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Retraction

Retracted: Crop Growth Monitoring System Based on Agricultural Internet of Things Technology

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] J. Wu, "Crop Growth Monitoring System Based on Agricultural Internet of Things Technology," *Journal of Electrical and Computer Engineering*, vol. 2022, Article ID 8466037, 10 pages, 2022.

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Research Article

Crop Growth Monitoring System Based on Agricultural Internet of Things Technology

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In order to improve the effect of crop growth monitoring, this paper combines the Internet of Things technology to construct a crop growth monitoring system based on the agricultural Internet of Things technology. Moreover, this paper combines the fuzzy theory to process the data of the agricultural Internet of Things to reduce the uncertainty of the data processing of the agricultural Internet of Things. After improving the fuzzy algorithm, this paper builds an intelligent model, builds the system structure framework according to the actual needs of crop growth monitoring, sets up and analyzes the environmental parameters, and builds the crop growth monitoring system from multiple perspectives. Finally, after constructing the system structure of this paper, the performance of the system proposed in this paper is verified. From the test results, it can be seen that the crop growth monitoring system based on the agricultural Internet of Things proposed in this paper has a good effect.

1. Introduction

In the process of agricultural development, a variety of interdisciplinary and multifield technologies are integrated, such as information technology, bioengineering, and agricultural-related technologies. With the application of modern electronic measurement and control devices, the technical level of facility agriculture has been greatly improved. Moreover, with the application of intelligent measurement and control technology, China's facility agriculture is developing in the direction of automation and intelligence [1]. At this stage, the global modern industry has developed more maturely and with it comes the continuous and rapid penetration and influence of modern industrial technology into agricultural technology. With the rapid development of related technologies such as wireless sensor networks and computers, it is particularly urgent and important to realize real-time monitoring of the crop growth environment in facility agricultural facilities. Some developed countries attach great importance to the development of the agricultural sector and have taken the continuous and rapid development of facility agriculture as an important measure for long-term sustainable development. In order to ensure the smooth progress of daily cultivation in the facility and the high-efficiency and high-quality output of crops, the primary condition is to achieve real-time monitoring of the crop growth environment (air and soil temperature and humidity, light intensity, soil salinity, etc.) in the facility. For this work, the traditional method is to rely on human experience to learn or use measuring instruments such as temperature, humidity, and illuminance measuring instruments to complete the manual detection method. When the measured growth factor value is not suitable for crop growth, artificial ventilation, humidification, dehumidification, and so forth are usually used to solve the problem. This will not only cause waste of manpower and material resources but also affect the yield and quality of crops due to inaccurate measurement results. In particular, in recent years, facility agriculture has become more popular in China, and the coverage area is increasing. Traditional monitoring methods have been unable to meet the existing needs of facility agriculture. In order to completely get rid of the shackles of the natural environment for crops, it is urgent to establish an efficient, scientific, convenient, feasible, and reliable monitoring system. Facility agriculture mainly includes the cultivation of plants and the raising of animals. According to the production characteristics of crops, livestock, and poultry, by monitoring related environmental parameters such as temperature, air humidity, moisture, CO_2 concentration, and light intensity in facility agriculture, it is possible to provide a suitable environment for intelligent measurement and control of animal and plant growth [2]. Constructing a safe and healthy facility agricultural ecological environment can effectively improve and stabilize the output and quality of agricultural and livestock products, reduce accidental losses, increase economic income, and reduce environmental pollution [3]. Using new technologies and methods to monitor the growth environment of crops in facility agriculture in real time has become an indispensable research direction for vigorously developing facility agriculture.

This article combines the Internet of Things technology to construct a crop growth monitoring system based on the agricultural Internet of Things technology and combines simulation experiments to verify and analyze the system in this article, which provides a theoretical reference for the subsequent development of intelligent technology for crop planting.

2. Related Work

The agricultural product growth environment monitoring system is the basis and prerequisite for the development of precision agriculture. The monitoring technology under informatization has been widely used in modern agriculture. It not only makes the tedious and repetitive environmental monitoring work simple and orderly but also improves the constant and the quality of agricultural products. In the past, on large areas, the monitoring of crop growth environment information mainly relied on remote sensing technology [4], while remote sensing technology could not achieve precise monitoring of a small area of farmland. In a certain farmland, only manual fixed-point measurement was required, which was time-consuming and labor-intensive and of low efficiency. In the monitoring environment, a large number of sensor monitoring nodes are needed to obtain environmental data, and the monitoring environment is harsh, the monitoring area is large, the amount of information is large, and the data transmission is far away. In response to these characteristics, the monitoring system for the growth of agricultural products has continued to develop [5]. Literature [6] designed a widely applicable agricultural facility environment digital monitoring system. The system uses sensors, controllers, and front-end single-chip microcomputers to form a bottom-level sensing system. Multiple bottom-level sensing systems and main control computers use a star-shaped network topology. Connection to the server is through the local area network. This design pattern is a common pattern for early sensor network applications in agricultural monitoring systems. With the development of wireless sensor networks, the application of wireless sensor network technology to agriculture has also become one of the main research directions of precision agriculture. Literature [7] analyzed the hardware and software characteristics of the traditional greenhouse information collection system and aimed at the shortcomings of difficult installation, upgrade, and maintenance of the system under the wired network environment, and wireless technology can avoid these shortcomings; it also designed a Bluetooth technology based on the shortcomings. Multiple underlying sensing systems and main control computers are connected by star network topology and connected to the server through LAN. Bluetooth is an early wireless communication technology. It has obvious shortcomings such as short communication distance, low anti-interference ability, and low data transmission rate [8]. The agricultural environment has relatively high requirements for these factors. With the development of wireless communication technology, the application of more advanced wireless communication technology in agricultural monitoring systems has become a major direction of agricultural informatization research.

ZigBee is a low-speed, short-distance, low-power wireless network protocol. The physical layer (PHY) and access control layer (MAC) of the protocol follow the IEEE802.15.4 standard [9]. The emergence of the ZigBee protocol has promoted the development of monitoring systems based on wireless communication. More and more agricultural monitoring systems use the ZigBee protocol to complete wireless communication transmission. Literature [10] designed a flower environment monitoring system based on the Zigbee protocol to achieve remote real-time monitoring of flower growing environment. The sensor node is based on the CC2430 chip. Literature [11] presented the application of wireless sensor network based on ZigBee wireless communication protocol in precision agriculture. The low-power local area network protocol based on IEEE802.15.4 standard has the characteristics of short communication distance and low power consumption. Wireless sensor network applications have entered a new stage in agriculture. Literature [12] proposed a soil moisture monitoring system based on GPS, ZigBee, and general packet radio service (GPRS) technology, in which the ZigBee protocol module is used for wireless communication between wireless sensor nodes and the GPS module is used for real-time positioning of sensor node positions. In GPRS, the module uploads the monitoring data to the database on the Internet remote server through the TCP/IP protocol in real time. Literature [13] designed a litchi orchard growth environment control system with wireless sensor network technology as the core and carried out data transmission based on wireless sensor network, general packet radio service technology (GPRS) and Internet, and realized remote real-time monitoring of litchi garden growth environment. In the past, many standardization organizations believed that IP technology was not suitable for wireless sensor networks because IP technology was too complex, and wireless sensor networks were low-power, resource-constrained networks. Literature [14] built a wireless sensor network based on the 6LoWPAN protocol and applied it in agricultural greenhouses to monitor the environment. The system gives an overall method for the construction of 6LoWPAN wireless network, 6LoWPAN gateway design, and 6LoWPAN sensor node design. The system test shows that the 6LoWPAN sensor network has realized the interconnection and intercommunication of the IPv6 network and the wireless sensor network and completed the monitoring of the growth environment of agricultural products. Literature [15] proposed a 6LoWPAN-based air environment monitoring program. The established 6LoWPAN star network topology can realize a sensor network with a larger node scale and use the LabView development platform to monitor harmful gases in the environment in real time.

3. Agricultural Internet of Things Technology Based on Fuzzy Theory

Fuzzy theory and fuzzy logic are used to manage imprecise and fuzzy information. In classical set theory, elements either belong to this set or not; however, in fuzzy set theory, elements can belong to a certain set in some way. Specifically, X is a set of elements and is called a reference set, a fuzzy subset of X is A, and one of its affiliation functions can be defined as $\mu_A(x)$ or $A(x)$, and $x \geq 0.9$. In the classical case, 0 means no affiliation, and 1 means that both express the same meaning. However, a certain value between 0 and 1 indicates a degree; that is, $\mu_A(x)$ represents the membership degree of element x to the fuzzy set A.

Changing the universal truth agreement will lead to a new type of proposition, which can be called a fuzzy proposition. Each fuzzy proposition may have a degree of truth between [0, 1], and the given fact state may indicate the compatibility of the fuzzy proposition. For example, the true proposition can be given as follows: this tomato is ripe, then the degree of ripeness needs to be described.

In this article, the format of the fuzzy axioms (fuzzy formulas) considered is $\phi \geq \alpha$ or $\phi \leq \beta$, ϕ is a fuzzy proposition, and $\alpha, \beta \in [0,1]$. The minimum value of ϕ in this representation is α and the maximum is β. For example, x represents a ripe tomato, and $x \geq 0.9$. It means that the tomato is quite mature (the probability that a ripe tomato is true is 0.9).

The fuzzy concept is as follows: the fuzzy concept A can be defined as $A = \{a_1^{v_1}, a_2^{v_2}, \ldots, a_n^{v_n}\}$, a_1 represents the object, and v represents its degree value in A. In the fuzzy concept, the membership function for the degree value of the object can be defined as $\mu_A : X \longrightarrow [0,1]$, where X represents the set of objects.

The fuzzy role is as follows: for a fuzzy role c, it can represent a binary fuzzy set that exists between objects in the range domain. The fuzzy role represents a set of a pair of objects and can be defined as $C = \{\langle a_1, b_1\rangle^{v_1}, \langle a_2, b_2\rangle^{v_2}, \ldots, \langle a_n, b_n\rangle^{v_n}\}$, where a_i and b_i represent two objects and w_i represents the degree value of the relationship. Moreover, the calculation function of w_i can be $\mu_C : A \times B \longrightarrow [0,\ 1]$, and A and B are used to represent the set of objects, in which A denotes the role domain and B denotes the role range.

Fuzzy attributes are as follows: the fuzzy attributes can be defined as $R = C{\cdot}A$, C denotes the fuzzy roles, and A denotes the fuzzy concepts in the range of fuzzy roles.

The fuzzy property with variables is as follows: the fuzzy property with variables can be expressed as $<X, Y>$, where X denotes the set of semantic parameters and Y denotes the affiliation function members.

The fuzzy context is as follows: for the fuzzy context FA, it can be defined as FA = $<MA.\ M_o,\ M_R>$, where M denotes the set of fuzzy concepts, M_O denotes the set of concepts, and M_R denotes the set of fuzzy attributes.

Fuzzy OWL2 has three main parts: fuzzy concept, fuzzy role, and individual. The fuzzy concept represents the fuzzy set of individuals, and the fuzzy role represents the binary relation of fuzzy concepts. There are two important elements in fuzzy OWL2 logic: fuzzy data type and fuzzy modifier.

3.1. Fuzzy Data Type. The fuzzy data types are in the form of trapezoid, triangle, left trapezoid, right trapezoid, and so forth, and their expressions are defined as follows.

For a fuzzy concept A on an element set X, when it is necessary to reflect the affiliation degree of each element x to the fuzzy set A, the available methods are single point method, Zadeh method, sequential even method, vector method, and affiliation function method. Among them, the affiliation function method is the most suitable for describing the fuzzy set A.

Using fuzzy theory to process fuzzy information, it is necessary to first define the affiliation functions, and these affiliation functions can be represented by data types. The common membership functions are linear membership function, triangle membership function, trapezoidal membership function, right semitrapezoidal membership function, left semitrapezoidal membership function, normal membership function, and so forth. In the element set x e $[a,\ 3]$, the triangular affiliation function, trapezoidal affiliation function, left semitrapezoidal affiliation function, right semitrapezoidal affiliation function, and normal affiliation function are defined in the five following equations [16]:

$$\text{Triangular}(x, \alpha, \beta; a, b, c) = \begin{cases} 0, & x \leq a, \\ \dfrac{x-a}{b-a}, & a < x \leq b, \\ 1, & x = b, \\ \dfrac{b-x}{b-c}, & b < x \leq c, \end{cases} \tag{1}$$

$$\text{Trapezoidal}(x, \alpha, \beta; a, b, c, d) = \begin{cases} 0, & x \leq a, \\ \dfrac{x-a}{b-a}, & a < x \leq b, \\ 1, & b < x \leq c, \\ \dfrac{d-x}{d-c}, & c < x \leq d, \end{cases} \tag{2}$$

$$L(x, \alpha, \beta; a, b) = \begin{cases} 0, & x \leq a, \\ \dfrac{b-x}{b-a}, & a < x \leq b, \\ 1, & x > b, \end{cases} \tag{3}$$

$$R(x,\alpha,\beta;a,b)=\begin{cases}1, & x\le a,\\ \dfrac{x-a}{b-a}, & a<x\le b,\\ 0, & x>b,\end{cases} \tag{4}$$

$$\mathrm{Normal}(x,\alpha,\beta;a,b)=\begin{cases}e^{-\pi(x-v)^2}, & |x-v|\le\dfrac{b-a}{2},\\ 0, & |x-v|>\dfrac{b-a}{2}.\end{cases} \tag{5}$$

The fuzzy affiliation function can be used to describe a fuzzy modifier or a fuzzy data type. For example, for the modifier "very," a linear affiliation function can be used to define its value as 0.8. For the fuzzy data type "Young Age," it can also be defined as Young Age(x)-left(0,200,10,30). Fuzzy modifiers are also allowed to modify the data type; that is, fuzzy data types are added after the fuzzy modifier. The following example paper represents the height of a user in an event context by means of a function curve. The text uses the affiliation function to represent the degree of each of the three, which are the right trapezoidal affiliation function, the trapezoidal affiliation function, and the left semitrapezoidal affiliation function (R_{Short} (μ; 120,200; 145,155), R_{Middle} (μ; 120,200,150,160,170,180), and R_{High} (μ; 120,200; 175,185)). The curve representation is shown in Figure 1 [17].

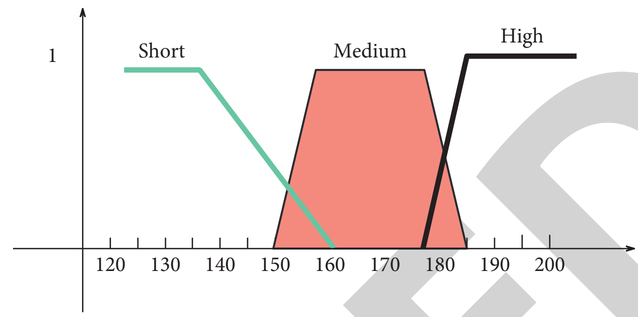

Figure 1: Affiliation function-effect curve of height fuzzy set.

3.2. Fuzzy Modifier. Fuzzy modifiers are more common in event contexts, and their own semantic expressions are generally located between precise and fuzzy concepts to serve as a qualification of these concepts. Fuzzy modifiers in event contexts can indicate the degree of progress of an event or the scope of the context and so forth. Fuzzy modifiers mainly include degree fuzzy modifiers and paradigm fuzzy modifiers.

A degree ambiguity modifier is a prefix symbol that modifies the information that follows and can be used to reduce or enhance the tone. The degree ambiguity modifiers are "rather," "very," and "extremely," which can be used as prefixes to modify contextual knowledge; for example, "the speed of the car is quite fast (rather quick)" and "the hit rate is very high (very high success rate)." The information modified by these degree fuzzy modifiers is fuzzy information. The degree fuzzy modifier can be defined in the following equation [18]:

$$\mu_{A_\lambda X}(x)=[\mu_X(x)]^\lambda=\mu_X^\lambda(x). \tag{6}$$

We have that $U=(-\infty,+)$ is the affiliation of element x in the fuzzy set to the fuzzy set X. $\lambda\in R^+$ is a degree operator; when $\lambda>1$, λ is a reinforcement degree tone operator. When $\lambda<1$, λ is an intensive degree tone operator. For fuzzy concepts with fuzzy modifiers in front of them, their affiliation degrees can be obtained by the power set of the affiliation degree $\mu_X(x)$ and the degree operator. The degree fuzzy modifier is modified as a prefix and equation (6) is only applied to fuzzy relations and fuzzy concepts. For exact relations and ordinary concepts with fuzzy modifiers in front, this complex fuzzy concept can be represented by a fuzzy affiliation function. In this paper, the modifiers used are exact modifier and fuzzy modifier; most of them exist as fuzzy modifier plus exact information, so it finally comes down to the definition of fuzzy affiliation function.

The scope fuzzy modifier is a prefix notation that modifies the information that follows. The fuzzification of contextual information can be manifested in two ways: (1) fuzzifying precise information such as ordinary relations and precise concepts in the event context and (2) fuzzifying again fuzzy information such as fuzzy relations and fuzzy concepts in the event context.

The ambiguous scope modifiers include "may" and "approximately." They can be used as prefixes for precise relations, precise concepts, fuzzy relations, and fuzzy concepts. They can be used as prefixes to modify precise relations, precise concepts, fuzzy relations, and fuzzy concepts, for example, about 177 km/h, which is a mode of range fuzzy modifier plus precise concepts. The range blur corrector can be defined in the following equation:

$$\mu_N(x)=\mu_X(x)\times\mu_E(v,x). \tag{7}$$

Here the fuzzy set description $N=X\cup E$, $\mu_X(x)$ is the affiliation of element x to concept X, and E denotes the fuzzy relation, which generally indicates the similarity relation, that is, the range fuzzy modifier. The fuzzy modifier proposed in this paper can satisfy the triangular distribution. When $U=(-\infty,+\infty)$, the fuzzy relation E can be expressed in the way seen in the following equation [19]:

$$\mathrm{Triangular}(x,\alpha,\beta;a,b,c)=\begin{cases}0, & x\le a,\\ \dfrac{x-a}{b-a}, & a<x\le b,\\ 1, & x=b,\\ \dfrac{b-x}{b-c}, & b<x\le c.\end{cases} \tag{8}$$

For the exact concept "177 cm," its affiliation can be expressed as follows:

$$X_{177\mathrm{cm}}=\begin{cases}1, & x=177,\\ 0, & x\ne 177.\end{cases} \tag{9}$$

The precise concept "177 cm" is modified by the range fuzzy modifier "about" to give the fuzzy information "about 177 cm," which can be expressed as follows:

$$\mu_{\text{about177}}(x) = X_{177}(x) \times E(177, x) = E(177, x). \quad (10)$$

Figure 2 shows the general implementation of contextual reasoning in complex event architectures.

Context Reasoning refers to inferring some new knowledge or discovering and solving some inconsistent information between contexts based on existing context information, which can determine the intersection of certain contexts, solutions to events, the best choice, and so forth.

Distributed context reasoning is to derive the $i+1$th layer context from the ith layer context, where the first layer context reasoning is based on fuzzy evidence theory. Bayesian theory must have a consistent recognition framework, and conditional probabilities and prior probabilities must be complete. The evidence theory uses the prior probability distribution function to obtain the posterior evidence interval and uses the evidence interval to quantify the credibility of the proposition. It can assign evidence to propositions, providing a certain degree of uncertainty; that is, evidence can be assigned to mutually incompatible propositions or to overlapping propositions. Evidence theory requires less harsh conditions and can express the meaning of "uncertain" and "vague." When the probability value is known, evidence theory is equivalent to probability theory.

Probability EII(B) and expected certainty EC(B) are calculated as follows [20]:

$$\begin{aligned} \text{EII}(B) &= \sum_i m(A_i) \cdot \sup(A_i \cap B), \\ \text{EC}(B) &= \sum_i m(A_i) \cdot \inf(A_i \Rightarrow B). \end{aligned} \quad (11)$$

In the above formula, m is a set function. When A_i and B are not fuzzy sets, EII(B) and EC(B) are the standard D-S theoretical likelihoods.

For inclusive measure, $I(A \subset B)$ is the degree of inclusion of set A by set B. The formula is as follows:

$$I(A \subset B) = \frac{\min_x\{1, 1 + \mu_B(x) - \mu_A(x)\}}{\min_x\{\mu_A(x)\}}. \quad (12)$$

At the same time, the trust function is calculated as follows:

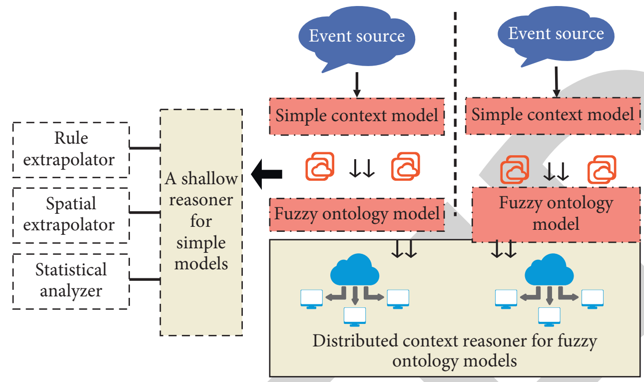

Figure 2: Overall implementation diagram of contextual reasoning.

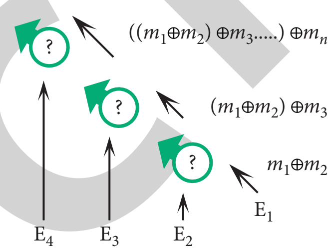

Figure 3: Fuzzy reasoning process.

$$\text{Bel}(B) = \sum_A I(A \subset B) m(A), \quad (13)$$

and fuzzy similarity is as follows: the key to fuzzy D-S evidence theory is the realization of the fusion calculation "$\oplus$" of evidence. The frame of discernment is $\Theta = \{\theta_1, \theta_2, \ldots, \theta_3\}$, fuzzy sets A and C are two random fuzzy subsets, and the similarity between them is

$$w(C, A) = 1 - \frac{1}{|\Theta|} \sum_t \left|\mu_C(\theta_i) - \mu_A(\theta_i)\right|. \quad (14)$$

The calculation method of the fusion calculation field is as follows: assuming that the fuzzy focal elements are $\{A_1, A_1, \ldots, A_p\}$ and $\{B_1, B_1, \ldots, B_q\}$, the calculation method of $\oplus$ can be defined based on w, as shown in the following formula:

$$\frac{\sum_{A_i \cap B_j - C} w(C, A_i) m_1(A_i) w(C, B_j) m_2(B_j)}{\sum_{A_i} \sum_{B_j} w(A_i \cap B_j, A_i) w(A_i \cap B_j, B_j) m_1(A_i) m_2(B_j) - \sum_{A_i} \sum_{A_i \cap B_j - \phi} w(\varphi, A_i) w(\phi, B_j) m_1(A_i) m_2(B_j)}. \quad (15)$$

In the above equation, m is the basic probability assignment in D-S evidence theory. Based on the evidence fusion calculation, the fuzzy reasoning process shown in Figure 3 can be realized.

Then improve the inherent computational intensive problem of evidence theory and Zadeh's paradox. In order to solve the computationally intensive problem, an evidence selection strategy is designed to sort and select the most credible evidence according to the weighted summary value of the probability distribution of evidence. In order to solve the problem of Zadeh's paradox, a conflict factor is introduced into the reasoner of fuzzy evidence theory, as shown

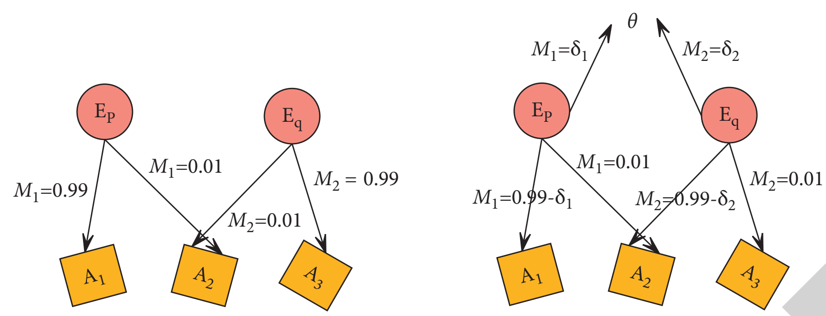

Figure 4: Conflict factor solves Zadeh's paradox problem.

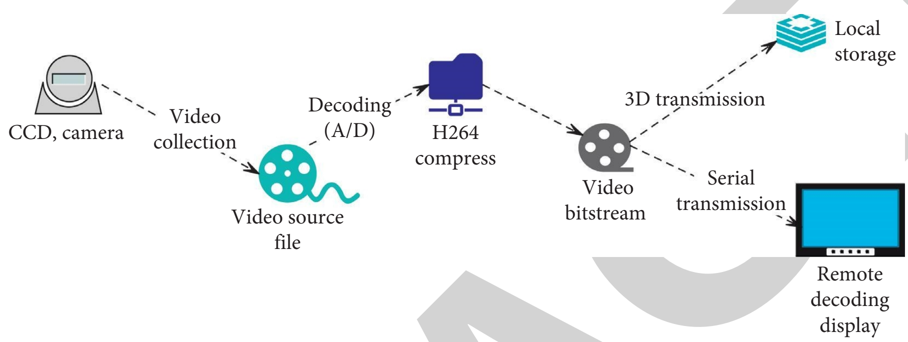

Figure 5: Flow chart of video file acquisition, decoding, compression, transmission, storage, encoding, and display.

in Figure 4. The definition of the conflict factor can be given as follows.

The conflict factor is

$$\begin{aligned} m'(x|e) &= (1-\delta)^* m(x|e), \\ m'(\Theta) &= \delta^* m(x|e) + m(\delta). \end{aligned} \tag{16}$$

The conflict factor can be used to solve the Zadeh paradox problem and optimize the evidence selection strategy. In the algorithm research based on probability distribution, the definition of the quality distribution function is expressed according to the priority of the equipment, such as RFID readers and sensors. When the evidence data is large, the evidence can be sorted by the quality function, and, in order to improve the inference performance, the quality function of the small evidence data will not be calculated.

To expand the Dempster combination rule, the expansion of the Dempster combination rule is shown in the following formula:

$$m_1 \oplus m_2(C) = \frac{\sum_{A\cap B=C} \max_{x_i} \mu_{A\cap B}(X_i) m_1(A) m_x(B)}{1-\sum_{A,B}\left(1-\max_{x_i}\mu_{A\cap B}(X_i) m_1(A) m_x(B)\right)}. \tag{17}$$

4. Crop Growth Monitoring System Based on Agricultural Internet of Things Technology

Video front-end encoding is the process of A/D conversion of the collected video source files, and compression is the process of H.264 encoding and decoding of digital video signals to output video stream. Decoding is the process of D/A conversion of the video code stream before the video is displayed after the video code stream is transmitted or stored remotely. Video file decoding, compression, transmission, and encoding are examples of the key parts of whether the video file is distorted and whether the monitoring process is successful. Figure 5 shows a flow chart of video file acquisition, decoding, compression, transmission, storage, encoding, and display.

The sensor network system structure of this system is shown in Figure 6. Its structure is of a hierarchical network type. The bottom layer is the sensor nodes deployed in the actual environment, followed by the transmission network, the base station, and finally the Internet connection. In order to obtain accurate data, the deployment density of sensor nodes is usually high, and they may be deployed in nonadjacent monitoring areas, thus forming multiple sensor networks. This system deploys different sensor networks in different greenhouses. The node transmits the collected data to the network management node, and the gateway node is responsible for sending the data from the node to the base station through the output network. The transmission network is a partial network responsible for coordinating the information of various sensor network management nodes and comprehensive gateway nodes. In this system, 4G technology is used for transmission. The base station sends sensor data to the data processing center through the Internet, and the terminal can access the data through the computer to access the Internet.

A single environment collection node includes a sensor module and a wireless module. The wireless module integrates a radio frequency module, processor, memory, battery module, and so forth. The data collected by the sensor is

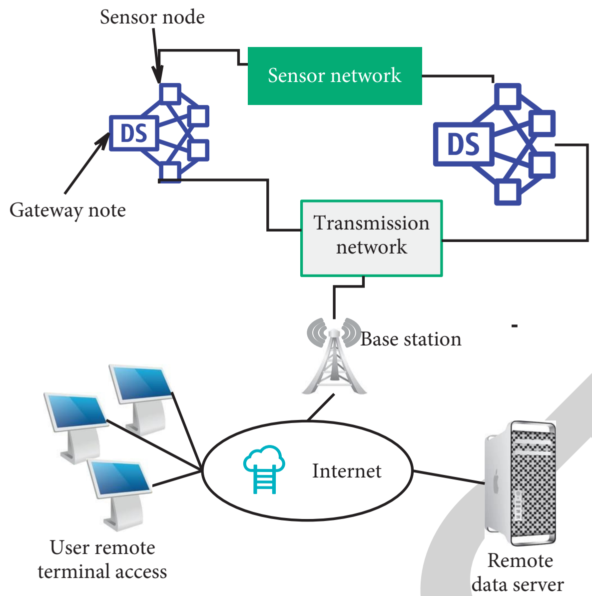

Figure 6: Sensor network system diagram of crop environmental parameters.

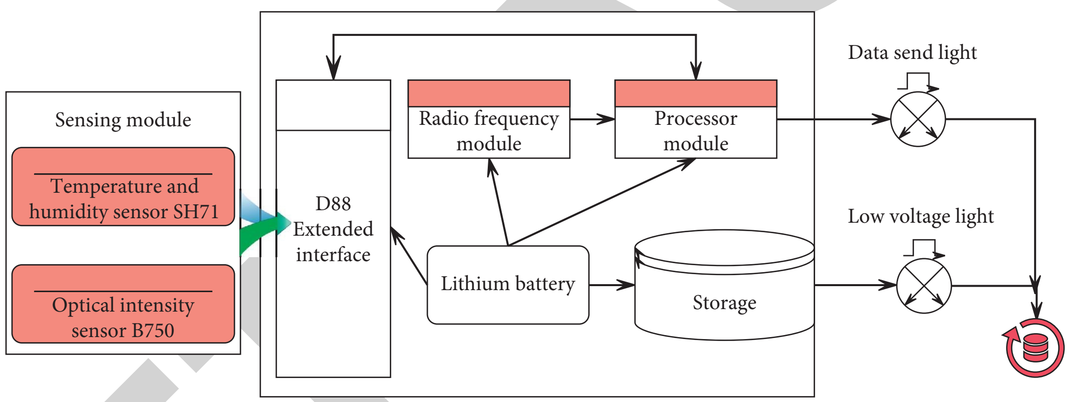

Figure 7: Wireless sensor node.

controlled by the processor module, and the big data collected is sent to the sink node through the radio frequency module. The wireless sensor node is shown in Figure 7.

One of the most effective ways for nodes to save energy is the sleep mechanism. When the sensor node currently has no sensor measurement task and does not need to forward measurement data for some nodes, the system will automatically turn off the node's wireless communication function, data collection function, and even calculation function to save energy. When a sensor task is generated, only the nodes in the surrounding area will be activated, forming an active area. The active area will migrate as the sensor measurement data is transmitted to the gateway node, and the original active node will switch to a sleep mode after leaving the active area, thus reducing energy consumption. The data transmission measured by the sensor is transmitted along the active area, as shown in Figure 8.

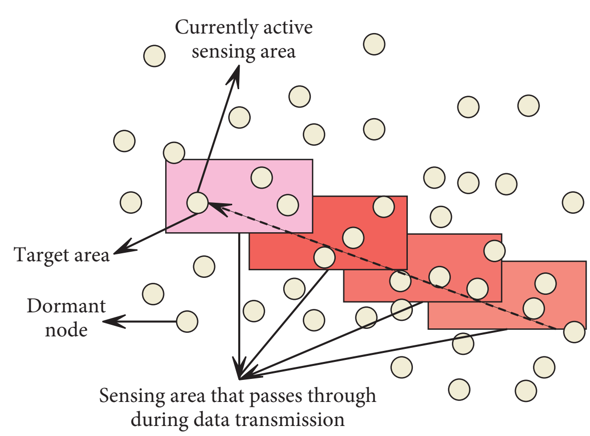

Figure 8: Network activity area in wireless sensor network.

The software design of the wireless sensor node in the multisource information collector of the crop production process must not only meet the practical requirements of the system but also meet the energy consumption requirements of the long-term system. In practical applications, the energy consumption of the ZigBee communication process is much

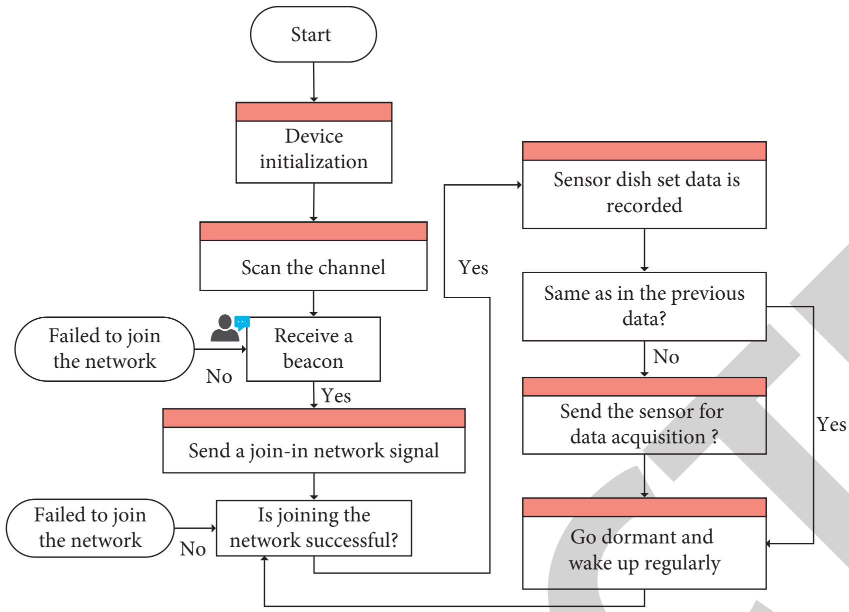

Figure 9: Working flow chart of sensor node.

Table 1: System channel H.264 encoding performance.

Video channel	Time (seconds)	PAL system (frames/sec)	Theoretical value (MB)	Compression value (kB)
Channel 1	11	26.5	37	316
Channel 2	11	26.5	37	293
Channel 3	11	26.5	37	325
Channel 4	11	26.5	37	288
Channel 5	11	26.5	37	316
Channel 6	11	26.5	37	293
Channel 7	11	26.5	37	325
Channel 8	11	26.5	37	288
Channel 9	11	26.5	37	316
Channel 10	11	26.5	37	293
Channel 11	11	26.5	37	325
Channel 12	11	26.5	37	288
Channel 13	11	26.5	37	316
Channel 14	11	26.5	37	293
Channel 15	11	26.5	37	325
Channel 16	11	26.5	37	288
Channel 17	11	26.5	37	316
Channel 18	11	26.5	37	293
Channel 19	11	26.5	37	325
Channel 20	11	26.5	37	288
Channel 21	11	26.5	37	316
Channel 22	11	26.5	37	293
Channel 23	11	26.5	37	325
Channel 24	11	26.5	37	316
Channel 25	11	26.5	37	293
Channel 26	11	26.5	37	325
Channel 27	11	26.5	37	288
Channel 28	11	26.5	37	316
Channel 29	11	26.5	37	293
Channel 30	11	26.5	37	325

Table 2: Performance evaluation of crop growth monitoring system.

Number	Performance
1	95.8649
2	95.1050
3	88.5797
4	89.8117
5	95.0074
6	91.4517
7	91.5412
8	91.0494
9	88.2842
10	84.2735
11	89.6524
12	96.6496
13	87.3904
14	84.3179
15	84.8494
16	83.7323
17	86.5937
18	84.2388
19	85.2125
20	94.7945
21	96.9356
22	88.0433
23	92.8280
24	87.7675
25	83.5343
26	83.6641
27	86.4006
28	85.8211
29	95.6650
30	84.9064
31	91.0114
32	94.5882
33	91.3004
34	90.0499
35	83.7182
36	86.8930
37	84.8505
38	84.0571
39	95.0360
40	87.9913

greater than the energy consumed in other processes, so reducing the communication time of the ZigBee module in the software design is one of the best energy-saving methods. CC2430 has a variety of ways to wake up the sleep mode and set the sleep state of the sensor node reasonably and can meet the data collection times of each node and complete the corresponding collection task of the node. The software flow is shown in Figure 9. The temperature, humidity, and care collection time in the system is once every ten minutes; that is, a cycle is completed in ten minutes.

After constructing the system structure of this article, the performance of the system of this article is verified, and the performance of the system channel H.264 encoding of this article is verified, and the results shown in Table 1 are obtained.

On this basis, the performance evaluation of the crop growth monitoring system in this paper is carried out through the expert evaluation method, and the results are shown in Table 2.

From the above research, it can be seen that the crop growth monitoring system based on the agricultural Internet of Things technology proposed in this article basically meets the current crop intelligent planting monitoring needs.

5. Conclusion

Whether crops grow well is closely related to whether the growth environment of plants is guaranteed, and adjusting the changes of environmental parameters within the fluctuation range that is most suitable for crop photosynthesis or most suitable for crop growth is also one of the fundamental purposes of modern agricultural management. What kind of environment produces what kind of fruit? This shows the importance of the environment to the cultivation of crops. Similarly, stepping up research on the monitoring and control system of environmental factors is also a way to increase crop production and maintain value, and it is also a branch of the development of modern precision agriculture. Correspondingly, the research on intelligent information technology and system integration of precision agriculture has also become the focus of the cross-combination of computer and agricultural disciplines. This article combines the Internet of Things technology to build a crop growth monitoring system based on the agricultural Internet of Things technology and combines simulation experiments to verify and analyze the system in this article, which provides a theoretical reference for the subsequent development of intelligent technology for crop planting. The experimental research results show that the crop growth monitoring system based on the agricultural Internet of Things technology proposed in this article basically meets the current crop intelligent planting monitoring needs.

Data Availability

The labeled datasets used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares no conflicts of interest.

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