Research on the application of Internet of Things model in smart agriculture

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Abstract: With the rapid development of science and technology, the application of the Internet of Things model in all walks of life has gradually become a trend that can not be ignored. In the field of agriculture, the integration of the Internet of Things is leading a new era of smart agriculture. This paper will deeply explore the application of the Internet of Things model in smart agriculture, focusing on image recognition technology, agricultural ecological data collection and analysis and big data display system design and implementation. Through the analysis of these key areas, we will reveal how the Internet of Things brings new ways of application to agriculture, improve agricultural production efficiency, reduce resource waste, and provide more accurate data support for agricultural decision-making.

Key words: Internet of Things model; Smart agriculture; Applications

I. The application value of the Internet of Things model in smart agriculture

In the field of smart agriculture, the application of the Internet of Things model is not only a technical means, but also a strategic initiative with far-reaching value. First of all, the application of the Internet of Things model in smart agriculture provides efficient, accurate and intelligent solutions for agricultural production, thus injecting new vitality into every link of the agricultural production chain. Secondly, the wide application of the Internet of Things technology makes farmland monitoring more refined. Through the deployment of sensor networks, real-time monitoring of key parameters such as soil temperature and humidity and nutrient content can be achieved. Such fine monitoring not only helps to scientifically and reasonably fertilize and irrigate crops, improve crop yield and quality, but also reduces resource waste and ultimately realizes sustainable development of agricultural production. Finally, the introduction of the Internet of Things model makes smart agriculture more intelligent at the decision-making level. Through the collection, analysis and mining of large-scale data, agricultural managers can obtain information about production environment, market demand and many other aspects. This information not only contributes to scientific and rational planning of agricultural production, but also provides strong support for marketing and optimization of agricultural product supply chain. Decision-makers can predict market demand more accurately, adjust production structure flexibly, and achieve an accurate match between supply and demand. In this process, the application of the Internet of Things model has created huge economic value for smart agriculture. By improving the efficiency of agricultural production and optimizing the utilization of resources, the agricultural economy has been significantly enhanced.

II. The application of the Internet of Things model in smart agriculture

1. The application of image recognition technology in agricultural monitoring

(1). Identification of pests and diseases

① Monitoring methods and techniques

In the monitoring of pests and diseases, the Internet of Things combined with image recognition technology has become a key solution. By placing a network of high-resolution cameras and sensors in farmland, image recognition technology can monitor the growth status of plants in real time. The collected images are analyzed by a deep learning algorithm to identify features such as color and shape of plant leaves, thereby quickly and accurately detecting the presence of pests and diseases. This monitoring method achieves all-round coverage of farmland conditions and provides reliable data support for agricultural production.

② Practical case analysis

In the application of a smart agriculture demonstration base, real-time monitoring of wheat diseases and pests was successfully realized by setting high-definition cameras and sensor networks in wheat fields. Once abnormal leaf color and poor growth are detected, the system will immediately issue an early warning. For example, image recognition algorithms are able to identify disease spots on wheat leaves at an early stage, picking up signs of disease days earlier than traditional manual inspections. This enables farm managers to quickly take appropriate prevention and control measures, ultimately avoiding the spread of disease and ensuring wheat yield and quality.

(2) Fire monitoring

① Fire identification algorithm

The application of image recognition technology in fire monitoring has also achieved remarkable results. By deploying infrared cameras around farms, the system can monitor fire sources in real time. The deep learning algorithm is able to accurately identify the characteristics of the flame, including temperature and brightness. Such algorithms ensure the timely discovery of fire sources and greatly improve the efficiency of fire monitoring.

② Prevention and emergency response

In practical application, a large orchard uses image recognition technology for fire prevention and emergency response. By analyzing image data within the farm, the system can predict potential fire risks in advance, such as detecting areas of unusually high temperatures, hot spots, etc. After the warning signal is issued, farm managers can quickly mobilize emergency teams and take emergency measures, such as adjusting irrigation systems and clearing flammable vegetation. This real-time emergency response effectively reduces the fire damage to the farm and protects farmland assets and crops.

(3) Farm intrusion detection

① Security monitoring system

Farm intrusion detection realizes the monitoring of the security situation around the farm through image recognition technology. In a smart agriculture system, cameras are combined with a network of sensors to accurately identify people and vehicles entering the farm area. This security monitoring system provides farms with real-time, all-round security data, helping to spot potential threats in a timely manner.

② Protection strategies that integrate iot technology

Farm intrusion detection not only relies on image recognition technology, but also combines the Internet of Things technology, through the integration of a variety of sensor data, such as infrared sensors, sound sensors, etc., to form a more comprehensive security monitoring system. For example, in the practical application of a large farm, a night intrusion event was successfully identified through the combination of image recognition technology and infrared sensor. The system issued an alarm in time, and the farm manager viewed the monitoring screen in real time through the Internet of Things platform, confirmed the intruder and took timely measures to maintain the security of the farm.

2. Collection and analysis of agro-ecological data

(1) Data collection technology

① Soil monitoring

Soil monitoring in smart agriculture is achieved through the deployment of a network of soil sensors that are able to monitor key parameters such as soil temperature, moisture, and nutrient content in real time. For example, on a smart farm, by embedding soil moisture sensors, the farm manager can check the soil moisture status of different plots at any time. When the humidity is low, the system automatically triggers a smart irrigation system to achieve precise irrigation and improve the efficiency of water use.

② Water quality monitoring

Water quality monitoring is achieved by setting up water quality sensors at key locations such as water sources and irrigation canals. For example, in a smart greenhouse project, real-time monitoring of the quality of irrigation water was achieved by embedding water quality sensors in the irrigation system. When the water quality is abnormal, the system will send an alarm in time, and farm managers can take corresponding measures to avoid adverse effects on plants.

③ Meteorological data collection

Meteorological data collection through weather stations and other equipment to obtain atmospheric temperature, humidity, wind speed and other information. In the project of an agricultural weather station, the real-time monitoring of the surrounding meteorological conditions was realized by deploying meteorological sensors. These data are used to make reasonable agricultural production plans, such as taking timely measures to cool down before the arrival of high temperature weather to ensure the normal growth of crops.

(2) Data analysis and model building

① Growth model

Using the collected multi-dimensional data such as soil, water quality and meteorology, plant growth models can be established to predict the growth of plants under different environmental conditions. For example, a deep learning-based crop growth model was built by combining data such as soil moisture, air temperature and light intensity. The model is able to accurately predict the growth rate of crops, providing a scientific basis for rational agricultural production plans.

② Optimize the agricultural production process

Data analysis also provides support for the optimization of agricultural production processes. In a smart farm project, decision support models were built through in-depth analysis of data such as historical soil nutrients and crop yields. The model uses machine learning to continuously optimize agricultural production processes, including fertilization schemes, planting density and so on. Through real-time monitoring and feedback, farms have successfully reduced fertilizer use and increased crop yields.

(3) Intelligent irrigation systems

Intelligent irrigation system is an important application of the Internet of Things model in smart agriculture. In practice, by integrating information such as soil moisture and meteorological data, the intelligent irrigation system can achieve accurate control of the irrigation process. For example, in a large paddy field, the system adjusts the irrigation time and amount of water by constantly collecting soil moisture and meteorological data. This intelligent irrigation system not only improves irrigation efficiency, but also reduces waste of water resources.

3. Design and implementation of Web large screen big data display system

(1) Selection of big data visualization tools

In the iot environment of smart agriculture, choosing the right big data visualization tool is a crucial step. Take Tableau as an example, the tool provides powerful data analysis and visualization capabilities, and is able to easily process multi-source data such as agricultural sensors and meteorological data. With Tableau, users can build interactive dashboards to realize real-time monitoring and analysis of agricultural production data.

(2) Data dashboard design

On the one hand, real-time monitoring data. In order to realize the real-time monitoring of the agricultural production environment, we can design a dashboard that displays various sensor data, such as soil moisture, temperature, light intensity, etc. Through the visual display, farm managers can quickly understand the actual situation of the current farmland. For example, by displaying soil moisture distribution through a plot heat map, managers can spot possible dry areas at a glance. Decision support information, on the other hand, is displayed. Decision support is a key link in smart agriculture, and the design of data dashboard should focus on this aspect. By integrating historical data with real-time monitoring data, dashboards can provide predictive analytics to help farm managers make more informed decisions. For example, by analyzing meteorological data and crop growth cycles, the system can provide recommendations on the best planting times to help farmers choose the right crop varieties.

(3) User friendliness and customizability

The design of user-friendly and customizable interface is an important factor to ensure the practical application of the system, as follows: on the one hand, user friendliness. Considering that farm managers may not have a professional information technology background, the interface should be simple and intuitive, providing clear instructions for operation. For example, intuitive charts and graphs allow users to quickly understand trends in farm data without having to delve into technical details. On the other hand, customizability. Different farms may have different needs, so the system should have some customizability. Users can choose which data to display and in what form according to their needs. For example, certain farms may focus more on water efficiency, so they can customize dashboards to highlight water-related data metrics.

Conclusion: This paper deeply studies the various applications of the Internet of Things model in smart agriculture, not only highlighting its role in image recognition technology, such as pest identification, fire monitoring and farm intrusion detection, but also paying attention to the collection and analysis of agro-ecological data, as well as the design and implementation of the Web large screen big data display system. Through these studies, we not only provide a more intelligent and accurate means for agricultural production, but also provide a more comprehensive data support for agricultural management decisions. The development of smart agriculture is not only the progress of technology, but also the active exploration of sustainable agricultural development. It is also expected that the research results of this paper can provide useful references for the promotion and application of smart agriculture, so as to realize the sustainable prosperity of agriculture.

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