Research on key technologies of intelligent agriculture under 5G environment

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Abstract: The application of agricultural Internet of things technology is the need of modern agriculture development, and also is an important sign of the future agricultural development level, which will be the direction of future agricultural development. The core technology of intelligent management is to adopt the methods of automation and information. In order to achieve accurate agricultural automation control and facilitate the information and intellectualization of management, it is necessary to develop intelligent agriculture with Internet of things, intelligent perception, intelligent control and cloud platform technology as the core.

1. Research objectives
It is proposed to make full use of intelligent perception and radio frequency identification technology of agricultural information on 5G environment to realize the deep integration of information technology and agriculture. Using the agricultural analysis technology of big data, the agricultural big data involves data analysis and mining, such as precise seeding and fertilization, to realize data visualization management. With the help of beidou enhanced positioning technology, precise agriculture is provided with high precision and wide coverage of location services, realizing all-weather construction of agricultural machinery. Finally, it achieves the goal of promoting agricultural modernization through information, and realizes the strategy of rural revitalization and the strategic goal of smart agriculture.

2. Research content
Smart agriculture is an important symbol of modern agriculture. How to build a new agricultural development model based on 5G environment where smart agricultural technology and human health complement each other is the key to promote the successful transformation and upgrading of modern agriculture. This research is put forward on the basis of these studies and the analysis of research results in home and abroad. The main research contents are as follows:

(1) 5G technology
5G, the fifth generation of mobile communication technology, is the further extension and development of 4G, which will further improved network performance and meet the communication requirements in 2020 and the future. The human society have entered the era of data. Through the application of agricultural big data onto agriculture, the optimization of agricultural economy will be continuously promoted to achieve sustainable industrial development and regional industrial structure optimization. The 5G network is an innovation revolution. The human society have entered the era of "great wisdom moving cloud ". The combination of big data, artificial intelligence, mobile Internet and cloud computing is getting closer and closer. 5G will bring big data industry prosperity and drive the rapid growth of smart agriculture.
The architecture of its fusion application system is shown in figure 1.

(2) Built an intelligent agricultural production system based on the key technologies of intelligent perception and RFID based on the Internet of things.

As a big agricultural country, intelligent agriculture will become a new direction of agricultural development. The application of current data sensing and acquisition technology, combined with cloud computing, mobile mutual inductor, big data and other high-tech information technology, to achieve the control of agricultural production and agricultural products, in a real sense to build a 5G environment of intelligent production mode. The schematic diagram of intelligent agriculture platform are shown in figure 2.:
Through a variety of wireless sensor real-time acquisition of agricultural production field parameters such as temperature and humidity, light, CO2 concentration, use of video surveillance equipment for crop growth condition and other information, remote monitoring environment, agricultural production will be collected at the same time parameters and obtain information from the digital transformation and summary, the transmission network real-time uploaded to the intelligent management system; According to the requirements of various indexes of crop growth, the system can automatically open or close agricultural facilities by remote control (such as remote control of water-saving irrigation, energy saving and oxygen increasing, etc.) to realize intelligent agricultural production.

Use RFID, bar code and other identification technologies to build a safe traceability system for agricultural products, realize the safe traceability of the whole process of agricultural products, promote the brand construction of agricultural products, and enhance the added value of agricultural products; Establish wireless sensor network, develop intelligent agricultural application system, collect and analyze real-time data of air, soil and crop growth status, systematically plan the distribution of agricultural industrial parks, reasonably select crop varieties, identify and manage diseases online, and scientifically guide ecological rotation.

(3) **Agricultural analysis technology based on big data to tap the source of intelligent agricultural value.**

Big data in agriculture is the practice of big data concepts, technologies and methods in agriculture. Agricultural big data technology break through the limitation of traditional analysis for structured data management, inherit the merits of the statistics, the huge amount of data search, comparison and statistical analysis, clustering and classification of pay more attention to the data associated with the business, focus on multimedia, complex data mining analysis and comparative analysis of historical data.

(4) **Based on beidou augmentation and positioning technology, it provides precise agriculture with high precision and wide coverage of location services, and realizes all-weather construction of agricultural machinery.**

Precision Agriculture is a new trend in the development of Agriculture in today's world. It is a system supported by information technology to locate, time and quantitatively implement a set of modern agricultural operation technology and management based on spatial variation. Precision agriculture consists of ten systems, namely, global positioning system, farmland information acquisition system, farmland remote sensing monitoring system, farmland geographic information system, system, intelligent agricultural machinery and tools system, environmental monitoring system, system integration, network management system and training system.

Beidou enhanced positioning technology is adopted to provide precise agriculture with high precision and wide coverage of location services, to meet the automatic requirements of driving, sowing, fertilizing, irrigation and harvesting of agricultural machinery, so as to realize all-weather construction of agricultural machinery. At the same time, the Internet of things infrastructure in the field is utilized to realize the leap from agricultural mechanization to Internet fine agriculture, from automation and informatization to DT era, and realize the online fine agriculture planning, implementation, management and linkage based on data, so as to realize the real implementation of Internet agriculture. Therefore, we believe that high-precision satellite navigation equipment is the necessary equipment for agricultural automation and precision agriculture.

**Generally speaking, beidou precision positioning service system actually establishes "stations" on the ground, and USES the "network" on the ground to enhance the positioning and navigation accuracy of the "network" in the sky, improve the performance of the beidou system, and make the positioning accuracy and reliability of the beidou system higher. This is also an important contribution of beidou ground-based enhancement system.**

(5) **Intelligent agricultural monitoring system.**

Based on agricultural Internet of things technology, real-time and remote access to facility environment information and video information, and through analysis, remote or automatic control of
wet curtain fan, spray drip irrigation, heating and lighting and other equipment, for high yield, quality and ecological conditions. Agricultural environment intelligent monitoring system, can obtain real-time and remote greenhouse and field air temperature and humidity, soil moisture temperature, carbon dioxide concentration, light intensity and video image, through model analysis, can automatically control greenhouse wet curtain fan, spray drip irrigation, internal and external shading, top window side window, heating and lighting and other equipment; At the same time, the system can also push real-time monitoring information and alarm information to managers through mobile phone, PDA, computer and other information terminals, to achieve the greenhouse information, intelligent remote management. As shown in figure 3. below:

![Figure 3. Intelligent agricultural monitoring system platform](image)

3. Key research issues
Agriculture is the primary industry in China. The essence of the agricultural Internet of things is to apply the Internet of things technology to agricultural production and management, making it more informationized and intelligent. Based on the above research contents, the following key issues are determined based on the criteria of difficulty and importance of the problem to the whole research:

(1) **Key technologies of intelligent perception and radio frequency identification to conquer agricultural information**

RFID based identification research has been expanding, positioning and navigation is the hot field of its application, which reflects the integration of RFID research trend with the location information of Zig Bee, GPS and wireless sensor network and other signals.

RFID signals have specific signal attenuation rules at different relative heights, so it is urgent to standardize the perceptual information. To strengthen the study of uniform standards for animal and plant identification, the influence of plant shape and the relative height of antenna on signal transmission was studied to further solve the influence of crop planting density on wireless signal loss.

(2) **Realize the deep integration of information technology and agriculture, and give birth to a variety of smart agricultural technologies**

Agricultural model, agricultural knowledge system and so on are the field technologies produced by the deep integration of modern information technology and agriculture. The core technology of intelligent management is to realize scientific and intelligent management of agricultural production by means of automation, information and expert system.
The core technology of water and fertilizer integration is to deliver fertilizer and water to the root soil of crops in a timely, appropriate and accurate manner through the irrigation system according to the law of crop water demand and fertilizer demand and soil moisture and nutrient status, so as to supply crops for absorption. Through system control, automatic control of irrigation quantity, fertilizer absorption quantity, fertilizer liquid concentration, pH and other parameters, realize the timing and quantitative control of irrigation and fertilization, and provide all-round water and fertilizer management. Function module is shown in figure 4. below:

![FIG. 4. intelligent irrigation function module](image)

High performance data acquisition and monitoring equipment are adopted to realize accurate agricultural automation control and to facilitate the informatization and intelligence of management. Develop timely irrigation and fertilization strategies, and realize automatic irrigation management through automatic control means. Combine the technology of information transmission and Internet to realize the remote management of agriculture.

(3) **Data processing technology based on cloud computing, realizing dynamic storage and management of cloud and terminal data**

To solve the integration and development of different network technologies. The technical specifications to be strengthened include sensing node address identification method, unified service network access, data fusion technology, dynamic self-organization technology, data exchange technology, cross-layer data access and agricultural big data technology. The system classifies and encrypts data, and realizes the dynamic storage and management of cloud and terminal data according to certain rules. Complex data mining and comparative analysis of historical data.

**Agricultural big data is transforming from technological innovation to application innovation, and 5G will also bring huge amount of original data to agriculture, thus promoting the continuous progress of intelligent agriculture.**

4. **Conclusion**

Solving key technologies in intelligent agricultural production of 5G environment can not only effectively improve modern agricultural technology, but also meet the needs of agricultural information, which is a collaborative innovation combining digital agriculture and traditional agricultural research. It is advanced and exploratory at the present stage, but the practicability of the research remains to be further improved.

With the further development and application of 5G technology, this research will be supported by more intelligent technologies and data processing technologies, which is expected to be more widely applied in the field of agricultural practical technology promotion and scientific research.

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References
[1] Li shu. Research on parametric channel modeling and simulation technology of the fifth generation mobile communication [D]. North China electric power university (Beijing), 2018.
[2] Yue xuefeng. Research on intelligent agriculture and its key technologies based on the Internet of things architecture [D]. Shanghai applied technology university, 2018.
[3] Zhang yuejie. Research on the construction of precise monitoring and intelligent control system based on intelligent agricultural information platform of Internet of things [D]. Qufu normal university, 2017.
[4] Yang xiaoqi. Research on big data of intelligent agriculture platform construction based on Internet of things [D]. Qufu normal university, 2017.
[5] Chen xiaohua. Research and design of vehicle-mounted positioning system in precision agriculture [D]. Southwest jiaotong university, 2018.
[6] Gubbi J, Buyya R, Marusic S, et al. Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions[J]. Future Generation Computer Systems, 2018,29(7):1645-1660.
[7] Nibgbin W,Junmin L. The design of ZigBee network nodes based on CC2430[J]. Application of Electronic Technique, 2018, 3:41.
[8] Suo gao-yu. Field information collection and variation study of precision agriculture based on GIS and geostatistics [D]. South China agricultural university, 2018.
[9] Peng Xiangnan, Zou Xiaoping, Yu Zhaoxian, Yang Yuan. Design of household appliance control system based on Zigbee, 2017.
[10] Ji bing. ARM based variable spray control system design [D]. Chinese academy of agricultural mechanization science, 2018.