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Crop Pest Detection Method based on Agricultural Internet of Things

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Abstract **– Networking is the supporting technology of intelligent agriculture. Sensing devices of agricultural Internet of Things are developing towards micro power consumption, low cost, high reliability and self-adaptation. Sensor networks are also gradually equipped with functional features such as distribution, self-organization, multi-protocol compatibility and high throughput, which can realize real-time, accurate and efficient data processing. Combined with related technologies of agricultural Internet of Things and with pest monitoring as the application background, a pest detection system based on the Internet of Things was built, including software and hardware design of wireless acquisition node for pest monitoring, design of remote wireless network for pest monitoring with multi-type sensor fusion, and system architecture of wireless network for pest monitoring, etc., to support the development of intelligent agriculture.**

Keywords **– Crop Pest Detection, Agricultural Internet of Things, Sensor, Intelligent Agriculture.**

I. INTRODUCTION

Crop diseases and insect pests have brought great harm to agricultural production. If it is light, it will reduce the output and quality of agricultural products, and if it is heavy, it will make local agricultural land particles without harvest. Therefore, it is of great practical significance to strengthen the prevention and control of crop diseases and insect pests. Chemical, physical and mechanical, and biological technologies are used to control crop pests and diseases. For a long time, people used to spray pesticide chemical methods to solve the problem of crop pests and diseases, resulting in environmental pollution, soil compaction and other ecological problems. With the development of information technology, the emergence of digital agriculture, and the combination of the Internet of Things technology and physical and biological methods of pest control, not only can solve the problem of environmental pollution caused by pesticides, but also greatly reduce the cost, and received good results. Sex inducer is a kind of method to induce crop diseases and insect pests by physical and mechanical methods, but there are some problems in this method at present, such as the number of diseases and insect pests is difficult to count and people can not accurately grasp the distribution characteristics of diseases and insect pests. For example, sending technicians out into the field to count the pests in the traps is not only a lot of work but also unhygienic. For this purpose, a set of automatic measurement and reporting system of crop diseases and pests based on Internet of Things technology is developed, which can automatically identify the types of crop diseases and pests, automatically count the number of diseases and pests, and make forecast and early warning according to these data. Pest detection is mainly manual detection, mainly by text description, hand-drawn and recorded ICONS and other paper resources. This traditional technology has some problems such as low accuracy, poor timeliness, low utilization rate and high labor intensity, which brings great inconvenience to the summary, statistics, analysis and information sharing of pest information. Remote monitoring and early warning systems are used in some areas, but because these systems are located in areas with complex terrain, it is a great challenge for the power supply of the system. Most systems use solar energy for power collection, but it is not suitable for places with short illumination time [1-4].

Agricultural Internet of Things is a integration of multiple technologies including sensors, collaborative perception, collaborative information processing, wireless communication and network, and comprehensive information service [5-7]. It is a typical comprehensive information system with multiple sources and heterogeneous data. It involves leaf images of melons and vegetables diseases and pests, many environmental information about the natural growth of melons and vegetables, and different kinds of sensors and different signal types. It also involves the isomerism of the system, including the isomerism of the database management system, the transmission network, the hardware platform, the architecture, the operating system, and so on, and the use of each sensor environment is more complex [8-11]. In order to make full use of the massive data collected by many different types of sensors to forecast and forecast melon and vegetable pests, it is necessary to standardize the heterogeneous data. In view of the above heterogeneity problems in the monitoring system of melons and vegetables diseases and insect pests that may appear in the Internet of Things environment, methods and systems such as data standardization, information coordination and early warning among heterogeneous databases, among different data table field names, among different data table field types, among different melons and vegetables environmental information and leaf images are studied [12-14]. We will focus on key technologies such as automatic classification and counting of diseases and pests, realize remote systematic monitoring of major diseases and pests, develop a monitoring and early warning network system for major crop diseases and pests, and improve our ability to monitor and early warning of major crop diseases and pests as well as our ability to provide guidance and services for prevention and control [15, 16].

II. Intelligent Agricultural Platform Construction

Intelligent agricultural platform construction mainly carries out the applicability research of different monitoring and control equipment needed for smart agriculture; Study on data collection and utilization of key factors such as temperature and humidity, light intensity, PH value, CO2 concentration required by the growth of different crops in food crops, grapes and facilities greenhouses, and establish cultivation standard models; Research on nondestructive testing technology of crop dielectric properties; Research on image recognition technology of crop diseases and pests; Prediction of relationship between image information and crop yield; Production process quality traceability research, etc. Through the establishment of a smart agricultural system with matrix monitoring, agricultural management, knowledge base, agricultural experts, farm management, processing and packaging as the core, it connects scientific research institutes, production enterprises, the public and government departments to provide data collection, processing, transmission, storage, intelligent decision-making and public information services. The precision intelligent agriculture research platform is a scientific research demonstration base jointly built by Academy of Agricultural Sciences of Henan Xinyang to seize the development opportunity of national “Internet + agriculture” and follow the principles of "integration of disciplines, complementary advantages, resource integration, collaborative innovation and sharing of results", to accelerate the application and promotion of intelligent agriculture research and promote the transformation and upgrading of modern agriculture. The platform architecture is shown in Fig. 1, which integrates modern information technologies such as the Internet, the Internet of Things, cloud computing, intelligent control, intelligent decision-making, and satellite remote sensing to closely align with the precise, efficient and intelligent development direction and needs of modern agriculture, implement unified planning and design, build a unified resource system, share a unified scientific research platform, and provide unified integrated services. At present, it has one control center and three experimental bases for smart agriculture, including

fields, vineyards and solar greenhouses, with subsystems such as image acquisition, sensor monitoring, remote transmission, data analysis and intelligent control. Through real-time monitoring, data collection, transmission analysis and model establishment of key factors such as light intensity, air temperature and humidity, soil temperature and humidity at different depths, soil PH value, CO2 concentration and meteorology required during the growth of different crops such as grain, fruit and vegetables, etc. It can realize efficient perception, analysis and prediction, remote control and scientific evaluation of each link in the whole growth period of crops.

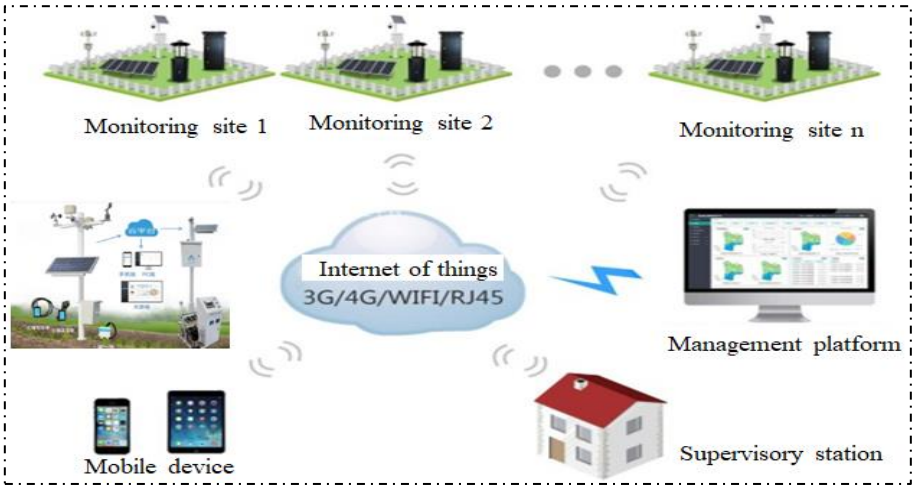

Fig. 1. Smart agricultural Internet of Things management platform.

III. Smart Agriculture Pest Monitoring Platform Construction

Through the intelligent insect situation measurement and reporting system, intelligent disease monitoring system, biological real-time warning and monitoring system, pest automatic-inductive monitoring instrument, agricultural environment monitoring system, solar power supply system and other related equipment to realize the disease and insect status, disaster situation, air temperature, air humidity, dew point temperature, soil temperature, light intensity and other important parameters in the growth process of various crops the number of real-time monitoring. The measurement results can be displayed in real time on the large screen TV and LED screen of the monitoring station. Meanwhile, the data can be transmitted to the analysis system platform. With the professional analysis and processing function, more and better scientific guidance can be provided for the processing and analysis of crop growing environment information. The construction of the intelligent agricultural Internet of Things platform has realized the information management of crops in the base. The intelligent monitoring equipment in the base can be managed remotely and real-time through the network, providing immediate and effective information and management tools for production decision-making.

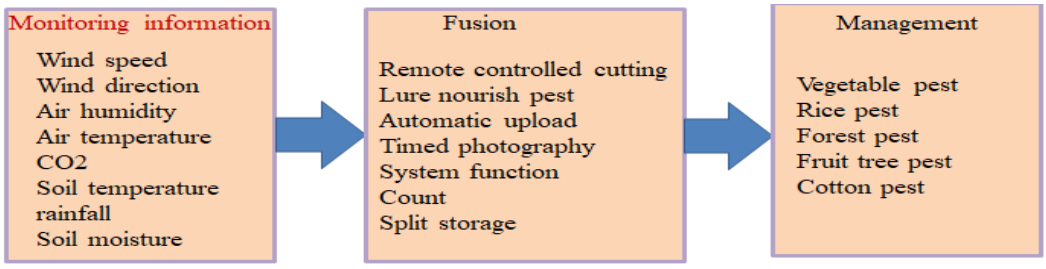

Fig. 2. Crop pest monitoring platform.

IV. APPLICATION

In cooperating with Academy of Agricultural Sciences of Henan Xinyang, a crop pest remote monitoring system is constructed, as shown in Fig. 3. The system includes bug situation monitoring, spore monitoring, meteorological moisture monitoring and seedling situation monitoring. The main functions of each module include real-time view of bug situation, spore monitoring, meteorological moisture content, seedling situation and other information, manual input function, statistical analysis function, early warning management and other functions. The data acquisition module of microclimate observation station can realize the data acquisition of each front-end climate observation station according to the specific communication protocol, and the collection interval can be flexibly set. Data collected include air temperature, air humidity, atmospheric pressure, illumination, wind speed, wind direction, rainfall, soil, soil PH and other indicators. The intelligent insect situation monitoring equipment in the field can trap and kill insects without pollution and is environmentally friendly. At the same time, GPRS/4G mobile wireless network is used to collect on-site images at regular time and automatically upload them to the remote monitoring service platform of the Internet of Things. The staff can know the situation and changes of the insect situation in the field remotely at any time and formulate prevention and control measures. After system setting or remote setting, photos taken on the spot will be sent wirelessly to the monitoring platform. The platform will automatically record and collect data every day to form a pest database, which can be presented to agricultural experts in the form of charts and lists for remote diagnosis.

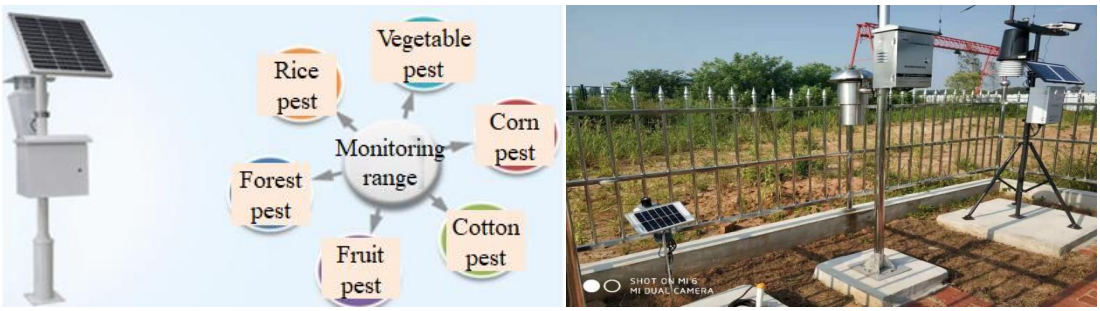

Fig. 3. Crop pest remote monitoring system application.

V. CONCLUSION

Real-time collection and monitoring of Internet of Things data is the most basic statistical analysis basis. Intelligent cloud computing platform uses intelligent algorithm to process information, and establishes disease and insect pest warning model database, crop growth model database, alarm information guidance model database and other information database, so as to realize real-time monitoring of diseases and insect pests. Through the alarm information combined with practical operation, farmers can adopt the best farming operation and realize effective control of diseases and insect pests. The modern agricultural Technology Platform, based on the Internet of Things and big data driven, is an integrated framework of IoT technology for the production of end-to-end services, which can collect data through sensors, cameras and drones with the help of the latest communication technology.

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CONFLICT OF INTERESTS

The authors declare they have no financial or conflict of interest exists in this manuscript.

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