Information Collection Method of Organic Vegetable Diseases and Insect Pests Based on Internet of Things

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Abstract. The traditional method of collecting pest information of organic vegetables is not wide enough, the intelligent method of collecting pest information of organic vegetables under the Internet of things is studied. Firstly, the data of intelligent terminal of the Internet of things is collected through the Internet of things technology, including spatial location data collection, numerical data collection to carry out all-round data collection and data fusion of organic vegetable pest information to get complete organic vegetable pest information, and then use JSON to code the data of Internet of things intelligent terminal, and then use wireless communication technology and select C/s Finally, through interpolation data processing and spatial clustering data processing, combined with Internet of things technology, the data processing of Internet of things intelligent terminal is carried out. Through the Internet of things technology for data collection, data coding, data transmission and data processing, the intelligent collection of organic vegetable pest information can be realized. Through the experimental comparison, it can be concluded that the intelligent collection method of organic vegetable pest information under the Internet of things is wider than the traditional method, which proves the effectiveness of the intelligent collection method of organic vegetable pest information under the Internet of things.

Keywords: Internet of things · Organic vegetables · Pest information · Intelligent collection

1 Introduction

With the development of the economy and the improvement of people's living standards, people are paying more and more attention to food safety issues [1]. Organic vegetables are naturally grown and non-polluting vegetables. The development of organic vegetables provides an ideal choice for solving current food safety problems [2]. In particular, the cultivation of organic vegetables is focused on natural production [3]. Therefore, the development of organic vegetables has a broad market space [4]. First, the industrialization of organic vegetable cultivation is conducive to environmental protection. Second, the organic vegetable industry can provide quality agricultural products to the society.

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Third, the organic vegetable industry can obtain good economic benefits. Fourth, the organic vegetable industry can increase the market competitiveness of domestic agricultural products and promote the coordinated development of the economy.Fifth, the organic vegetable industry can increase employment opportunities. Organic vegetables have no chemical residues, have a good taste, and have proven to be more nutritious than ordinary vegetables. Organic food is known as the "sunrise industry" and has a broad market. Organic vegetables require vegetables to be used in the process of planting, such as pesticides, fertilizers, growth regulators, etc., and can not use genetically modified technology, and must be certified by an independent agency. Nowadays, the demand for safe food is increasing, and the development of organic vegetables provides an ideal choice for solving current food safety problems. However, the occurrence of pests and diseases will have a serious impact on the yield and quality of organic vegetables. Therefore, the information collection is the only way to ensure the high yield and quality of organic vegetables. In order to effectively manage, it is necessary to collect long-term information on the biological habits of pests and diseases, summarize the occurrence and succession, optimize and improve pest control techniques, thereby improving the ability of pest control and prevention, and exerting pest control in organic vegetables. The role of stable production and increased production. Under the popularization of the Internet of Things, the application of Internet of Things technology in agricultural production, management and management has become extensive. The combination of Internet of Things technology and agricultural applications has gradually formed the agricultural Internet of Things. The traditional manual collection method is time-consuming, labor-intensive and inefficient, lacking timeliness and accuracy, and it is difficult to meet the requirements of modern agricultural information collection. Therefore, the intelligent information collection methods are studied.

In this paper, with the help of the advantages of the Internet of Things, combined with GPS technology, an intelligent terminal data collection method is designed, which collects the information of areas where the pests and diseases of organic vegetables are seriously damaged, and collects the numerical data of related pests and diseases objects by field investigation. Multi-source data are fused to make the data show spatial correlation. The data of intelligent terminal of Internet of Things is encoded by programming language, and the data is processed by interpolation and spatial clustering algorithm. Intelligent collection of diseases and insect pests information of organic vegetables was completed.

2 Intelligent Collection Method Under the Internet of Things

2.1 IoT Intelligent Terminal Data Acquisition

The occurrence of plant diseases and insect pests is complex, but it usually happens in two ways: spot occurrence and occurrence area [5]. Plant diseases and insect pests of organic vegetables have object attribute and space attribute. Object data include the occurrence grade and time of plant diseases and insect pests of organic vegetables. It is necessary to collect the object attribute and spatial attribute of plant diseases and insect pests of organic vegetables at the same time. In the collection of object attributes, The occurrence grade needs technicians to count the incidence rate, according to the evaluation standard of the occurrence grade of diseases and insect pests, the diseases and insect pests are classified and treated.

Spatial Position Data Acquisition

Spatial location data acquisition is the main content of mobile GIS data acquisition. There are two basic modes of data acquisition: one is to collect geographic information entities in x, y.

The coordinates are entered clockwise, and the second is the representation of geographic entities using points, lines, polygons, and grid adjacencies [6]. GPS survey is a new generation of satellite navigation and positioning system established with the rapid development of modern science and technology. It has the characteristics of globality, all-weather, high precision, automation and high benefit. GPS measurement has been widely used because of its all-weather, real-time and precise 3D navigation, good anti-jamming and confidentiality. With the popularization of smartphone, GPS model can be used to measure and collect space position. Therefore, GPS and Internet of Things technology are used to collect the spatial position of plant diseases and insect pests in organic vegetables, and the collected information has some points and areas.

Organic vegetable diseases and insect pests may occur in spots, and may exist in the form of spots on current satellite images. It is more suitable to collect organic vegetable pests in the form of spots [7]. Point data collection mainly refers to the recording of pest occurrence locations on maps in the form of points and their transmission to Internet of Things servers [8]. The client uses mobile GIS technology to load the off-line map of the research area and display the current collection position by GPS technology, and uses the drawing engine to map the pest occurrence area.

In areas where there are serious pests on organic vegetables, the pests may be displayed in the form of polygons on the satellite images in the form of patches, and the surface collection shall conform to the actual situation of pests. When collecting data in the fields, the agricultural technicians may use their smart phones to locate the pests and directly display the data on the maps. Then the agricultural technicians may use the mobile APP to load the offline map of the research area, display the location of the current collection area through the GPS technology, record the occurrence of pests on the maps in the form of polygons through the drawing engine, and locate the pests through the smart phones. Then the agricultural technicians may collect the data in the fields and directly display the data on the maps. Then the agricultural technicians may use the mobile APP to load the offline map of the research area, display the location of the current collection area through the GPS technology, record the occurrence of pests on the maps through the drawing engine, and then transmit the collected pests through the Internet of Things client to the server center through the network.

Numerical Data Acquisition

When collecting data, it is necessary to collect the object attributes, such as the occurrence grade of the pests and diseases, the time of collection, the users of the strip field, etc. The essence of this kind of problem is numerical data acquisition. Because numerical data acquisition does not involve spatial location, it can be collected by paper record and electronic record. It is necessary to classify the pests and diseases. The criteria of pests and diseases on organic vegetables in different areas are different [9].

Field investigation by agricultural technicians is needed to determine the grade of plant diseases and insect pests of organic vegetables in an area. There are three kinds of investigation contents: aphids rate, hundred insect numbers and foliage rate. Because pests and diseases are rare, it is difficult to investigate the number of 100 pests. The percentage of foliage and the percentage of aphids are the usual investigation methods. In the field survey, the common methods are three-level sampling, subsection, typical and random. To determine the specific unit, we should use random sampling survey, sampling methods commonly used in the field survey are five-point, diagonal, chess-board, parallel and "Z" type and so on. Five-point sampling method is from the field is the center of the intersection point to the middle point of four corners, such as 5 points sampling, this method is the most common method. Diagonal sampling can be divided into single diagonal sampling method and double diagonal sampling method. Single diagonal sampling method is in the field of a diagonal, at a certain distance to select all the required sample points [10, 11]. The double diagonal sampling method is to distribute the sampling points evenly on the two diagonals of the four corners of the field. The checkerboard sampling method is to divide the field under investigation evenly into many plots, and then to distribute the sampling points evenly among certain plots of the field [12]. The parallel sampling method is suitable for the investigation of diseases and pests with uneven distribution. Z-shaped sampling method has more sampling points in the edge of the field but less in the middle. It is suitable to use this method when there are more migratory pests in the field. Among them, the method recommended by agricultural technicians in field survey is "five-point survey". The five-point method of field survey is shown in Fig. 1.

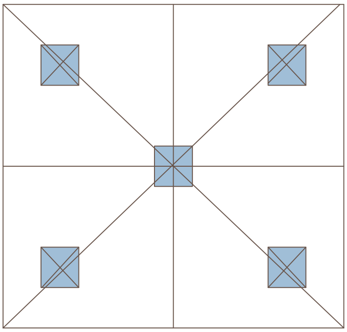

Fig. 1. Five-point survey

Based on the statistics, According to the national criteria for classification of major crop pests (DB65/T 2584–1998), And combined with the actual situation in the study area, Classification of pests and diseases to 5 levels (set M pest rate):1 level, $M \leq 5\%$, Small occurrences; Level 2, $6\% \leq M \leq 25\%$, Moderate mild occurrence; Level 3, $26\% \leq M \leq 50\%$, Moderate occurrence; Level 4, $51 \leq M \leq 75\%$, Moderate bias occurs; Level 5, $M > 75\%$, Recurrence.

Through the collection of numerical data, it is convenient to realize data fusion.

Data Fusion

In order to collect the data of diseases and insect pests, we need to pay attention to the spatial and numerical properties of the data, and the fusion of the two multi-source properties is also very important.

Using IOT technology, through the use of an intermediate nature of the file on the digital image, three-dimensional spatial positioning and other digital properties are combined to complete the external association. The specific operation means is to use extensible markup language to store the digital information or path string of digital image. But in practical application, in the process of association, the continuous read-write operation of data is easy to lead to the increase of data management redundancy and the decrease of security. Moreover, the mode of multi file description can easily lead to the reduction of data integrity in transmission.

The spatial positioning database based on Internet of things technology is composed of spatial data elements of geographic information and geometric measurement. The basic elements are composed of points, lines and planes, the spatial features are composed of basic elements, and the spatial model is composed of spatial features. The spatial models with the same attributes are gathered together to form the spatial geometry layer, and are stored and processed in binary data blocks. In this kind of spatial positioning database, the spatial and numerical properties of spatial data can be stored and integrated. At the same time, it can realize the integration of graph and attribute, and integrate them with the existing enterprise information system, so as to make GIS integrate into IT mainstream.

Spatial database is used to fuse the spatial position of pests. Among them, spatial association can be used to manage this kind of data, and can be directly associated with the database through GIS to read the data information, which can greatly reduce the difficulty of data processing and make the data displayed in ArcGIS Desktop intuitively.

2.2 IOT Intelligent Terminal Data Coding

The positioning device is added to the intelligent terminal. Through the data processing module of C/s, the data can be exchanged offline to complete the collection and transmission of pest information data. Among them, in the data transmission, because this kind of data contains spatial relationship data and numerical data. It is usually encoded using JSON and XML.

The full name of XML is an extended markup language, a structured markup language that allows users to define their own markup language.XML is a lightweight data storage file relative to relational databases with the following characteristics:

The feature of XML file is that the content and the overall structure of the text are completely complementary and interfere. With this feature, the data processing can realize the management of text content and the framework of processing process is completely separate. It has the advantages of interactive operation, uniform format characteristics, and supports diversified coding operations and easy to expand functions.

Based on the Internet of things, the data acquisition and utilization is the way of client-side and server-side interaction. The client is mainly responsible for the data collection. The server performs processing and transmission. But when the client and server interact with each other, the spatial data is required to be transmitted at a high speed. At this time, XML file can not meet the needs of use, choose JSON for data processing, which is a light data exchange mode, and it is easy to transmit data. It can realize the data conversion between different platform systems.

The characteristics of XML file are as follows: its content text and data structure do not interfere with each other. Thus, data processing can effectively separate the management of content text from the management of data processing flow. It has the following advantages: good interactivity, unified format, multiple and diversified coding, scalability and so on. XML files can communicate and interact freely in various operating systems. Basically, all the systems on the market can support XML files. Its own encoding method is easy to record, and it can handle a variety of encoding languages, and it can further expand the scope and format of use according to the documents. Through the architecture of Internet of things, through the server to connect the client for data collection, in which the client for data collection, the server for transmission and processing. XML is not suitable for this kind of data processing because of the speed requirement. At this time, the use of JSON, as a data exchange format with small amount of calculation, has the advantage of fast speed, and can realize the data conversion and transmission between different platforms and systems.

JSON format data can be directly encoded in the server, which is very convenient for the development and subsequent maintenance of the server and client. With this advantage, this method is used for data collection.

2.3 Intelligent Terminal Data Transmission in Internet of Things

At present, C/s transmission processing mode is widely used. Through the ISO structure of the system architecture, fully develop the potential advantages of the hardware of each port, and further reduce the communication energy consumption and time-consuming of the system. Using function distribution, the communication task is divided into several subtasks, and each subtask is divided into different computers. Data collection, expression and processing are realized in the client. The core processing is carried out on the server side. In this paper, GPS positioning device is added here. Data acquisition function module and C/S module are used to collect data. At this time, we can use C/S mode for data transmission, and design a communication module to support.

2.4 Data Processing of Intelligent Terminal in Internet of Things

After collecting the data of diseases and pests, it is necessary to process the data to finally complete the intelligent collection of the information. Its data theory is weighted average, which multiplies the values of the known sample points by the corresponding units, then sums up the total values and divides them by the sum of the units. Assuming that Xi is a known sample point, Wi is a weight corresponding to a known sample point, and Y is a weighted arithmetic mean, the formula for calculating the weighted arithmetic mean is as follows:

$$y = \frac{\sum X_i \times W_i}{\sum (W_i)} \tag{1}$$

The Fourier transform is used to redefine the long-distance composite wave function: it is expressed as a state where many single-frequency waves are superimposed. Among them, the expression of the long-range synthetic wave function is:

$$X(k) = \sum_{n=1}^{N} x(n) \cdot \exp\left(\frac{2\pi}{N}(n-1) \cdot (k-1)\right) \tag{2}$$

In the formula, $X(k)$ represents the value of the long-range synthetic wave function, N represents the number of vegetable pest information, represents the number of vegetable pest information time series, $x(n)$ represents the vegetable pest information time series, and k represents the number of elements in the long-distance pulse wave function.

Fourier transform the $x(n)$ in Eq. (2):

$$x(n) = X(k) / \sum_{k=1}^{N/2} \left[\cos\left(\frac{2\pi \cdot k}{N \cdot dt}\right)\right] \tag{3}$$

In the formula, dt represents the time interval between two points of the long-range synthesized wave.

Suppose i represents the array element, $A(x, y)$ represents a collection point in the long-range synthesized wave, and $F_1(0, F_1)$ represents the focal point of the long-range wave information. Among them, the delay from $A(x, y)$ to $F_1(0, F_1)$ is Δt_{i1}, then the phase difference expression between the two is:

$$\Delta\varphi_{i1} = \frac{2\pi \cdot k}{N \cdot dt} \cdot x(n) \tag{4}$$

In the formula, $\Delta\varphi_{i1}$ represents the phase difference between $A(x, y)$ and $F_1(0, F_1)$.

Using formula (4) to obtain the long-distance information of the k harmonic transmission of $x(n)$ can be expressed as:

$$d_1(k, x) = \left(\frac{\cos\Delta\varphi_{i1} + \sin\Delta\varphi_{i1}}{2N}\right) \tag{5}$$

Remote information can be received in the same way:

$$d_2(k, x) = \left(\frac{\cos\Delta\varphi_{i1} + \sin\Delta\varphi_{i1}}{S}\right) \tag{6}$$

In formula (6), the expression of the long-distance area S is:

$$S = \sum_{i=N}^{N} A(i) \tag{7}$$

In the formula, $A(i)$ represents the value of the amplitude weighting function. If $A(i) = 1$, the receiving distance is not weighted; otherwise, the receiving distance performs amplitude weighting.

The formula for calculating the weight y_i in the inverse distance weighting method is:

$$yi = \left(\frac{d_2(k, x)}{SP_{di}}\right) \tag{8}$$

P_{di} is the distance between the interpolation point and the known sample point. From the formulas (8), we can see that the formula for calculating the weighted average of inverse distance Y is as follows:

$$Y = \frac{\sum X_i \times \frac{1}{P_{di}}}{\sum \frac{1}{P_{di}}} \tag{9}$$

The method of inverse distance interpolation can calculate the occurrence level of pests and diseases sampling strip field by inverse distance weighted average on the basis of organic vegetable sampling strip field. Because organic vegetable sampling strip field is representative in the occurrence grade, and the occurrence is "dot" at first, and gradually develops into "sheet" shape over time, in a certain range of buffers should show the trend of inverse distance change, so this method is adopted. The inverse distance interpolation method is used to process interpolation data.

The K-means clustering and the minimum span tree need to be selected during the grouping process. Through the interpolated data processing and spatial clustering data processing combined with the Internet of Things technology, the IOT intelligent terminal data processing can be realized. Through the Internet of Things technology for data collection, data encoding, data transmission and data processing, intelligent information collection of organic vegetable pests and diseases can be realized.

3 Simulation Experiment

In order to ensure the effectiveness of the intelligent collection method under the Internet of Things, a simulation experiment was designed. Horizontal collection refers to the average collection in the time of occurrence, and the average occurrence level is calculated. The average grade is taken as the level at the time. Longitudinal collection refers to the average level at the time of the year in the 10-year time span, and the average value is used as the level of organic vegetable pests and diseases at that time. The experiment was repeated 50 times, and the results were averaged to improve the accuracy and credibility of the experiment. The results of the horizontal collection experiment are shown in Fig. 2, and the results of the longitudinal collection experiment are shown in Fig. 3.

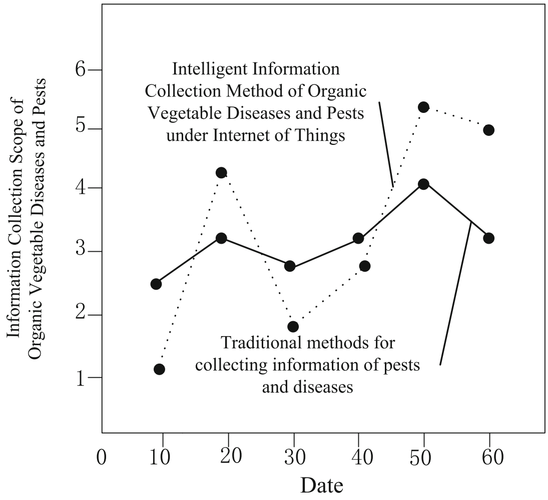

Fig. 2. Lateral acquisition experiment results

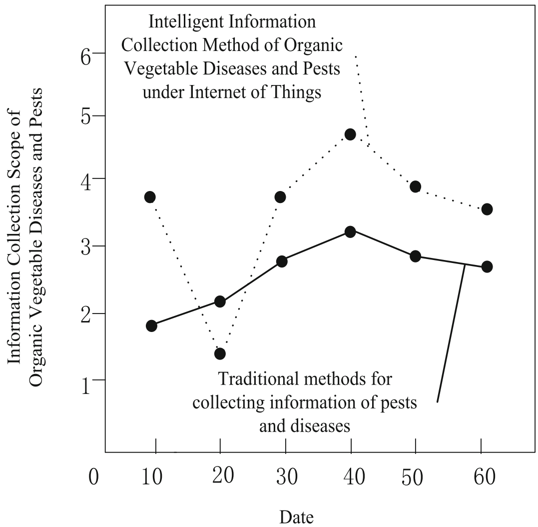

Fig. 3. Longitudinal collection of experimental results

Through experiments, it can be seen that whether it is the horizontal collection of organic vegetable pest information or the vertical collection of organic vegetable pest information, the intelligent collection method under the Internet of Things is more extensive than the information collection using traditional pest information collection methods. This is because the method designed in this paper firstly collects the spatial information through GPS technology, then collects the specific indicators of diseases and insect pests by field investigation, uses the Internet of Things to fuse the two data with multi-source data, so that the data of diseases and insect pests can be displayed in spatial correlation, and uses interpolation and spatial clustering algorithm to process the data, thus reducing redundant data and enhancing the data processing ability.

4 Conclusion

The intelligent collection method of organic vegetable pests and diseases under the Internet of Things enables the agricultural technicians to collect, integrate and analyze the information, which is simpler, more convenient, more scientific and effective, and enables the agricultural technicians to conveniently view and Understand the development trend of pests and diseases. When organic vegetable pests and diseases are likely to occur, it is possible to grasp the trend information and collect prevention and control measures at the first time, which has important application value for the production of organic vegetables and pest control.

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