Key Technologies and Applications In Intelligent Agriculture

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Abstract. With the development of new generation information technology such as artificial intelligence, Internet of things and big data, traditional agriculture has changed and gradually changed to intelligent agriculture. In intelligent agriculture, sensor technology can collect all kinds of information in agricultural production, communication technology can transmit the collected information, and use big data analysis to guide agricultural production and agricultural product sales. The application of artificial intelligence makes agricultural production high-yield and high efficiency, and unmanned driving technology can realize automatic production and fine management. This paper elaborates the application of these key technologies in agriculture.

Keywords: Sensor technology, Internet of things communication technology, Big data, Artificial intelligence, Unmanned driving, intelligent agriculture

1. Introduction
Intelligent agriculture is a new stage of agricultural production. It is a comprehensive application of artificial intelligence, big data, Internet of things and other information technologies in agriculture. Intelligent agriculture can realize the sharing of perceptual information, the centralization of data resources, the deepening of intelligent control and the humanization of public service. It has changed the shortcomings of traditional agriculture, such as high labor cost, high production cost input, low productivity, unpredictable output and product quality.

2. Sensing technology
Sensing technology is a modern science and engineering technology about obtaining information from nature, processing and identifying it. Various sensors act as sensory organs to obtain information, such as temperature, angle, displacement, etc. Different sensors have different working principles.

In intelligent agriculture, sensor nodes measuring different physical quantities can be automatically organized to form a sensor network. The sensor network can realize the intelligent sensing of various physical quantities needed by crop growth. In the planting industry, temperature and humidity sensors can be used to obtain the temperature and humidity in the air and soil, the pH value of the soil can be obtained by using the pH probe, the carbon dioxide concentration can be obtained by using the gas sensor, and the physical quantities such as the sunlight intensity can be obtained by using the light sensor. The sensor network can also be used to monitor crop growth data such as leaf color, stem change, stamen change, fruit size and so on. These provide timely and accurate information for...
producers, so as to determine when fertilization is needed, when pollination is needed, when spraying agriculture and when picking is needed, so as to realize scientific management and accurate operation. In this way, the cost of agricultural products is reduced and the quality is improved. Special biosensors can also be used to affect the genetic genes of seeds in the process of breeding and seedling raising, so as to achieve the purpose of cultivating excellent varieties. In animal husbandry and aquaculture, sensors can be used to obtain environmental data such as gas content and water quality, so as to prevent the risk of epidemic and ensure the safety of products. Sensor is the helper of farmers, is the necessary equipment in large-scale agricultural production. [1] The application of sensor in intelligent agriculture is shown in the following figure:

![Figure 1](image.png)

**Fig. 1** The application of sensor in intelligent agriculture

### 3. Internet of things communication technology

Communication technology is a key link in the Internet of things industry. It plays a role in undertaking sensors and other products in the sensing layer and docking with terminal products in the application layer. At present, there are many Internet of things communication technologies, mainly including Bluetooth, ZigBee, RFID, Wi Fi, NFC, Lora, Nb IOT and other technologies. Each communication mode has its own advantages and disadvantages. Bluetooth is generally used for short-range wireless communication, and its power consumption is relatively large compared with other communication methods, and the use of field consolidation is not much. Compared with Bluetooth, ZigBee is an ideal short-range wireless communication mode with low cost and low power consumption, and its networking complexity is low, which is suitable for occasions with low data transmission rate requirements. RFID is more widely used. It is a wireless communication technology that does not need to establish optical contact or mechanical contact between the identification system and the identified target. It identifies the target through the wireless signal and completes the reading and writing of relevant data.

Internet of things communication technology is mainly used in the production and circulation of agricultural products in intelligent agriculture. All kinds of data obtained by sensor network need to be transmitted by various communication methods. In the modern breeding industry, wearable devices based on Bluetooth technology are used to collect individual information such as ovulation, disease and production of livestock, so that the breeders can deal with them in time. The use of RFID technology can automatically collect the breeding information of each livestock, and establish the identification system of livestock, which can leave information from breeding to processing, ensure food safety production, and realize the quality tracking and traceability of agricultural products. In the planting industry, ZigBee technology is used to transmit the information collected by each sensor node, which can realize the functions of automatic management of farmland, accurate measurement and traceability of agricultural products [2].
In food processing, RFID tags can be used to realize intelligent packaging. RFID electronic tags carry all kinds of food information, such as the origin of the food, what feed or fertilizer has been used in the breeding or planting process, how long the growth cycle is, when the fishing or harvesting time is, whether there are drugs used, how long the processing time, whether additives are used, how about the storage conditions and shelf life, and how about the transportation process. These information can be read by intelligent terminal equipment, which is convenient for consumers to understand and promote the communication between producers and consumers. The application of communication technology in intelligent agriculture is shown in the following figure:

![Fig. 2 The application of communication technology in intelligent agriculture](image)

4. **Big data**

The emergence of big data has changed the traditional farmers' production mode with experience as the guiding ideology. Through the collection, analysis and processing of big data, people can intuitively understand the change trend of things and predict the development of things. Therefore, if we master the huge data information, and can analyze and process the effective data with the help of technology, we can also help people to complete the precise customized service, avoid the problems of oversupply, unsalable agricultural products and unable to meet the personalized demand in traditional agriculture, and realize the prediction of demand, the distribution of crop types in advance, and the maturity period.

The use of big data in agriculture can provide information for the supply and marketing of agricultural products, guide the adjustment of agricultural production layout, reasonably plan the output, and help farmers improve productivity and income. From all aspects of agriculture, big data can adjust the production process in the production link, increase the added value of agricultural products in the processing link, guide the orderly operation of the agricultural product market in the sales link, and ensure the food safety detection problems in the storage link. With the help of big data technology, the majority of crop growers can obtain the climate information, rainfall information, air humidity information, temperature information, soil moisture, soil fertilizer amount and other data for agricultural production in the first time. Big data technology can accurately analyze and screen these data, quickly obtain effective data suitable for local agricultural production, and then guide farmers correctly Carry out agricultural production activities. With the big data platform as the technical support, and using the massive data of the platform, it can accurately push agricultural products according to the characteristics of agricultural products and consumer preferences, and increase the possibility of agricultural products sales. Due to the widespread use of intelligent mobile terminal devices, the application of big data technology is more convenient. E-commerce can timely understand the needs of customers, provide personalized services according to the special needs of target customers, and improve the shopping experience of consumers[3]. The application of big data in intelligent agriculture is shown in the following figure:
5. Artificial intelligence

Artificial intelligence is a new technology science, which includes the research and application of robots, image recognition, language recognition, expert system, natural language processing, etc. Although artificial intelligence is not human intelligence, it can realize the intelligence that thinks like human beings and may exceed human beings[4].

With the development of various technologies in the field of artificial intelligence, the combination of artificial intelligence and agriculture has begun to erase sparks, and has a broad prospect. Human can use artificial intelligence to realize intelligent selection. Through finding the best conditions for seed germination, the whole year crop planting can be realized. We can use machine learning technology in agricultural environment to manage irrigation time accurately and save water consumption. We can use machine vision to identify whether crops have weed growth or pest erosion and predict harvest time. We can establish the knowledge database of agriculture, help farmers master information technology and data processing technology, and farmers can ask for various problems in agricultural production. For example, the treatment of diseases and pests according to syndrome differentiation, with the help of artificial intelligence system, even the inexperienced farmers can cope with various diseases and pests, and actively prevent and treat them in time.

6. Driverless Technology

The development of unmanned driving technology has been for many years, but its application in agriculture is relatively backward. At present, the main applications in agriculture are plant protection UAV, unmanned agricultural machinery and agricultural robot.

The application of plant protection UAV in agriculture has achieved initial results. It has low cost, small size and can adapt to various use environment. With the combination of UAV and advanced sensors, it can accurately draw the plot map, achieve effective sowing, achieve uniform and accurate spraying of pesticides and fertilizers, and accurately monitor the growth of crops. Unmanned agricultural machinery can realize intelligent land preparation, sowing, fertilization, plant protection and other operations. Agricultural robots can replace farmers for farming, and the production efficiency is higher than manual. Fertilizer robot is not the same as farmers, it will use soil data, its own analysis and calculation, according to local conditions to determine a reasonable amount of fertilizer, reasonable reduction of the total amount of fertilizer, so as to reduce costs and improve
groundwater quality. Weeding robot can recognize crops and weeds, and picking robot can judge whether crops are mature or not. The application of unmanned driving technology in agriculture has a very broad prospect. Intelligent agriculture will become the direction of global agricultural development in the future, and farmers will really feel the joy of harvest brought by scientific and technological innovation.

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