Internet of Things Technology and Its Application in Agricultural Production

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Abstract: The openness and mutual integration of Internet of things technology enable it to realize all kinds of accurate information management through sensors, data transmission network and data integration operation. Due to the comprehensive nature of the Internet of things technology, it is more and more widely used in agricultural production. By adapting the technology of different fields of Internet of things “end”, “management” and “cloud” to agricultural production, we can give full play to the characteristics of information technology, realize the monitoring and automatic management of all aspects of agricultural production, so as to achieve more accurate production regulation and create the best agricultural and forestry environment. In the process of modern agricultural production and irrigation, the information collection means are relatively backward, the technical system is not perfect, resulting in low efficiency of information collection, incomplete data, lack of basis for analysis and decision-making, resulting in the failure of fine management and other problems, Analysis of agricultural environment temperature, light, air quality, soil water potential, leaf water potential and other data, form irrigation requirements, realize automatic irrigation application, so as to achieve the modern agricultural production concept of precision drip irrigation and green energy saving.

1. Introduction

At present, it has entered the era of interconnection of all things. Through the wide coupling application of IOT technology, it has played a more active role in the field of agricultural production. Through the construction of land nutrient monitoring environment, accurate automatic fertilization operation is realized, which not only reduces the work intensity of farmers, but also ensures the micro ecological environment of the land, and greatly improves the yield per mu; The combination of agricultural combined harvesting and Internet of things technology can accurately identify the maturity of crops, so as to achieve reasonable harvesting and ensure the scientific growth and picking of crops. Perception and feedback are two important nodes in the application of Internet of things technology in the agricultural production process. Through analyzing the production process of crops and the development requirements of green agriculture, combined with the application of Internet of things technology, this paper puts forward the research topic of agricultural precision irrigation Adaptive irrigation control and other technologies can effectively monitor crop growth in real time and dynamically, and feed back relevant growth data. Through calculation and analysis of

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its irrigation requirements, precise drip or root irrigation can be realized, which not only saves irrigation water, but also prevents agricultural crop damage caused by flooding irrigation. This project is composed of IOT end side sensing unit, data collection subsystem, intelligent sprinkler irrigation subsystem and equipment management center. The design is in accordance with the requirements of agricultural production and meets the agricultural safety standards.

2. Application of Internet of Things in Agriculture

The Internet of things is an extension of the traditional Internet. Through the application combination of end side sensors, combined with information communication, cloud computing, big data collection and other applications in information technology, the time line and space line are organically combined to form a more effective intelligent sensing and analysis. The core of the Internet of things technology is data aggregation and exchange. Through various kinds of different communication networks and topologies, it effectively ensures the scientific acquisition of all kinds of data, and makes its application fields continue to extend. It has been widely extended from the traditional living home, industrial automation to the field of agricultural production. As an important monitoring means of information acquisition, the development of IOT sensor technology provides an integrated, integrated and diversified information gathering node for the popularization and application of agricultural IOT. Through continuous monitoring of the current situation and historical situation of agricultural production environment, a trend analysis data can be formed, so as to obtain a more scientific analysis report of agricultural production environment, Support the follow-up agricultural production process to achieve the goal of fine management. Due to the dynamic and openness of the relevant agricultural Internet of things data, it can actively share with all aspects of agricultural production, whether it is crop production or cash crop planting, which can be used to mine the production environment indications, so as to make agricultural production more standardized, scientific and economical, and provide effective information support for the layout of green agriculture. For agricultural production environment data should match the traditional agricultural production, so that the data readability is good, information integrity, easy to achieve statistical query and analysis output. Connect the field and network to form an efficient combination of crops and Internet of things. Only in this way can we fully mobilize modern information means, feed back and support agricultural production practice, achieve the best production efficiency, and provide effective reference for field management. The overview of Agricultural Internet of things is shown in Figure 1 and 2.

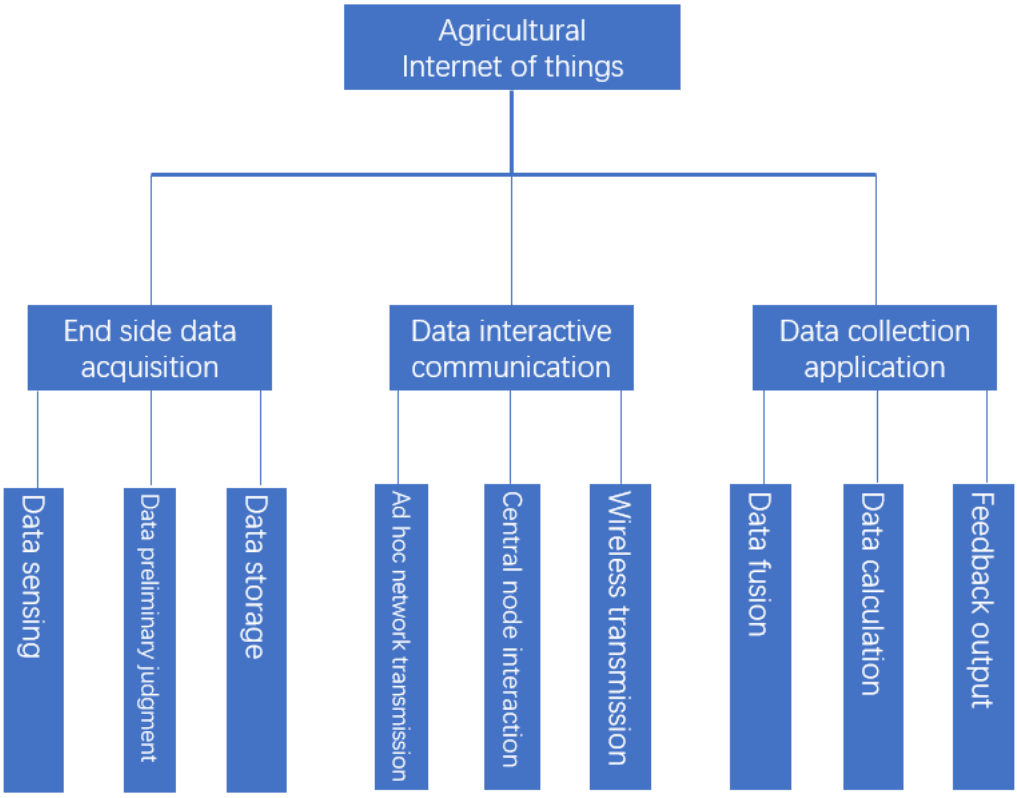

Fig.1 Overview of Agricultural Internet of Things

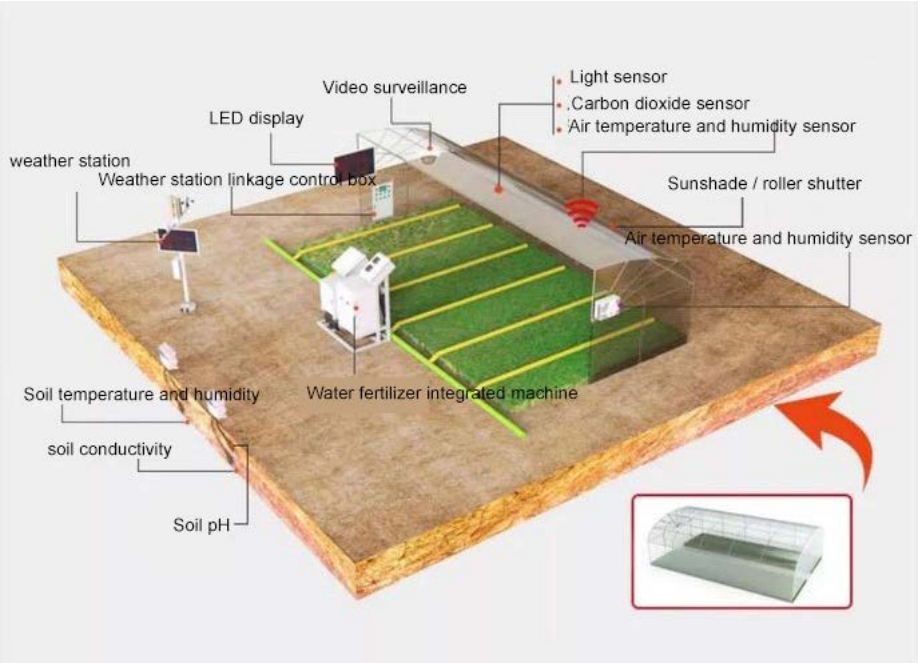

Fig.2 Schematic Diagram of Agricultural Production with Adaptive Internet of Things Technology

3. Principle of Adaptive Irrigation System Based on Internet of Things

China's current per capita cultivated land area is small, and per capita water resources are limited.

China's agricultural water consumption is far lower than the international standard, especially the current concept of green agriculture development urges us to save water, maintain the ability of soil and water and livestock. In the process of production, we should transform the past extensive agricultural development mode into fine production mode, use the least water and irrigate the most land, so as to ensure the effective use of agricultural water resources and maintain the best cost-effectiveness ratio of soil and water.

According to the climate characteristics and the growth characteristics of crops in China, it is necessary to further study the cultivation conditions of related crops and determine the optimal growth water irrigation environment. Therefore, we need to start with the research on the end side sensing unit of the Internet of things to determine its sensing ability, and carry out reasonable structural design according to the shape characteristics of crops to ensure accurate sensing. Through the integration of SOC integration technology and optical induction technology, and assisted by high-efficiency sensing and big data analysis technology, according to the environmental characteristics of crop growth, water storage, plant roots, leaves and stems and other water content state can be effectively perceived. Using the existing sensors for matching transformation, according to the growth requirements of different crops, real-time sensing of their growth temperature, humidity, acid-base balance and other biological characteristics information, and miniaturization of its end side sensing unit, forming a special sensing unit with superior sensing performance and complete sensing index.

The front-end IOT sensor unit and the middle and back-end equipment need to adopt the standard unified interface design. At the same time, according to the growth characteristics and detection focus of crops, priority must be given to the data information format standard formulation, so as to provide good conditions for the subsequent data application, analysis and feedback.

After the crop growth environment data and its own growth data are obtained by the sensor unit, it is necessary to conduct reasonable comprehensive analysis and judgment in the data collection subsystem. According to the climate condition data, crop growth data and future environmental development trend, the unified data centralized analysis is carried out, and finally the scientific data of crop drip irrigation is formed, and the control signal is converted, Operate all kinds of equipment.

In order to ensure the scientificity, completeness and accuracy of the data, it is necessary to form a reliable network communication hardware environment through reasonable design of wired and wireless transmission network, application of 5g or nb-iot transmission technology, and support of distributed transmission protocol such as mqtt, so as to ensure that the network topology is suitable for different crop growth environment and create conditions for the construction of the final drip irrigation system.

4. Composition of Adaptive Irrigation System Based on Internet of Things

The application system design consists of the end-to-side induction unit, data collection subsystem, intelligent sprinkler irrigation subsystem and equipment management center, matching relevant infrastructure, energy supply unit and water supply mode, and complete systematic design.

The monitoring and detection of crop growth status is an important basis for ensuring accurate and scientific irrigation. Therefore, the following configuration and integration mode are needed for the end-to-side induction unit. Firstly, the monitoring unit of the Internet of things is established to monitor the natural environment of crop growth. The traditional sensor end facilities can be used to monitor the temperature and humidity, air and soil moisture status of the growth continuously; Secondly, through the research and design of transformation, adaptation and finalization, the biological information of crop growth should be accurately induced and collected, such as the water content of rhizome and leaf, chlorophyll standard, etc. All kinds of data are converted to analog to

digital, and can be recorded and other data are formed, and data aggregation is completed through wireless transmission.

The data collection subsystem mainly analyzes the data of various agricultural Internet of things, and at the same time, it integrates various information of environmental sensors and meteorological sensors, conducts comprehensive research and judgment, and assists in artificial fitting to form scientific feedback data of crop irrigation demand standards.

Intelligent sprinkler irrigation subsystem shall use digital to analog conversion to form standard control signal according to the irrigation standard data provided by the data collection subsystem, cooperate with each pump station and end-point irrigation facilities, control the water storage and drip irrigation speed, and complete the fine irrigation operation for crops in the form of irrigation and spray.

The system schematic diagram is shown in Figure 3:

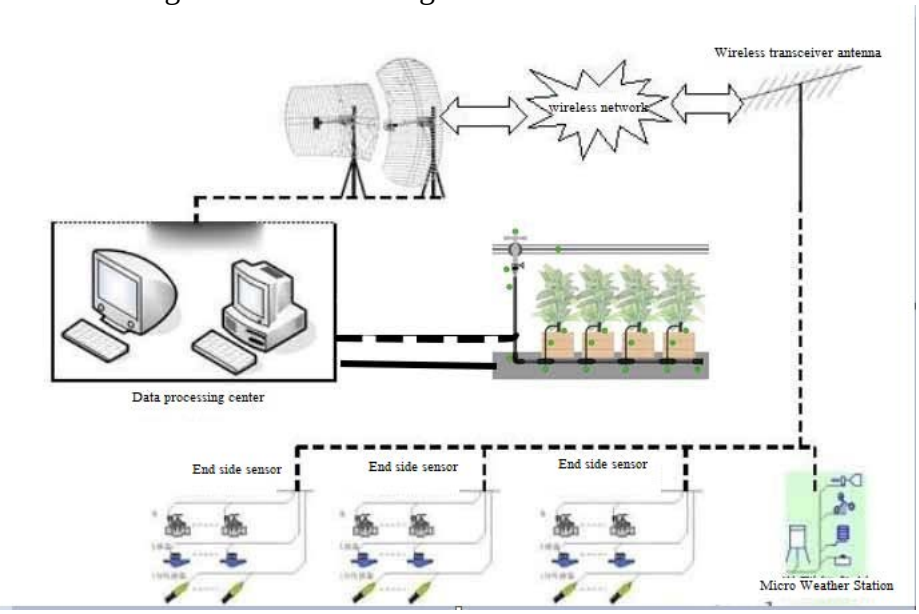

Fig.3 Schematic Diagram of IOT Adaptive Irrigation System

4.1 Introduction of End side Induction Unit Chip

Mc9s08aw60 adopts eight bit co processing unit, which can effectively implement the change calculation requirements of various induction information. HC08 optimizes the instruction subset, which is more conducive to debugging development, and simultaneous interpreting with single line background debugging mode. It can effectively improve the debugging efficiency of different sensors' corresponding interfaces. The 60kb on-chip programmable flash resources can be flexibly called, and can be connected with sensors with various interfaces more flexibly in combination with I2C bus transmission, so that it can be used more conveniently in the end of the Agricultural Internet of things.

4.2 Connection between Mc13191 and Mc9s08aw60

The communication between mc13191 and mc9s08aw60 adopts SPI form and shares the same time base signal. The external device of the end side sensor is connected through the PTB of mc9s08aw60, and the ptb3 pin is used as the analog input of the end side sensor for various crop planting environments or plants to complete the analog-to-digital conversion and baseband modulation of relevant information.

5. Sensing and Control Principle of End side Induction Unit

5.1 Operation of Various End side Induction Units

The main function of end-to-side sensing unit is to conduct information transmission, which requires accurate access to the basic information of the environment and crops. The information is analog, so it needs to form digital code through digital to analog conversion, and then it is transmitted through wireless ZigBee ad hoc network. Crop data and environmental data are integrated agricultural growth factors. Through the comprehensive sensing and transmission of the system, the data can be visualized in the background to provide effective data support for agricultural technicians to pay attention to the growth of crops.

5.2 Data Collection Subsystem

The data collection subsystem is the “nerve center” of the whole IOT adaptive irrigation system. Through the monitoring and sensing units throughout each crop itself and its growth environment, the growth and environmental status information of one or more crop growth areas can be obtained by using wired and wireless transmission mode, combined with the specific requirements of different crops for irrigation, Through comprehensive analysis of data and comparison of historical information, the final fine irrigation plan can be formed, so as to closely combine agricultural irrigation with Internet of things technology, and ensure that the growth of crops can get the best hydroponic support. Data receiving can be realized by socket technology, which provides message interface to complete message sending and receiving. The specific processing steps are: the server initiates, the client requests the connection, and the data connection is successful. The specific flow of irrigation data transmission and storage is shown in Figure 4 and table 1.

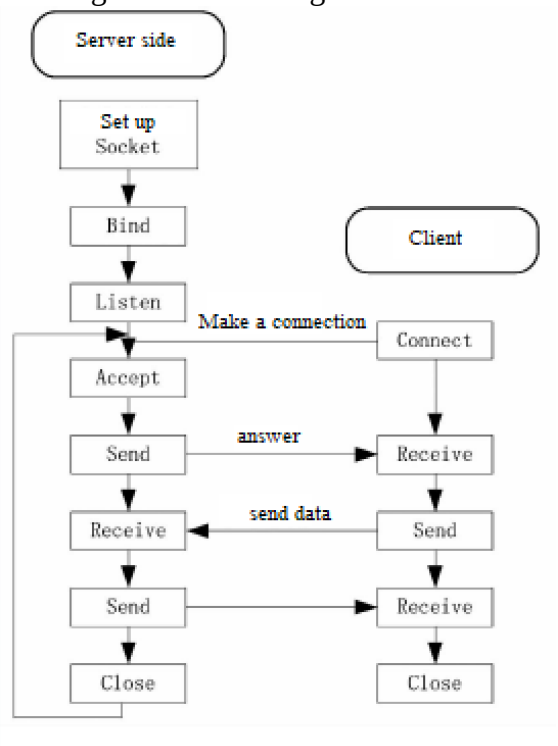

Fig.4 Flow Chart of Data Transmission

Table 1 Data Storage Structure

Data storage table					
Sensor address	Recording time	air temperature	air humidity	Soil moisture	Sunshine intensity
Byte	Date	Byte	Byte	Byte	String

5.3 Adaptive Intelligent Irrigation Subsystem

The ultimate goal of Internet of things agriculture is accurate and adaptive agricultural work. Adaptive intelligent irrigation is based on the data collected by the data collection subsystem to carry out analog conversion to form control instructions suitable for different regional crop irrigation requirements, and to control all kinds of irrigation electrical facilities, using different irrigation modes to complete the final fine field irrigation, maximize the water consumption, and ensure the safety of crop growth.

6. Conclusion

With the development of information technology, the Internet of things will play a more and more important role in the whole process of agricultural production. This paper uses the end side sensing technology of the Internet of things, combined with the big data analysis of crops and environment, supplemented by adaptive intelligent irrigation, to build a scientific closed-loop crop water supply mode, which provides a positive exploration for the fine irrigation of modern agricultural production, The promotion can provide beneficial support for the development of green agriculture in the central and western regions of China.

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