



Study and design of the agricultural informationization model based on internet of things

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ABSTRACT

In order to improve the agricultural automatic and intelligent level, this article analyzes the research situation domestic and foreign agricultural Internet of things, and constructs the model of agricultural informationization based on Internet of things. The model has three sub models: agricultural information collection model, agricultural information transmission model and intelligent agriculture information processing model, which corresponds perception layer, network layer and application layer of Internet of things respectively. The paper detailed describes the whole frame, hardware composition and software flow of the agricultural information collection model, the hardware composition of module and structure design of wireless sensor networks in agricultural information transmission model, finally the structure diagram and interface design of the agriculture intelligent information processing model are also introduced briefly.

Keywords: IOT, agricultural information , model design

INTRODUCTION

Agricultural informationization has become a symbol and the key of modern agriculture, as the service function of agricultural information technology growing, the development of agricultural informatization can significantly promote agricultural's sustained develop, and it will be more and more become the basic resource and development of agricultural production activities. However, the traditional extensive agricultural informationization development mode has already can't satisfy the requirement of agricultural sustainable development, the application of the Internet of things in agricultural informatization can effectively reduce the human consumption and the impact on the farmland environment, which can obtain accurate crop environment and information, so as to use all kinds of equipment with the function of automatic、 intelligent and remote control, that people can never leave home to monitor farmland information. It will realize scientific planting and management and promote the modern agricultural development mode change, which will provide a new platform for the development of our country agriculture, and change the traditional mode of agricultural informationization development[1].

Agricultural informationization based on Internet of things, which can be defined the application of the Internet of things in the process of agricultural informationization. It contains a sensor network that constituted with a number of sensor nodes, this network with the communication network, which contains computer network, satellite network and other modern information network, will form a huge network, that can match the advanced agricultural production facilities and land, through a variety of sensors, GPS, smart cameras, intelligent terminal and tools such as 3G mobile phone to collect and gather information, and through the information transmission network to transfer

information to database system of agriculture and agricultural information storage system, such as agricultural database system and digital library. Then process and decide the agriculture information with the technology of cloud computing and information processing system, finally use the related network and automatic control technology to realize the agriculture agricultural information release and remote control[2]. Agricultural informationization based on Internet of things has made intelligent agricultural realize the intensive production process. Now The Internet of things has been widely used in the agricultural informatization in China. Huang Liusheng *et al* have made a depth discussion in intensive irrigation farming implementation method based on wireless sensor; Liu Minghui *et al*. have studied agricultural plant diseases and insect pests forecasting expert system with the application of WebGIS ; JuRonghui *et al* have use GSM short message technology to realize the real-time control of greenhouse. The major special projects of digital agriculture have been set up in China, like xinjiang, heilongjiang, jilin, Beijing, Shanghai, hebei, jiangsu and other places , which include 26 facility agriculture digital technology 、 digital technology field crops and inherit technology integrated application of digital agriculture demonstration base[3].

In this article, The agricultural informationization model which based on iot will be set up, with the architecture for multipoint real-time monitoring of field environment parameters, to master the environment evolution and crop growth information form. The system will upload the monitor data to the database, that can give the field information at any time for managers and users , who can make an accurate crop breeding scheme.

EXPERIMENTAL SECTION

1. The agricultural informationization model based on Internet of things

In this paper, the three sub models of agricultural informationization building, which based on the three layer system of IOT , perception layer is the agricultural information collection module. The transport layer is the transmission network model which can transmit the gathering information rapidly and efficiently . The application layer corresponding to agricultural control model that can dispose all kinds of information of. The function of the system framework is shown in figure 1:

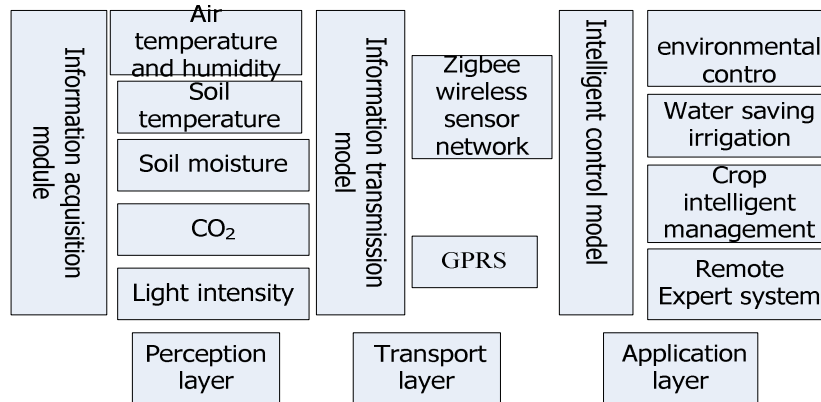


Fig. 1 The whole model function frame

2. Information acquisition model

The module of information perception and acquisition is located in perception layer in system, which make use of a variety of sensing devices to percept and collect the data dynamically ,that include major crops growth process and the main factors affecting the growth in the environment such as air temperature、 air humidity、 soil temperature and humidity、 light and other information related to crop growth condition, and then through the wireless sensor network based on Zigbee technology and mobile network transmission platform to the management center, statistics agricultural condition data information to make a reference for later analysis.

Agricultural condition data perception information acquisition is the first important link for information system, which is the basis for the later work. The goal of this model is able to realize the pertinence, accuracy and timeliness of the collected data information, block diagram is shown in figure 2.

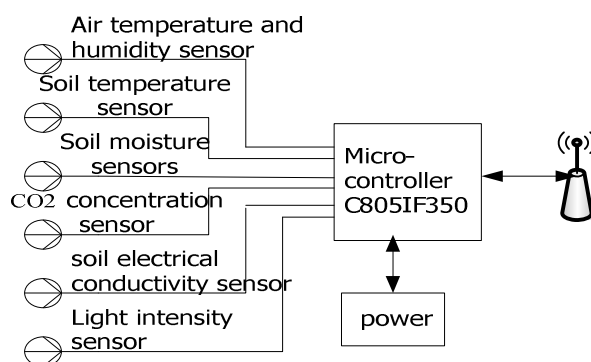


Fig. 2 Agricultural information collection module block diagram

The sensor used in the system has high stability, strong anti-jamming capability, long transmission distance, high accuracy and fast response characteristics[4], specific performance shown in the following table.

Table 1 Sensor parameter list

Sensor name	Measuring range	Working voltage	Power consumption	precision	Signal output form
Air temperature and humidity	-40°C~+123.8°C	2.4V-5.5V	550uA	temperature±0.4°C Humidity±3%	Digital 12C
Soil temperature	0-100%	5V-10V	21mA	±3%	Analog voltage 0-2V
Soil moisture	-55°C~+125°C	3-5V	1mA	±0.5°C	Digital
CO2	0PPM~5000PPM	9V-18V	25mA	±30PPM	Analog voltage 0-5V
Soil conductivity	0-30ms/cm	5V-10V	0.5mA	±0.2%	Analog voltage 0.4-2V
Light intensity	0-256000LUX	2V-3.3V	250mA	±20LUX	Digital

Microcontroller platform is the core of the information acquisition module, mainly be responsible for the control of the sensor array, data acquisition, control the wireless communication module for data transmission. This paper chooses C8051F350 MCU. It is a completely integrated mixed-signal system-on-a-chip (SOC), based on high speed 8051 kernel, and the instruction set is fully compatible with MCS - 51, is one of 8051 derivative single-chip microcomputer currently which is the fastest and the most complete function. Besides has the standard 8051 digital peripheral components, it also integrated the data acquisition and control system on chip components in common use and other digital peripherals and features, RAM and Flash space is larger and has multiple I/O port, and also configure A/D converter and A variety of communication bus, power consumption is low, its performance can meet the demand of perceptual node design[5].

Sense node mainly complete the perception and transmission of information. Adopted the way of passive awareness information, perceptual node receives the collection command, then complete the information collection and forwarding tasks. That is after the microprocessor of perceptual node received acquisition task, it first to collect and process the information, the data have been processed is forwarded to the information transmission nodes by wireless transmission module, and transmitted to the PC by the transport node. Communication between microprocessor and wireless module adopted universal serial asynchronous protocol communication methods, and the uniform data transceiver protocolthe has been made in wireless transmission protocol. Information collection module software design process as shown in the figure below.

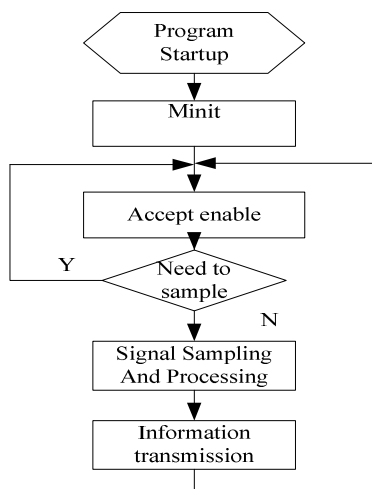


Fig. 3 Information acquisition module software flow chart

3. Information transmission model

In this paper, The transmission network subsystem have been design to make an concrete analysis of system from the angle of the transmission phase, which mainly includes two parts: the field environment of wireless sensor communication network module and the external transmission network module. The first module is collected for the field of environmental information to the base station transmission, mainly through the wireless sensor network based on Zigbee technology; The second module is the information management platform of the transmission from the base station to the center, mainly using the GPRS network. The subsystems use the advantage which is the wireless sensor network node non-contact, can carry on the characteristics of mobile management and GPRS network communication speed, large capacity, high reliability advantages, foster strengths and circumvent weaknesses, to further improve the quality of network communication, achieve the goal of transmission information accurate and reliable.

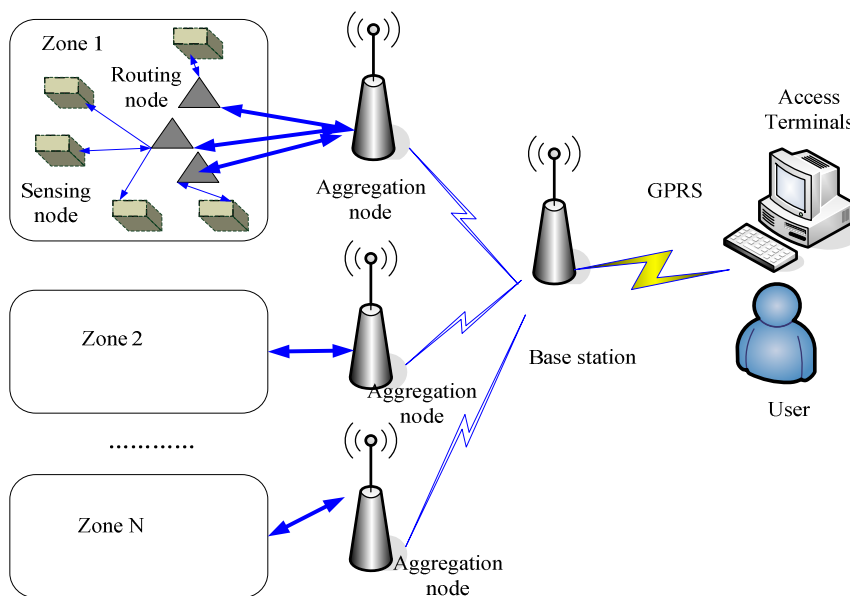


Fig. 4 Transmission network structure diagram

3.1 wireless sensor network module design

The system of wireless sensor networks is to use the wireless transceiver module of LSD - RFCC1100. LSD - RFCC1100[6] is a real single chip UHF transceivers, designed for low power wireless applications, the main circuit is set in 315, 433, 868 and 433 frequency band of the ISM (industrial science and medicine) and SRD (short range device), also can let is set to 300 ~ 348 MHz, 400 ~ 464 MHz and 464 ~ 928 MHz frequency. CC1100 has high sensitivity, programmable control data transfer rate and output power, built-in frequency compensation function, data albino function, RSSI (received signal strength) monitoring function, very suitable for this system networking requirements.

3.2 remote data transmission module design

According to the current domestic and the actual situation of the existing communication resources available, at the same time, considering the system is running after the completion of the wild environment and easy to manage, the design mainly adopts the network mode of wireless mobile communication as the main channel. Remote data transmission is mainly completed by GPRS module . GPRS module use the H7210 products[7], the terminal support dual-band GSM/GPRS, accord with standard of ETSI GSM Phase 2 +, embedded TCP/IP protocol, the real-time clock, to provide users with high speed, times online, transparent data transmission of virtual private data communication network. When using fist need to install the SIM card to get the unique ID in the mobile (SIM card). CC1100 module in the system to receive the data that sended by wireless sensor node, then the data communicated by a serial port to GPRS DTU. After the GPRS DTU receives the data information, the information was packaged accordance with the GPRS data format, and the data is sent via wireless GPRS network to processing and monitoring center, realize the data remote transmission. The control commands from the data servers were received at the same time, then sent to each wireless sensor nodes by CC1100 module.

4. Intelligent information processing model

Intelligent information processing model is mainly the design of the information monitoring center software, was developed by using Microsoft Visual Basic.NET development tools to carry on the design, the collection of real-time data from nodes to establish a database for unified management. In management center can query any position of a sensor node parameter value and historical data and real-time environment through the design of software interface, and the software will automatically to the real-time data from the environmental parameters with default values, if outnumber than the default environment parameter value, the software will sound a warning and send a message to remind managers, at the same time it will send a signal to control the terminal device and automatly adjust environment parameter values. Management center system structure diagram as shown in figure 5.

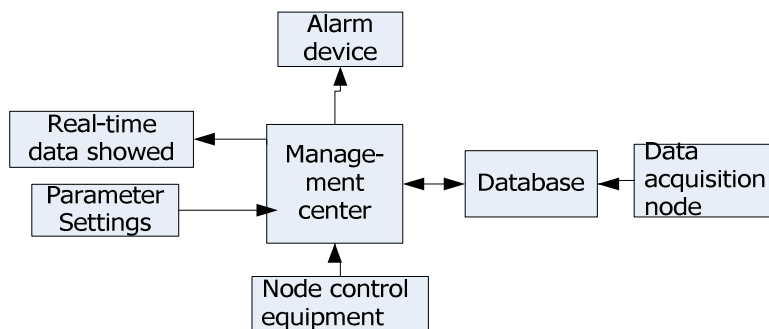


Fig. 5 Information processing model software structure

The data display interface of information processing model as shown in figure 6, after startup it will display real-time data of each node and renew historical data, used of analysis and research. The initial value of the system environment parameters can by modified and setted by setting the button. When the environment parameter value exceeds the preset range, interface will display and alarm,inform managers to make corresponding processing, and starts the node control equipment to automatically adjust the environment parameters.

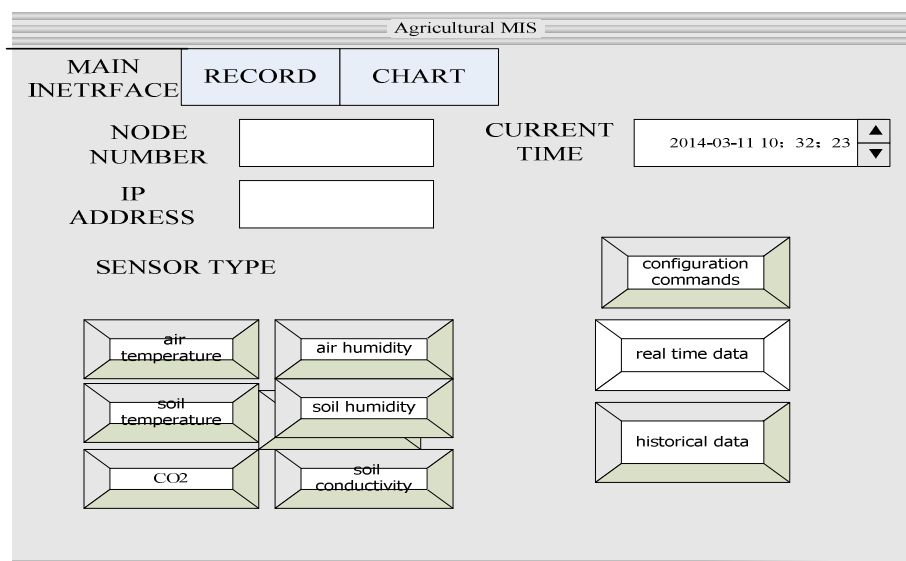


Fig. 6 Agriculture information processing interface

The related parameters of the service request was setted in the main interface, such as query node, sensor types, query types etc, and the query command is sent to the server. Database server will make a operation according to user's request, and get the query of data back to the client.

RESULTS AND DISCUSSION

Based on the three-layer system of IOT, this paper builds three child model of agricultural informationization, respectively for the agricultural information perception、information transmission and intelligent agriculture information processing model, three sub models with three layers structure of iot one-to-one correspondence, respectively responsible for information collection, transmission and the agriculture information intelligent processing. Managers can accurately grasp the field of real-time environmental index, so as to make a reasonable management of field with the right measures. By applying Internet of things in the agricultural informationization, greatly improve the automation and intelligence of agricultural production, and have a long-term and important significance to improve agricultural efficiency, increase farmers' income, the reasonable use of agricultural natural resources, protecting agricultural development environment.

Acknowledgements

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