Research and development of wireless sensor networks in the context of Rural Revitalization

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Abstract: Wireless Sensor Network (WSN) integrates three modern information technologies, Sensor Technology, Computer Technology and Communication Technology.It has a good application prospect in the construction of Rural Revitalization, and effectively promoting the development of Precision Agriculture and Smart Agriculture in China. This paper introduces the composition and characteristics of WSN. At the same time, combining the development trend of Rural Revitalization and Agricultural Internet of Things, the system of Agricultural Internet of Things based on WSN was analyzed, and the application direction of Agricultural Internet of Things was elaborated. Finally, the research status of WSN was discussed.

Keywords: Wireless Sensor Network; Rural Revitalization; Agricultural Internet of Things

Introduction

Agriculture is the foundation of the country, and the foundation is the foundation of the country. China's agriculture has been the basis of national development since the development of slash and burn cultivation five thousand years ago. However, at present, agriculture is facing prominent problems in social, economic and ecological aspects. The continuous reduction of cultivated land resources, the transfer of agricultural labor to non-agricultural areas, the lack of water resources and environmental pollution all affect the sustainable development of agriculture. Agricultural modernization is the inevitable choice of China's agricultural development, and its starting point lies in relying on modern agricultural information technology. By using information technology to drive agricultural modernization reform and modern science and technology to lead sustainable development, China's agriculture can break through the bottleneck of development and truly become an important foundation for national stability and security.

Wireless sensor networks (WSN) is known as one of the most influential technologies in the 21st century. Since the 1970s, wireless sensor networks have emerged in the field of national defense and military affairs. In recent years, wireless sensor networks have become more and more prominent in the fields of smart home, environmental detection, intelligent agriculture and so on. The intelligent greenhouse monitoring and control system based on wireless sensor network can automatically monitor the environmental factors closely related to crop growth (temperature, carbon dioxide concentration, soil fertility, etc.) and automatically control the conditions of ventilation and irrigation equipment through threshold setting, which is convenient for fine farming and intelligent management, saving human and material costs, and even increasing crop yield. The innovative use and creative research of wireless sensor networks in the field of agriculture can also support the sustainable development of agriculture, let traditional agriculture access the reform wave of modernization, and help realize the revitalization goal of "strong agriculture".

1 Introduction to wireless sensor networks

Wireless sensor network is a wireless network composed of multiple sensor nodes. These sensor nodes can be widely arranged in the monitoring area. Each node can carry out data monitoring and information processing. They need to cooperate and communicate with each other, and finally transmit the monitored information to users. A complete wireless sensor network usually includes sensor nodes, sink nodes and management terminals. Sensor nodes are data collectors and data transfer stations in the network. As the data collector, the sensor built in the node collects environmental data and sends it to other nodes through the data transmission network; As a data transfer station, in addition to completing the task of data collection, each node should also receive the data from surrounding neighbor nodes and forward it to neighbor nodes closer to the sink node or directly forward it to the sink node. The sink node is mainly responsible for the connection between the sensor network and other networks (GPRS, etc.), plays the role of gateway, and can also collect, summarize and pre process the data of the surrounding sensor nodes. The management terminal is a window of human-computer interaction. Managers can manage the whole wireless sensor management through mobile management devices, computers and other tools.

Sensor node is the basic unit of wireless sensor network, which is mainly composed of data acquisition module, data processing module, data transmission module and power module. The data acquisition module is mainly composed of sensors for monitoring information. Usually, one or more sensors can be installed according to the different tasks of sensor nodes and wireless sensor networks. The data processing module is mainly composed of MCU, memory and other components. It is the "brain" of the entire wireless sensor node and is responsible for device control, task scheduling and data processing of the entire node. The data transmission module is usually responsible for sending the data collected by the sensor and receiving the information from other nodes or sink nodes. The power module is responsible for providing necessary energy for the normal operation of the whole node.

2 Wireless sensor networks in the context of Rural Revitalization

Rural Revitalization is a major strategy to solve the key problems of China's agricultural and rural farmers, and agricultural and rural informatization is the strategic commanding point of agricultural and rural modernization. China's agricultural informatization construction

started late and has a weak foundation. After years of development, the informatization infrastructure has been significantly improved, and the construction of smart agriculture has achieved preliminary results. However, at this stage, it still faces problems such as insufficient network infrastructure, insufficient innovation ability, and insufficient effective data. The "14th five year plan" period is a critical period for China's agricultural and rural modernization from weak to strong, from "bonsai" to "landscape". A new round of scientific and technological revolution is in full swing, modern information technology innovation is unprecedentedly active, and new technologies are emerging in endlessly, providing sufficient technical basis for the realization of China's agricultural and rural informatization and Rural Revitalization.

Informatization is the only way to promote the modernization of China's agricultural production and the key to improve the quality of agricultural development. At this stage, agricultural and rural informatization is not only the network infrastructure, but also committed to the development of smart agriculture. Smart agriculture combines modern science and technology with planting, animal husbandry, fishery, etc. with the help of sensor and other Internet of things technologies, it uses big data, cloud computing and other tools to deeply mine business-related data, and carries out model construction and speculation on the basis of data, so as to realize unmanned, automatic and intelligent management. For example, the Agricultural Internet of things system based on wireless sensor network is used to realize intelligent agricultural management. In its greenhouse control system, sensors are used to monitor environmental parameters such as temperature, relative humidity, light intensity and soil nutrients that directly affect crop growth. The control terminal records relevant data in real time and conducts intelligent environmental control. If the temperature exceeds the appropriate temperature range for plant growth, It can control the relevant ventilation equipment through wireless sensor network for temperature regulation.

As a representative technology of the modern Internet of things, wireless sensor network and its application in smart agriculture will shine brightly. Unlike WiFi, GPRS and other wireless transmission networks, wireless sensor networks play the role of data transmitter, data collector and processor, which is equivalent to having "senses", "brain" and "nerves" at the same time. At the same time, wireless sensor networks have many characteristics, such as self-organization, data centric, reliability and so on. The self-organization of wireless sensor networks can ensure that the nodes can be automatically configured and managed through the topology control mechanism and network protocol wireless network system, and can well adapt to the agricultural environment under different conditions such as wind, sun, snow, rain and so on. Even in the highlands and forests where people are inconvenient to reach, the nodes can be deployed and the network can be established by UAV placement. Wireless sensor networks are data centric. The whole network collects, transmits and processes data. All tasks are around data. In wireless sensor networks, sensor nodes have strong functionality. Sensor nodes can choose different types of sensors such as temperature, humidity, carbon dioxide concentration, illumination according to the actual agricultural needs, which are suitable for different agricultural scenarios such as planting, animal husbandry, fishery and so on. Sensor nodes also have certain dynamics and reliability. A large number of sensor nodes are often arranged in the same monitoring area to ensure both full coverage and data accuracy. Even if sensor nodes fail or fail due to environmental factors or power depletion, relevant nodes can be replaced at any time.

3 Research examples of Wireless Sensor Networks

In a broad sense, agriculture includes five industries: planting, forestry, animal husbandry, fishery and sideline industry. It has many agricultural scenes, such as greenhouse, pastoral mountains, paddy fields and fish ponds. Different application scenarios create different requirements for wireless sensor network systems. For example, the monitoring parameters, sensor node functions, data types, etc. of greenhouse and fish pond application scenarios will be completely different, and the wireless sensor network systems for environmental monitoring and agricultural machinery control will also be very different. Therefore, in the face of different application scenarios, different wireless sensor network systems are needed to meet different needs, and targeted wireless sensor network design can give full play to its advantages.

Xu zhe developed and designed a set of artificial forest pest physical prevention and control system based on the Internet of things, which uses ZigBee wireless sensor network technology for local networking and communication, and uses LabVIEW software for man-machine monitoring of the software and hardware design of the artificial forest pest physical prevention and control system. The low power consumption characteristics make the application of the system in forest feasible. The Internet of things technology with ad hoc network function is applied to the plantation system, and the induced pest control module is designed by using the idea of physical control rather than medicine to lure and clean up pests, which makes up for the problems of the previous monitoring system that only manage but not control, only monitor but not implement, and the lack of response ability to control diseases and pests, and can control diseases and pests remotely in front of the control terminal.

Zhaojichun and other researchers based on ZigBee wireless sensor network, applied stm32f429zgt6 microprocessor system to collect environmental image, temperature, humidity, light intensity, carbon dioxide and other sensor data in real time, and transmitted the collected data to the cloud management server through MC35I GPRS wireless communication module to realize the design of agricultural environment intelligent monitoring system. And the test results show that: the mobile terminal application software management system can monitor the data collected by the wireless sensor network in real time, the packet loss rate of wireless data transmission is less than 0.86%, and the data transmission response time is less than 1 s. The system is stable and reliable, and can accurately perceive the environmental data of facility agriculture, which has a relatively good popularization and application value.

Based on the existing cotton picker models, Wang Huan proposed an efficient and reliable cotton flow monitoring technology. Using wireless sensor network technology, Beidou Positioning System and Beidou short message communication technology, he designed and studied the online monitoring system of cotton picker yield based on wireless sensor network, and finally completed the test of Beidou

Positioning System static positioning systemThe results of field vehicle walking accuracy test and field harvest test verify that the monitoring accuracy and positioning accuracy of the cotton picker online monitoring system meet the requirements.

The diversity of agricultural application scenarios poses many challenges to the existing wireless sensor network technology, so the technical issues such as security, reliability, node coverage and data reduction based on specific agricultural application scenarios must be further studied.

When Yan Wenhao and others carried out large-scale farmland monitoring, it was necessary to timely determine the areas with abnormal farmland environmental parameters. In order to achieve the effectiveness of monitoring, a DV hop localization algorithm based on hop classification weighting is proposed according to the requirements of high accuracy and energy saving of wireless sensor network node localization technology. Firstly, different hops in the network are classified; Then, the weighted strategy is used in different hop sets to obtain different average hops corresponding to different hops, so as to reduce the impact of average hop distance on positioning accuracy.

Zhangyaqiong aimed at the problems of small amount of data and high power consumption in data collection of wireless sensor networks in the farmland habitat monitoring scene, using mobile sink for data collection can improve the performance of wireless sensor networks. Mobile sink moves along a pre-defined path in wireless sensor networks and collects data from nearby sensor nodes. However, the speed of mobile sink is too fast or too slow, resulting in small amount of data collection or high transmission delay. The optimal data acquisition scheduling of mobile sink is determined by optimizing the data transmission scheduling of sensors and the speed of mobile sink.

Christian salim and others used the meteorological data in smart agriculture for simulation. This paper studies the machine learning data reduction algorithm (MLDR) and the prediction algorithm based on Pearson correlation coefficient (PDCP) for triple prediction. Under the premise of ensuring the data validity, it effectively reduces the amount of data transmission in the sensor network, so as to save node energy and reduce the occupation of network bandwidth.

4 conclusion and Prospect

Wireless sensor network has become a very important technical means in the development of Rural Revitalization Strategy, agricultural modernization and agricultural informatization. It will help the construction of precision agriculture and intelligent agriculture, and ultimately create a high-yield, high-quality and low-cost production system and agricultural ecosystem.

The wide application and research of wireless sensor networks in agriculture can not only promote the high-quality development of agriculture, but also reverse the development and progress of the basic technology of wireless sensor networks. At present, there are still many problems to be solved in the application of wireless sensor networks in agricultural informatization, such as cost reduction, data fusion, protocol innovation, etc. at the same time, the integration of wireless sensor networks with technologies and algorithms such as big data, machine learning, and deep learning will also have many breakthroughs and innovations. In a word, wireless sensor network technology has vast development space and prospects in the context of agricultural informatization.

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