

Research on Smart Agriculture IoT System Based Heterogeneous Networking Technology

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Abstract—Agriculture is the source of food and clothing for human society, the foundation of survival, the foundation of supporting the whole national economy, and the guarantee of continuous development and progress of society. Although China is a big agricultural country, China's agricultural competitiveness is still at a disadvantage compared with developed countries such as Europe and America. The main reason is that most areas of China are still in the mode of intensive farming and small-scale farming, relying mainly on abundant natural resources and low labor costs to gain international advantages. Information technology is used as a channel to connect all links of modern agriculture. Accurate, timely and effective acquisition, dissemination and application of information can greatly improve the level of agricultural management and promote the rapid development of agricultural economy. The emergence of the IoT provides a very favorable technical support for the development of smart agriculture. Under the background of big data era, this paper discusses how to effectively combine intelligent agriculture with IoT technology in China, and puts forward the construction method of intelligent agriculture IoT system based on heterogeneous networking technology, which is of positive significance to the development of agriculture.

Keywords—Big data, Smart agriculture, IoT

I. INTRODUCTION

In the development period of China's economic structure transformation, agricultural production needs to develop in the direction of modernization and informatization to meet the needs of social development [1]. The rise of IoT technology provides strong technical support for promoting agricultural production information management. The development of China's economy promotes the modernization of agriculture, especially the development of China's industry, so that the development of agriculture has entered a new stage. Most of the agricultural bases have gradually entered the mechanical age, promoting the transformation of traditional agricultural mode to modern agricultural mode [2]. China is a big traditional agricultural country, agricultural informatization is of great significance to the development of China's agriculture. Informatization takes information technology as a channel to connect all links of modern agriculture. Accurate, timely and effective access to, dissemination and application of information can greatly improve the level of agricultural management, thus promoting the rapid development of agricultural economy [3]. The emergence of IoT provides a very favorable technical support for the development of smart agriculture. Therefore, an extremely important part of the development of modern agriculture should be the use of IoT technology to promote the development of smart agriculture [4]. On the basis of IoT technology, the development of smart agriculture has been promoted. Compared with traditional

agriculture, smart agriculture is a new concept, which is the upgrading of traditional agricultural production [5]. Through the application of sensors and a variety of software, the IoT technology can effectively connect all aspects of agricultural production. Through data collection and collation, on the basis of big data information, it can realize the monitoring and control of agricultural production [6].

The application of wireless network communication technology based on IoT to the field of intelligent agriculture is the inevitable trend of intelligent and information-based agricultural production [7]. Due to the coexistence of multiple wireless networks in the field of smart agriculture, it is necessary to build a heterogeneous wireless network platform for efficient management [8]. The application research of heterogeneous networking technology provides technical support for efficient data transmission in smart agriculture, which can improve agricultural production efficiency and bring certain economic benefits [9]. Under the background of big data era, this paper discusses how to effectively combine IoT technology with smart agriculture in China, and puts forward the construction method of smart agriculture IoT system based on heterogeneous networking technology, which has positive significance for the development of agriculture.

II. SMART AGRICULTURE IoT SYSTEM ARCHITECTURE

In order to fundamentally grasp the measures of building a smart agriculture platform based on the IoT, the first thing to do is to understand the concept of IoT technology and smart agriculture. In the big data environment, the architecture of smart agriculture IoT system can be divided into three parts, namely, information perception layer, information transmission layer and information application layer. Through these three parts of the system architecture, agricultural production can be intelligently controlled and managed, and agricultural production can be informatized. The information sensing layer mainly obtains various data information in agricultural production through various sensors, such as temperature, humidity, illumination, nutrient solution mass concentration and other information, and makes a basic judgment on the growth status of plants through these information, providing a favorable reference for intelligent control and management [10]. The information transport layer is the central link of the smart agriculture IoT system, which mainly distributes the information obtained by the perception layer to the local area network or wide area network by communication protocol, and the transport layer includes the Internet, cloud computing platform, mobile communication network, wireless sensor network, etc. The information application layer mainly includes mobile phones, PCs, portable

computers and other terminal devices. Through scientific analysis of the crop growth environment information obtained by the information perception layer, the corresponding management decisions are made, and then the

decision information is transmitted to the transmission mechanism. The overall architecture of the IoT connection management platform is shown in Figure 1.

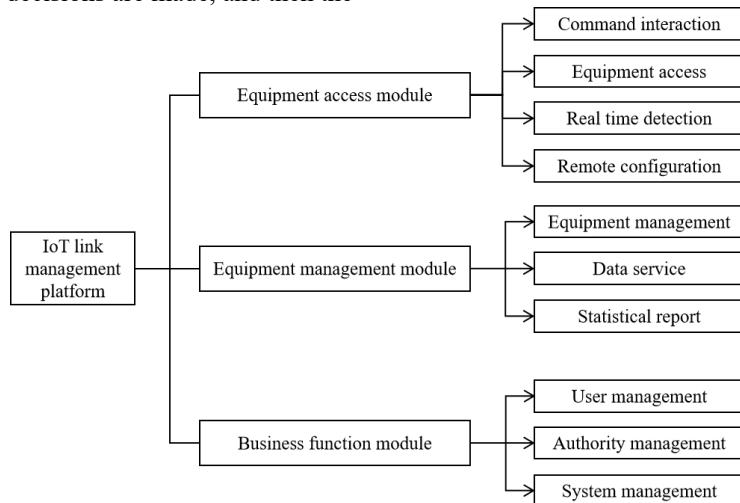


Figure 1 The overall architecture of the IoT connection management platform construction

The IoT is formed with the continuous improvement of information technology level in domestic society, so the IoT has strong information technology characteristics. The IoT can be closely integrated with the Internet to a certain extent, so as to better carry out the work of information collection, and carry out intelligent analysis of the collected data, finally making the connection between devices and networks closer. Smart agriculture can be called smart agriculture, because when it starts production work, the means it uses reflect the characteristics of strong informationization, so as to realize the remote diagnosis and remote monitoring of smart agriculture in a more timely manner. Smart agriculture refers to the modern agricultural production mode in which modern computer and information technology are applied to the agricultural production process, which is the advanced stage of agricultural production development [11]. Fundamentally speaking, smart agriculture is a more advanced level of agricultural development. It can integrate the brand-new mobile communication network system, IoT technology, etc., so as to make scientific use of various sensing organs, so that agricultural development can obtain higher quality technical support [12].

III. RELATED TECHNOLOGIES OF SMART AGRICULTURE IoT SYSTEM

A. Information perception technology

The basic technology of smart agriculture IoT system with big data lies in information perception technology. In order to better support subsequent operations, information data can be acquired by various sensors. The core of the IoT system is sensor technology, which mainly collects various agricultural information in agricultural production. For example, the illumination, temperature, humidity and nutrients of crops during agricultural production. On the basis of obtaining and analyzing the basic information of agricultural production, it can ensure that the detailed information of agricultural production environment can be clearly understood, and then provide reference opinions for management decision-making. The rational and scientific application of information sensing technology is the basis of

the application of IoT in smart agriculture. By collecting and analyzing the growth information of agricultural products in different stages through information sensing technology, the growth status of crops can be effectively controlled. Information sensing technology is the basic technology of intelligent agricultural IoT system. Only by obtaining information data through various sensors can it provide information basis for subsequent operations.

Radio frequency identification technology mainly uses radio frequency communication to automatically identify objects in a non-contact way, and to track and share information. The combination of radio frequency technology and sensing technology can sense the environmental information during food processing and storage, and provide a stable environmental guarantee for food quality. Radio frequency identification can also trace food and provide a strong basis for food quality monitoring and traceability. By using video recognition technology, crops can be identified in a non-contact way, so that the information of agricultural products can be tracked and shared. Through the combination of video recognition technology and sensing technology, the processing and storage environment of agricultural products can be sensed, so as to control the quality of crop-related products.

The remote sensing technology in the intelligent agricultural IoT system mainly monitors and records the changes of various physical forms and geometric shapes in agricultural production. By comparing and monitoring the information of temporal and spatial changes, the application layer can obtain the dynamic information in agricultural production in time, and provide technical support for making management decisions. In the smart agricultural IoT system with big data, with the effective application of remote sensing technology, it is possible to monitor and record the shape and geometric shape changes of various objects in agricultural production, and then transmit the information to the application layer, thereby comparing and monitoring the spatio-temporal change information, ensuring the timely acquisition of dynamic information in agricultural production, and better supporting management decision-making with technology.

B. Information transmission technology

Information transmission technology is an intermediate link to transmit the information obtained from the perception layer to the application layer. The quality and efficiency of information transmission directly affect the management decision of the application layer, so the information transmission as the central link is critical. Transmission to the application layer is the information transmission technology, which has a direct impact on the application layer management decision-making is the information transmission quality. Therefore, the key in the smart agriculture IoT system is the information transmission technology as the central link. At present, the wireless sensor network has been widely used in the intelligent agricultural IoT system, which mainly runs in the way of wireless communication [13]. In the wireless communication technology, an effective communication mode is Bluetooth. The wireless communication with Bluetooth does not need to be based on the base station networking in the running process, and it can form the communication network under the condition of several Bluetooth connections, ensuring that the point-to-point or point-to-many wireless communication network can be well realized. The remarkable characteristics of this networking mode are reflected in its strong flexibility, low investment, operation cost, mobility and so on, and it can guarantee its good integration with the wired network.

Information transmission technology is an important process of feedback on the perceived growth information of agricultural products, and the quality and accuracy of information transmission are very important for controlling the growth status of crops. Under the background of big data, in the development process of smart agriculture, real-time monitoring of crop production is carried out by adopting wireless sensor technology, which strengthens the application of IoT technology to a certain extent. With the

development of wireless communication technology, the strength and quality of wireless communication transmission signals are constantly upgraded, and the anti-interference is also constantly enhanced, which provides a strong guarantee for the efficient operation of the transport layer of the smart agricultural IoT system. Under the background of the rising level of science and technology at this stage, it has also brought good conditions for the development of wireless communication technology. The continuously optimized and upgraded wireless communication transmission signal strength and quality have also significantly improved its anti-interference performance, and better ensured the efficient operation of the transmission layer of the smart agriculture IoT system.

IV. IMPLEMENTATION OF INTELLIGENT AGRICULTURE IoT MONITORING SYSTEM

On the basis of preserving the traditional agricultural culture, the intelligent agricultural monitoring system applies the IoT technology to traditional agriculture, detects the growing environment of crops in real time through various sensors, wirelessly transmits the collected data to the gateway data center, and analyzes the real-time monitoring data of agricultural environment.

In the whole system software design, it is designed according to the data flow direction of the whole system, which mainly includes four data flow directions: data acquisition, data transmission, data storage and data processing. The terminal node completes the environmental data collection and reporting of each sensor in the farmland area, and receives relevant commands from the gateway, and realizes the software design of relevant control operations through the control module. The data flow diagram of the whole system software design is shown in Figure 2.

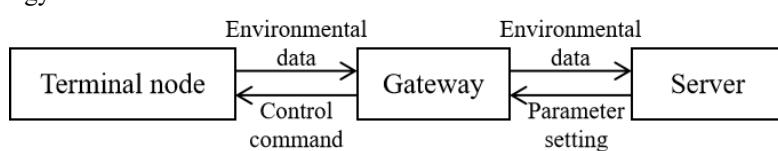


Figure 2 System software data flow

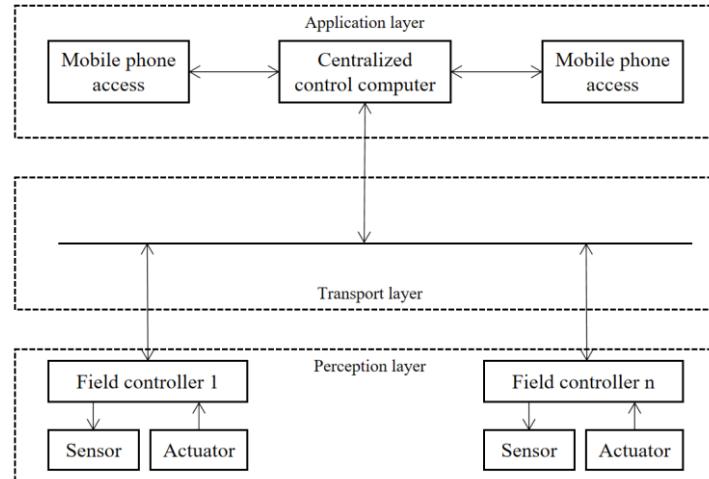


Figure 3 The overall structure of the system

According to the environmental control objectives and parameter characteristics of agricultural IoT, an intelligent

control system of agricultural IoT is designed based on heterogeneous networking technology, which can realize

comprehensive perception, reliable transmission and intelligent processing of environmental parameters of agricultural IoT. Based on the typical IoT architecture, the system is designed with three layers, including sensing layer, transport layer and application layer, as shown in Figure 3.

Information application layer is the terminal link of intelligent agriculture IoT system, which can automatically control information of intelligent agriculture, including cloud computing, decision support system, expert system,

geographic information system and intelligent control technology. Cloud computing includes a large amount of computing information, which will be stored in the cloud hosting. Information users can search information intelligently in the cloud computing platform according to their own needs, provide users with agricultural market information and practical technologies, and provide remote management services for agricultural production environment. The specific processing process is shown in Figure 4.

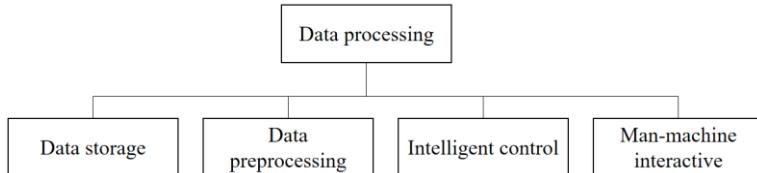


Figure 4 Data information processing process

In the process of agricultural production, there will be various complex problems. In order to effectively solve these problems, based on the accumulated experience of agricultural experts for many years, the problems are analyzed and judged, and then the countermeasures to solve the problems are provided to guide the solution of agricultural problems. Through GIS, we can judge the development trend of various data information in the process of agricultural production, and provide decision-making basis for the implementation of intelligent agricultural production regulation.

V. CONCLUSIONS

Smart agriculture is the main trend of China's agricultural development. The application of IoT technology is an important foundation for the development of smart agriculture, and it is also a key factor that determines the development process of smart agriculture. In this paper, under the background of big data era, the construction method of intelligent agricultural IoT system based on heterogeneous networking technology is proposed. Heterogeneous wireless gateways directly upload the monitoring node data to the cloud through wireless network cards to complete data analysis and processing, which can get rid of the dependence on the upper computer. In order to promote the long-term development of intelligent agricultural IoT system, it is necessary to improve the independent innovation ability of IoT technology, and strengthen the research and development of sensing technology and wireless transmission technology, so as to reduce the cost of agricultural production and improve the stability of agricultural production. The intelligent agriculture system involves too many related technologies, which is huge and needs constant improvement to realize the true intelligent agriculture.

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