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Application of IOT and Countermeasure in Agriculture of Shandong Province, China

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I. INTRODUCTION

Agriculture, as the dominant industry in Shandong Province, plays an important role in China. A number of indicators of the agricultural industry have always been in the forefront of the country. The total output value of agriculture, forestry, animal husbandry and fishery, the added value of the first industry and the export of agricultural products have always been the first in the country. Grain ranks the third in the country, cotton and oil plants rank the second, and the total output of vegetables, fruits, meat, eggs and milk, and aquatic products rank the first. According to statistics, Shandong Province, with 6% of the country's arable land and 1% of the country's water resources, has produced 8% of the country's grain, 13% of the country's vegetables and 10% of the country's meat, eggs and milk, making a positive contribution to the country[1].

The strong joint force of agricultural science and technology innovation in the whole province plays a leading and supporting role in the development of agricultural industry. Applying the IOT technology to agricultural production will form the Agricultural Internet of things, The Agricultural IOT connects all links of agricultural production through the network to realize the real-time monitoring and effective control of the whole agricultural production process.

Here are two examples to illustrate the application of IOT in agricultural production in Shandong Province, China.

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II. APPLICATION OF IOT IN BOHAI GRANARY SCIENCE AND TECHNOLOGY DEMONSTRATION PROJECT

a) Big data platform of Bohai granary science and technology project

In 2013, the "Bohai granary science and technology demonstration project" of the national major science and technology support plan was implemented. The project aims at the problems of 40 million mu of medium and low yield fields and 10 million mu of salt alkali wasteland in the low plain around the Bohai Sea, such as lack of fresh water resources, poor soil and salt alkali restricting grain production. It focuses on breaking through key technologies such as soil, fertilizer, water and seed, and establishes a grain production demonstration area in the local area. The goal is to increase grain by 3 billion kg by 2017 and 5 billion kg by 2020[2].

The big data platform is designed for this project. The platform system mainly includes four modules: data collection, mining analysis, monitoring and early warning, and decision-making service. Among them, the data acquisition module, through scientific assembly of various sensors such as meteorology, seedlings, soil and groundwater, forms a ground air integrated sensor cluster, constructs an intelligent sensing system for crop growth process environmental information, collects and transmits all kinds of data in real time, and provides all-weather and three-dimensional data support for subsequent data analysis, monitoring and early warning, and decision-making services [3].

The agricultural big data platform of Bohai granary has completed the functions of influencing factors analysis of grain production, data collection and transmission, data storage and partial data analysis and application. From bottom to top, the agricultural big data platform structure of Bohai granary can be divided into three layers: data acquisition layer, data storage layer and data application layer.

b) Wireless data acquisition system

There are many ways of data acquisition. The main way of data acquisition is on-site manual acquisition and Internet of things real-time acquisition. Using the self-developed real-time data acquisition base station of the Internet of things, the real-time and

accurate acquisition of key factors of meteorological information (wind speed and direction, air temperature and humidity, light intensity, rainfall, evaporation), soil information (salt, soil pH value, water level, water salinity, soil temperature and humidity) and crop growth (Leaf area index, dry matter accumulation, nitrogen content, nitrogen accumulation and chlorophyll content) is realized[4].

After data acquisition, ZigBee wireless sensor network technology is used for data transmission. ZigBee sensor network node is composed of four modules: processor, radio frequency transmission, sensor and power supply. The relationship between the modules is shown in the figure. The processor module is used for equipment control, task scheduling, logical calculation, coordination function, etc. of the network node. The radio frequency transceiver module is used for data transmission, frequency selection, etc. of the network nodes. The sensor module is used for Sampling and conversion of external sensing signals; The power supply module provides the necessary power for the network sensor nodes to maintain the operation of the network. The relationship between node modules is shown in Figure 1.

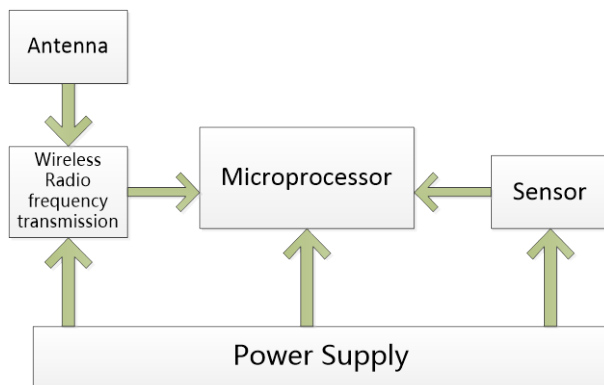


Fig. 1: Relationship between node modules

In the hardware design of ZigBee node, the CC2430 chip of TI company is used as the radio frequency transceiver module, and the MSP430 chip of TI company is used as the main control chip. Each ZigBee node is arranged in the monitoring area according to the requirements through ZigBee. The whole ZigBee wireless network system collects and uploads the data in the monitoring area to the monitoring host, and the monitoring host analyzes and collects the data.

MSP430 adopts the master mode, CC2430 adopts the slave mode, and the connection is simple and convenient. Four pins of SFD, FIFO, fifop and CCA are used to receive and transmit data; the processor exchanges data and sends commands with CC2430 through SPI interface. The processor accesses CC2430 internal memory through SPI interface. During the access process, CC2430 is the slave device of SPI

interface, which receives clock signal from the processor and performs input / output operation under the control of the processor.

c) Application results

There are three areas around Bohai Sea in the saline alkali land of Shandong Province. The platform has completed 72 data collection stations in three areas. The meteorological, seedling, soil and groundwater data of 27 demonstration sites in the Shandong project area of "Bohai granary" were collected, processed and analyzed, which effectively solved the problems of real-time data collection in the field of grain production. After research and development, testing, adjustment, optimization and demonstration application, the platform now has the characteristics of massive data source diversity, integration of historical and real-time data, multi factor comprehensive analysis and decision-making. It has been applied to the grain production management and decision-making process of typical plots in Shandong project area of Bohai granary, effectively guiding the grain production in the project area.

III. APPLICATION OF IOT IN THE SAFETY TRACEABILITY OF PIG INDUSTRY CHAIN

Internet of things (IOT) is a kind of network that connects any object with the Internet through RFID, infrared sensor, global positioning system, laser scanner and other information sensing equipment to exchange and communicate information, so as to realize intelligent identification, positioning, tracking, monitoring and management.

The quality and safety traceability system of agricultural products is to realize digital management of the whole industrial chain of agricultural products from breeding, transportation, slaughtering, segmentation, storage, processing to marketing.

Achieve precise management of production process and supervision, prevent cross mixing of products from different sources, Keep complete and detailed personal information of products, keep complete data, test reports and relevant certificates, so as to facilitate downstream producers and consumers to query and check at any time, Especially in the case of food safety incidents, find out the cause of the accident quickly, make control decisions immediately, minimize the possible losses and hazards, and reduce unnecessary panic[5].

In this application, a famous and excellent product pig in a region is taken as the research object, and the Internet of things technology runs through the whole industrial chain of pig from breeding, slaughtering and processing, logistics, sales and consumption. The data related to food safety in the industrial chain is transmitted to the database server through GPRS by the mobile terminal to the consumer for traceability query. At

the same time, the information multiple feedback mechanism is established to provide data support for pig breeding by using the information of breeding and slaughtering [6].

The whole industrial chain of pigs includes five links: breeding, breeding, slaughter division, logistics and sales, There are corresponding information management systems in each stage, which provide daily management for breeding plants, breeding plants, slaughterhouses, storage and logistics companies, and sales companies in different links, as well as write data to the database through the hardware collection terminal of the Internet of things, so as to provide data sources for the traceability of the whole industry chain. At the same time, in order to ensure the reliability and authenticity of the data source, the whole platform covers the supervision of the animal husbandry supervision department on the industrial chain information and the traceability query of consumers on the safety information related to meat products. The specific functions are shown in the figure2.

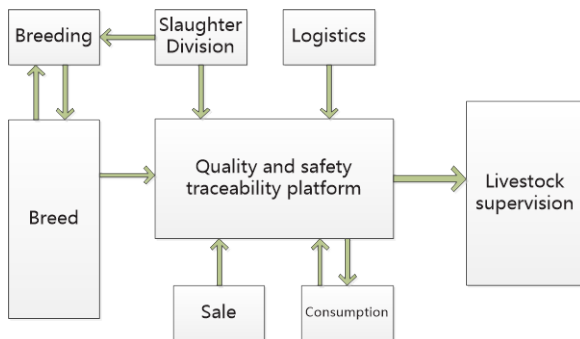


Fig. 2: Function division of pig whole industry chain traceability

The whole system adopts B / S architecture, which can be used through hardware platforms such as handheld devices and general PC, and is compatible with windows, Android, IOS and other operating systems, greatly facilitating the use of users, while reducing development costs and maintenance workload. After entering the pig traceability system information platform, They can directly input the traceability source code to query the traceability information of pigs.

The system is conducive to the real-time monitoring and control of the pig's growth environment by managers, convenient for consumers to query the information of all links from breeding to sales, and realize the tracking and traceability of pigs by consumers, governments and enterprises.

IV. CHALLENGES IN IMPLEMENTING IOT IN RURAL AREA

The new central document proposes to build agricultural and rural big data centers and accelerate

the application of modern information technology in the agricultural field, including the Internet of things, big data and artificial intelligence[7].

The application of Internet of things in the field of agriculture is still in its infancy, and there are still some constraints and bottlenecks. The price of chips, processors and other hardware equipment is high, the development of related software and application systems is relatively lagging behind, and the awareness and application level of grass-roots farmers on the Agricultural Internet of things need to be improved. It is not only limited to the Internet of things technology, accelerating the application of science and technology in agriculture should focus on the following aspects: Government guidance, policy support, increasing the interest of growers, encouraging market capital investment, Agricultural technology application demonstration and improving the innovation enthusiasm of agricultural researchers. With the in-depth implementation of the strategy of rural revitalization, the construction of modern agriculture and even smart agriculture is speeding up. Through improving the model of demonstration and guidance, strengthening the development and application training of relevant software and hardware, the application of Internet of things in the field of agriculture will be increasingly extensive, effectively promoting the level of agricultural production and efficiency.

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