architecture includes the nodes of wireless sensor networks, the node, the Internet and user interface, as shown in Fig. 1.

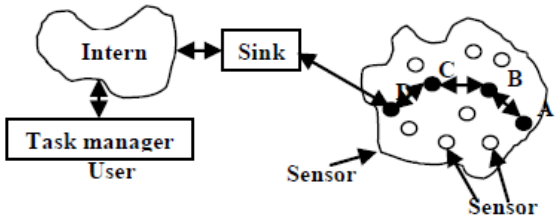

Figure 1. Wireless sensor network architecture.

Wireless sensor network node through the self-organizing way constitute a wireless network, in a collaborative manner real-time sensing, collecting and processing information in the network coverage area, and through multiple hops network, data receiver and transmitter node link transmit information to remote monitoring management center in the entire area. On the other hand, the remote monitoring management center can also perform real-time control and manipulate the network nodes [5].

B. General Packet Radio Service

Wireless communication uses GPRS network to realize data transmission, GPRS mobile data business access Internet by GSM network, GPRS in this system as a bridge connects wireless sensor collection site and data control center, that is, the wireless sensor network node to the sink node data transmission through the GPRS module is connected to the Internet. The GPRS business provides a point-to-point PPP link, so its dial-up Internet access to comply with the PPP network [6] and [7] protocol. System support for PPP protocol is completed when configuring the kernel, dial-up Internet before, should initialize first frequency of the wireless module, status, and so on.

GPRS uses wireless IP technology based on packet transmission mode, supports IP protocol and X.25 protocol, the transmission rate is up to 171.2Kbps, the data transmission can realize stable. Moreover, GPRS has obvious advantages in many aspects, such as the GPRS network covering a wide range and charged according to traffic, it takes few seconds to set up a new wireless connections, and can carry on the network connection at any time, etc [8].

III. KPLATFORM SYSTEM REALIZATION

A. Embedded Acquisition Equipment

Embedded acquisition equipment is the function of every certain time collecting a spot of agricultural environmental data, and these data are saved to the database on the server. Digital sensors use THM-101 air temperature and humidity data acquisition module, CD-101 air CO_2 concentration data acquisition module and PR101 photon acquisition module. The measurement range of THM-101 air temperature and humidity data acquisition module: -9.9℃ ~+70 ℃ , the measuring precision is ±5℃, the module can realize the field values of temperature, relative humidity values acquisition, at the same time, using its own RS-485 bus serial communication interface and other monitoring equipment to network links easily; CD - 101 air CO_2 concentration collecting module is the integration of atmospheric CO_2 content acquisition and display module, the sensor output signal is 0~10V, through the acquisition module step-down after transformation, and through the 12 bit ADC change device for A/D conversion, MCU read the current data from digital to analog converter, finally through RS - 485 command output data; PR101 photon acquisition module measuring range: 0~2000 uoml/s/m^2, measuring accuracy: ±5 %. According to the need, but also can increase the other sensor module. The series of digital sensor through the RS-485 line output, and can display the real-time data by LCD. Using the technical characteristics of digital sensor, and greatly simplifies the process of system development [9]. The hardware system uses RS-485 bus to connect all the digital sensor and embedded acquisition equipment, as shown in Fig. 2.

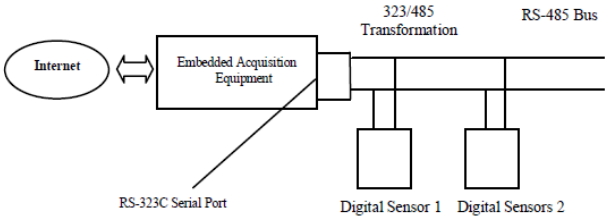

Figure 2. The Structure of connecting the digital sensor and embedded acquisition equipment through RS-485 bus.

B. The Data Server

This platform system adopts MS SQLServer2000 as database management system, for the sake of the security of the data and the upgrade and maintenance of the Web application server, separation of the database server and the Web application server. Including four main database: Tropical Crop Disease Database, Tropical Crop Pest Database, Tropical Agricultural Harmful Organisms Database and Tropical Agricultural Environment Database.

Tropical Crop Disease Database mainly saves tropical crop disease information, including: disease name, English names, scientific name, pathogenic information, hazard situation, distribution situation, control methods, the environment of the incidence, disease profile, etc.

Tropical Crop Pest Database mainly saves tropical crop pest information, including: pest name, English names, scientific name, hazard situation, distribution situation, life history, host species, control methods, natural enemy species, pest introduction, etc.

Tropical Agricultural Harmful Organisms Database mainly saves tropical crop pest dynamic information as well as main exotic harmful pest (invasive plants, invasive insects and invasive microbes) basic information and text information of China's 8 major tropical provinces, etc.

Tropical Agricultural Environment Database mainly saves tropical agricultural environment atmosphere temperature and humidity, illumination, CO_2 and soil temperature and humidity, etc.

C. The Web Server

The platform system uses the current popular "Web Browser /Web Server / Database Server" structure (also known as B/S/S structure), its basic idea is based on the distributed technology, the client layer and application layer for separation, the system according to the function is divided into customer layer, application layer and data layer, and placed in the same or different hardware platforms. The Web Browser as the client layer, the client layer is the user interacts with the system information window, its main function is to guide the operator using the defined service or function, checking the user input data, and displaying the system output data; Web Server as the application layer, handles the front-end client layer application request, completes the transaction logic computing tasks, and returns the result to the user; Database Server as data layer is responsible for providing and managing all kinds of data. System structure diagram, as shown in Fig. 3.

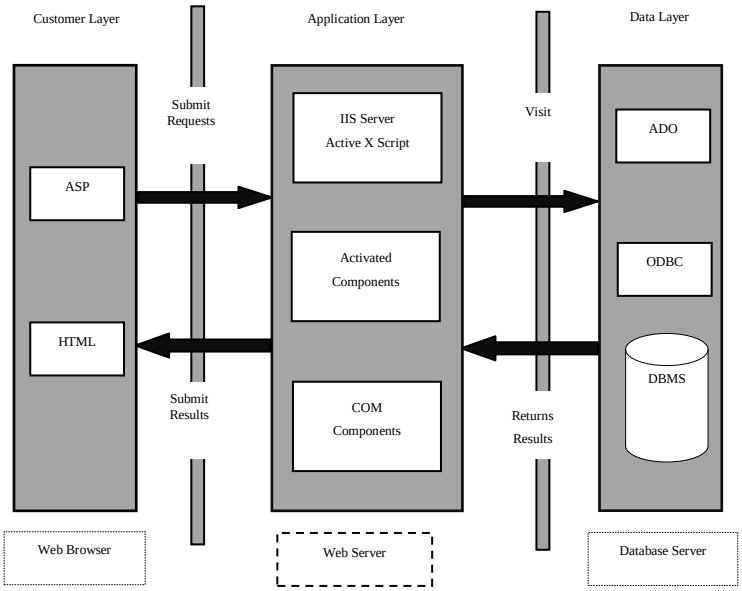

Figure 3. The system architecture diagram.

IV. Introduction

The paper is under the theory of the Internet of things, using the Internet of things architecture to realize remote acquisition and monitoring of tropical agricultural environmental data. The Backend System through the mining, the analysis and the reasoning of tropical environmental data, real-time intelligent retrievals from the database of diseases and pests, predicts their likelihood in the near future, and provides a simple and effective way for China's tropical agriculture decision, production management and the control of diseases and pests. The platform system next key research is how to combine with web crawler technology, the tropical agricultural expert system and tropical agriculture geographic information system, and prompts the tropical agricultural environmental remote data acquisition and monitoring and the early warning and control of diseases and pests more accurately, makes more targeted prevention measures.

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