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Retraction

Retracted: Exploration of Agricultural Economic Management Methods under Internet + Mode

Mobile Information Systems

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1].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) Peer-review manipulation

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] Q. Luo, "Exploration of Agricultural Economic Management Methods under Internet + Mode," *Mobile Information Systems*, vol. 2022, Article ID 9014184, 10 pages, 2022.

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Research Article

Exploration of Agricultural Economic Management Methods under Internet + Mode

Qian Luo

Hunan Open University, Changsha, Hunan 410004, China

Correspondence should be addressed to Qian Luo; luoqian0722@126.com

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In order to solve the problems that the production management of agricultural greenhouses consumes large human resources, low management efficiency, and the limitations of environmental monitoring, a visualized smart agriculture based on ZigBee and WiFi dual-protocol fusion Wireless Sensor Networks (WSNs) technology is proposed. A management system is proposed. The system takes STM32 as the main control core and builds a visual cloud computing platform based on the ESP8266WiFi module. The environmental parameters of the greenhouse are sent to the ZigBee terminal device through the serial port, and the user can remotely monitor the environmental parameters of the greenhouse in real time through the computer and mobile client, and control the working status of each actuator. The test results show that: (Transmission Control Protocol/Internet Protocol, TCP/IP) communication is not abnormal; under the control of the visual management system, when the system sends out control commands, the response time of each output terminal is basically between 1 and 2 s. The response of the output control unit has high sensitivity. Affected by the network delay, the fourth group of test data is larger, and in the case of network delay, the response sensitivity of each output terminal of the system decreases accordingly. *Conclusion*. The system has high accuracy of data collection, strong work reliability, can realize precise remote control, and has low cost, high stability, easy operation, and has certain promotion value.

1. Introduction

Agriculture is the basic industry of the national economy, providing basic material guarantees for people's lives, industrial production, and social progress. Traditional agriculture is a manual agricultural labor method based on human, animal power, hand tools, iron tools, etc. under natural economic conditions. It is characterized by the use of spontaneous and primitive allocation of labor and production materials, with planting as the center, and the combination of agriculture and animal husbandry. The regionalization of the agricultural economy is obvious, and the development is unbalanced. After entering the industrial society, traditional agriculture gradually transforms into modern agriculture. Modern agriculture is a socialized agriculture that applies modern technology and means of production provided by modern industry and scientific management methods [1]. Its characteristics are as follows. The agricultural production technology has changed from experience to science, and agricultural science and technology such as breeding, cultivation, feeding, soil improvement, plant protection, and animal protection have been rapidly improved and widely used. The self-sufficiency production in China has been replaced by the highly specialized and commercialized production. The agricultural production process is closely integrated with processing, sales, and the manufacture and supply of production materials, resulting in the integration of agriculture and industry, economic mathematics methods, electronic computers, and networks. Modern science technology is more and more widely used in modern agricultural macro-management and micro-management, and management methods have been significantly improved.

Modern agricultural production includes the cultivation of agricultural product seedlings, field management, processing of agricultural and livestock products, preservation, circulation, and market sales. This industrial chain model combines the production, processing, and sales of agricultural products to form a mechanism of sharing benefits and risks, and expand the external scale of agricultural production and farmers' operations. It is conducive to connecting small-scale farmers' operations with large markets at home and abroad, and is conducive to the use of advanced agricultural technologies and materials and equipment to improve agricultural productivity and economic efficiency, and is conducive to improving the level of specialization, commercialization, and modernization of China's agriculture. Modern agriculture has given birth to the agricultural economic management. Its goal is to scientifically plan and guide the country's agricultural production. Through effective management of the agricultural product processing industry chain, the production and circulation costs of agricultural and sideline products can be reduced, so that the agricultural and sideline products produced by farmers can realize their value and use value as much as possible, so that the rural labor force can participate in sharing the value-added of agricultural and sideline products in the logistics process, thereby improving the overall efficiency of the agricultural production [2, 3]. In modern agricultural economic management, agricultural product information, market information, and circulation information are the basis for the implementation of management measures such as agricultural production status analysis, industrial planning and guidance policy formulation, agricultural production structure optimization, and agricultural economic system formulation. The nervous system in the industrial chain, the level of information processing, and utilization have a very important impact on the operation and management of the modern agricultural economy.

2. Literature Review

Prasad et al. developed an intelligent greenhouse management system. The system was based on wireless sensor networks, which can detect the humidity, temperature, photosynthetic radiation, and other parameters in the greenhouse in real time. The system improved the management efficiency of crops and saved a lot of manpower and material resources [4]. Meng et al. is committed to designing and researching a crop growth monitoring system with strong reliability and high stability. The system was based on a wireless sensor network, with a variety of sensors as acquisition nodes, and red pepper as the experimental object to collect its growth environment parameters. The collected data was transmitted through the ZigBee network, which was convenient for farmers to inquire about the growth status of red peppers on agricultural sites [5]. In order to solve the problem of frost in greenhouses in winter, Sharma et al. personnel launched a greenhouse temperature control system. Frost could bring great harm to crops and inhibit the healthy growth of crops [6]. The system was guided by the wireless sensing technology, and terminal sensors were arranged in the agricultural field, and the collected information was sent to the server through the aggregation node. The remote server system compared the received on-site environmental information with the expert database to control the on-site boiler heating, thus effectively solving the problem of frost on the foliage of crops. Liu used multiple ZigBee terminal nodes and a ZigBee coordinator to build a wireless sensor network (WSNs) and set up an environmental parameter information collection system, so as to realize the intelligent sensing function of environmental parameters [7]. And based on WSNs technology, a cost-effective ginseng cultivation system was developed, which realized real-time collection of ginseng growth environment parameters, and formulated an effective plan to ensure the healthy growth of ginseng. Based on the modeling technology, Husseinet al. built a smart agriculture platform. And based on the experimental results of the platform, he proposed that the development of smart agriculture must be inseparable from the construction of models. And relying on the model basis, the future development goals of smart agriculture were planned, and the importance of the model in the development of smart agriculture was given full play [8]. Taking CC2530 chip as the main control core, a greenhouse control system based on wireless Mesh network was proposed by Xiao and Li. The system used ZigBee as the terminal control node, and sent the collected environmental parameter information of the greenhouse to the human–computer interaction interface for users to view. Through the user's remote control, multiple sets of low-voltage relays were driven to control shading curtains, thermal insulation films, water pumps, fans, and other equipment to work [9]. Shao et al. studied the effects of air temperature and humidity, light intensity, CO_2 concentration, and other environmental parameters on the growth process of strawberries, and deeply studied various problems encountered in the growth process of strawberries through the analysis. With PLC as the main controller, a monitoring platform was built through WinCC, and a set of strawberry growth environment monitoring and control system was built by using ProfiNet communication mode, so that the users could query the historical curve of strawberry growth environment parameters, which ensured the healthy growth of strawberries and provided a theoretical basis and practical experience for the development of modernized agriculture [10].

The traditional extensive artificial greenhouse management technology not only consumes huge manpower and material resources, but also requires farmers to spend a lot of time to ventilate, light, fertilize, and irrigate the greenhouse. And the efficiency is not high. Therefore, it is necessary to design a visual, intelligent, and digital modern smart agricultural management system. The "Thirteenth Five-Year Plan" clearly includes smart agriculture into it, and the development goal of agriculture is still to further advance towards modernization. Under the great wave of "Internet +" proposed by Premier Li Keqiang, network agriculture has shown a good development trend [11]. Under the development trend of such agricultural modernization, wireless sensing, automatic control, wireless network, and other technologies are organically combined with agriculture in the system, aiming to make breakthroughs in the agricultural production.

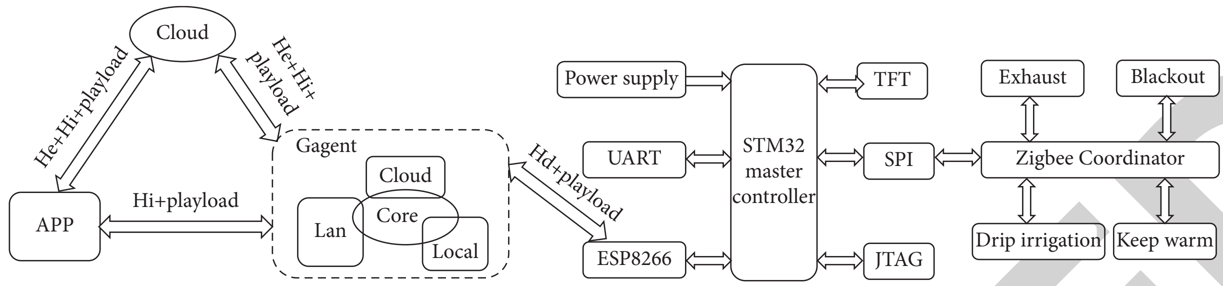

Figure 1: Overall system design.

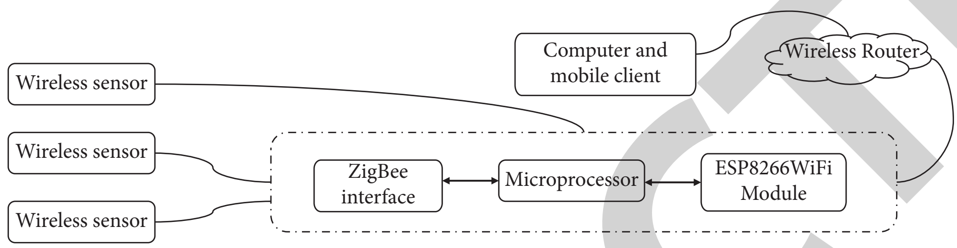

Figure 2: The overall hardware design of the system.

3. Research Methods

3.1. Overall System Scheme. In the running state, the system collects environmental parameters such as temperature and humidity, light value, CO_2 concentration, and soil moisture in the greenhouse through ZigBee nodes. The environmental parameters are uploaded to the cloud computing platform through wireless network transparent transmission. The master controller controls the output state of each actuator through the algorithm comparison and the set value comparison. In addition, users can also monitor all environmental parameters of greenhouse in real time in the cloud platform management system through computer and mobile phone client, and remotely control the working status of each actuators (controlling greenhouse ventilation, lighting, irrigation, and heat preservation) [12]. When network failure occurs in the system, each actuator can be controlled in manual mode to meet the multi-mode intelligent management of greenhouse. The overall design of the system is shown in Figure 1.

3.2. The Hardware Design of the System. The system collects all environmental parameters in the greenhouse through wireless sensor nodes, and sends the collected data to the ZigBee-WiFi gateway through ZigBee protocol. ZigBee cannot be directly integrated with the external network, so WiFi technology must be used as the transfer, and WiFi becomes the bridge of protocol conversion.

By converting the protocol gateway, data between ZigBee and WiFi can be transmitted and applied. At the same time, the cloud computing technology is used to establish data storage and access private clouds, which can support computers and mobile phone clients to view all the environmental parameters online in real time, so that the users can accurately manage greenhouses. Its hardware structure is shown in Figure 2.

3.2.1. Terminal Node Baseplate Design. The terminal equipment node mainly realizes the collection of environmental data of greenhouse, the control of equipment status, and the wireless transmission of data information. The control circuit consists of power supply module, debugging and downloading circuit, data acquisition circuit, and relay.

(1) Power supply circuit: The terminal node control chip is CC2530 with rated working voltage of 3.3 V, but the STM32 master controller, all data acquisition modules and relays need 5 V power supply, so 5 V power input is adopted, and 3.3 V voltage is output for CC2530 through ASM-1117 voltage regulator chip.

(2) Relay circuit: Relay is simple to control and easy to use, so the state of terminal node equipment is mainly controlled by relay. The relay control input pin is directly connected with the STM32 pin, and the output pin is connected with the terminal device. And the device state can be controlled by controlling the pin level of the MAIN controller of STM32.

3.2.2. ZigBee Module Design. ZigBee technology is popular among users for its low power consumption and wireless transmission. The main control chip is CC2530 chip. The CC2530 features a powerful low-power, enhanced 8051 core with a built-in analog/digital converter that supports up to 12 bits of ENOB (valid data) and can meet the design requirements by writing data to memory via DMA. ZigBee network is mainly composed of star, tree, and mesh structure. Among them, the mesh structure connects all ZigBee terminal nodes, as shown in Figure 3. The mesh topology has short delay and strong reliability, so the system is designed as a mesh wireless network [13].

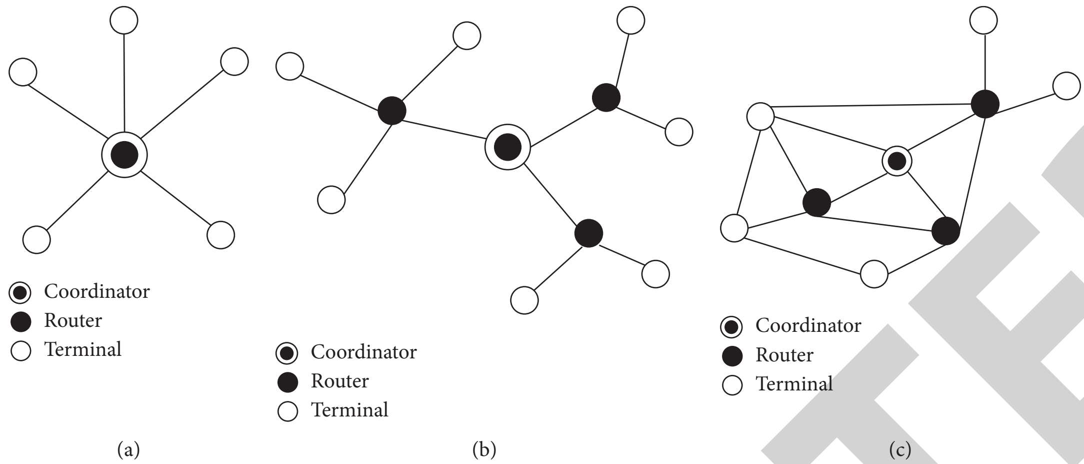

Figure 3: ZigBee network topology. (a) In shape. (b) Tree-like. (c) Mesh.

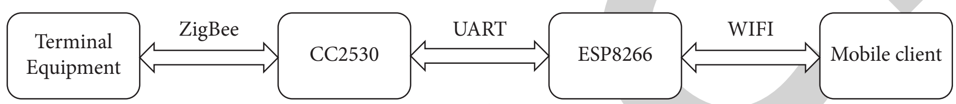

Figure 4: Gateway structure.

3.2.3. ZigBee-Wifi Dual-Protocol Fusion Communication. The ZigBee-wifi wireless gateway takes CC2530 and ESP8266 as the core chips, and the ZigBee-WiFi dual-protocol fusion is realized by codes. The gateway structure is shown in Figure 4.

Gateway structure ZigBee main control chip is CC2530 with IEEE802. 15. 4 standard, with a high working sensitivity and a strong anti-interference ability. The WiFi module chip is ESP8266, which integrates 802.11n radio frequency mechanism to provide the possibility of network coverage, and the integrated chip improves the processing speed. The ESP8266 provides a serial port for connecting to the ZigBee module and embedded TCP/IP protocol for information exchange with the ZigBee network.

In the wireless visualized intelligent agriculture management system, the hierarchical structure is used to build ZigBee network protocol. ZigBee network protocol includes physical layer (PHY), media access control layer (MAC), network layer (NWK), and application support layer (APS) structure. The bottom layer is composed of the physical layer and the media access control layer, which meets IEEE802.15.4 standard protocol and can be directly connected with the RF transceiver [14]. The network layer is concerned with the establishment and maintenance of the entire network. Its main function is to establish the network and select the information transmission path. Meanwhile, it is responsible for the security of the entire network. The application layer mainly includes application object, device object (ZDO), and application support sub-layer (APS), which conforms to the definition of ZigBee protocol. APS is responsible for receiving data sent by the network layer, while ZDO is responsible for network management and provides interface functions between the application layer and the network layer. The ZigBee protocol stack structure is shown in Figure 5.

The entire ZigBee protocol stack structure is complex. And each layer has a huge amount of code, which cannot be achieved only by personal efforts. In this design, ZigBee protocol stack Z-Stack is downloaded from the official website of TI company, and the system is designed by referring to the actual development cases. The program compilation environment of ZigBee chip CC2530 is IAR. IAR compilation environment can simulate various 51 kernel environments, with highly optimized, online debugging and other functions, which greatly saves debugging time. Z-stack is loaded into IAR, and the program can be written. After the program is compiled without error, it can be written into CC2530 chip through the emulator.

The network protocol layer of wireless gateway realizes the mutual integration of ZigBee and WiFi protocols. The terminal node follows IEEE802.15.4 protocol, and the environmental parameters of greenhouse are sent to ZigBee coordinator. Firstly, ZigBee physical layer receives and parses data packets layer by layer, then interprets various environmental parameters of greenhouse by gateway application layer, encapsulates WiFi protocol packet data, and transparently transmits it to the cloud computing platform through network. At the same time, users can monitor greenhouse environmental parameters through the cloud computing platform and issue control instructions, which are sent to the ZigBee coordinator module through the UART serial port and sent to the specified terminal node module through ZigBee to control the execution of greenhouse terminal equipment. The wireless gateway is mainly responsible for the data transmission between the wireless node and the client and the two-way data transmission of the cloud platform. The gateway programming is mainly based on STM32 master controller, the programming language is C language, and the compilation and debugging environment is Keil5. The system gateway program logic is shown in Figure 6.

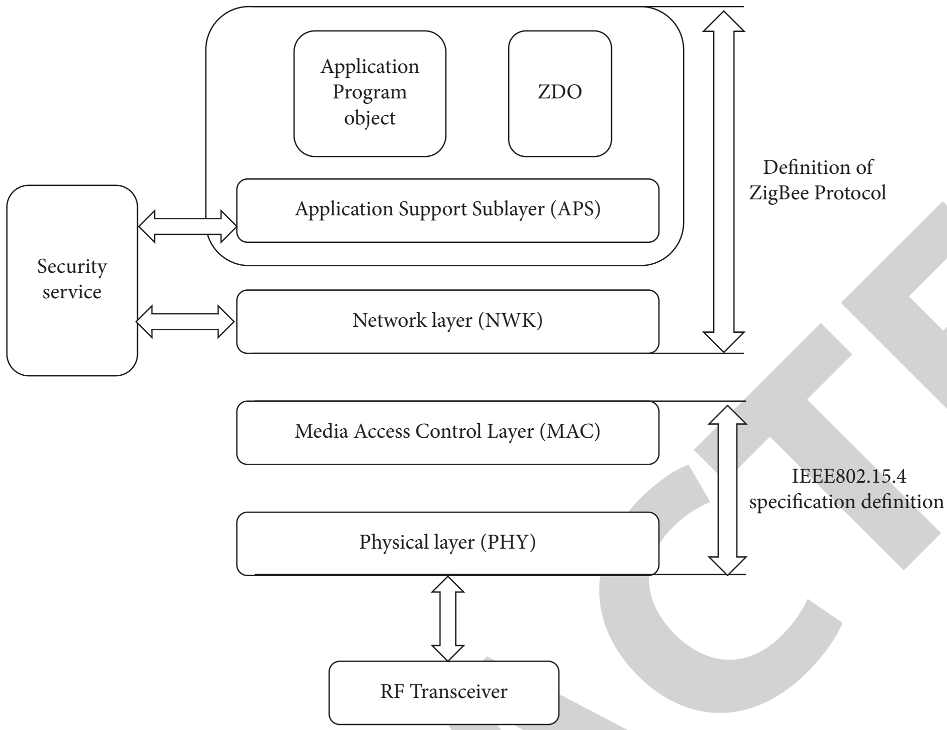

Figure 5: ZigBee protocol stack structure.

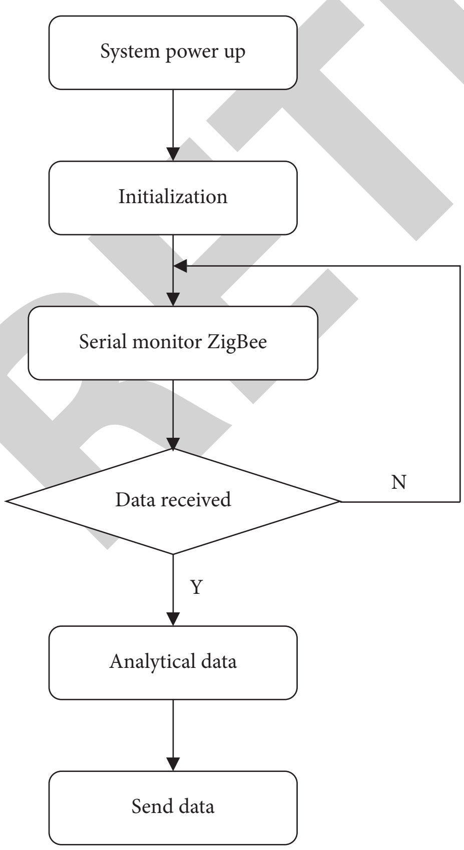

Figure 6: Flowchart of gateway program.

The wireless visualized intelligent agriculture management system is initialized after being powered on. At the same time, the serial port interrupts the monitoring ZigBee module. If the data is monitored, it will be parsed. After the analysis is completed, the data will be sent [15]. Data transmission is mainly as follows. First, serial port 1 receives the data collected by ZigBee terminal node, and the data is sent to the intelligent cloud platform by serial port 3. Second, the ESP8266WiFi module of serial port 3 receives the control instructions issued by the intelligent cloud platform, generates the control instructions for agricultural field equipment of ZigBee terminal node, and transmits them to ZigBee terminal node through serial port 1.

After the wireless visualization smart agriculture system is powered on, network configuration is required. At present, there are two common WiFi network configuration methods, one is Air Link, and the other is Soft AP. In the system, Air Link is used to configure the network. Figure 7 shows the WiFi access configuration. The Air Link protocol consists of the initialization of the protocol header, the assignment of other protocol bits, serial port write operations, and protocol confirmation checking.

3.3. ZigBee Software Design. When designing ZigBee software, each node terminal of the smart agricultural management system meets the specification requirements to ensure the formation of a network between different devices. The user can change the specification according to the specific design. The specification ID number of the protocol stack is set to 0 before each ZigBee node joins the network.

In order to ensure that the environmental parameters collected by each node of ZigBee are sent stably, the

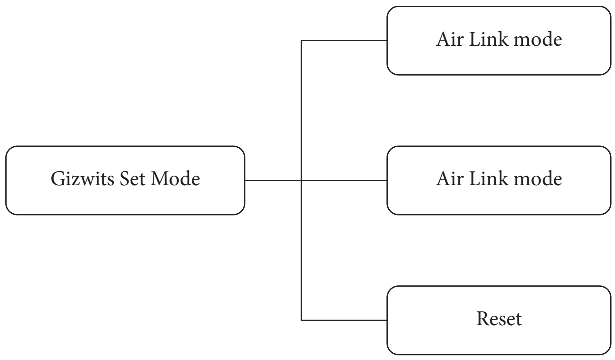

Figure 7: WiFi network access configuration method.

distributed addressing method is adopted to ensure that there is a unique address allocation without confusion [16]. Assuming that the maximum number of sub-devices that the parent device can have is Fm, the maximum number of routing sub-devices is Bm, and the maximum network depth is Sm, then the number of sub-segment addresses that can be allocated by the parent device is:

When $Bm = 1$, there is the following Formula (1).

$$\text{Cskip}(d) = 1 + Fm \cdot (Sm - d - 1). \tag{1}$$

When $Bm \neq 1$, there is the following Formula (2).

$$\text{Cskip}\ (d) = \frac{\left(1 + Fm - Bm - Fm \cdot (Bm)^{(Sm-d-1)}\right)}{(1 - Bm)}. \tag{2}$$

The child node is the short address allocation of the nth child router of the parent device, namely, Formulas (3) and (4) below.

$$\text{Achild} = \text{Aparent} + (n - 1) \cdot \text{Cskip}(d) + 1, n = 1, \tag{3}$$

$$\text{Achild} = \text{Aparen} + (n - 1) \cdot \text{Cskip}(d), n > 1. \tag{4}$$

The short address assignment of the nth child terminal of the parent device, that is, Formula (5) below.

$$\text{Achild} = \text{Aparent} + \text{Bm} \cdot \text{Cskip}(d) + n. \tag{5}$$

Fm— The maximum number of child devices that a parent device can have;

Bm— The maximum number of routing sub-devices; Sm— The maximum depth of network;

Cskip (d)— The number of sub-segment addresses that can be allocated by the parent device; n— The number of sub-routers;

Achild— The child node assigns the short address to the child router of the parent device.

When sending data to the ZigBee terminal device of the smart agricultural management system, the AF_DataRequest( ) function is usually called, and the data packet is sent to a target device of type afAddrType_t (defined in ZComDef.h).

3.4. Design of WiFi Cloud Computing Platform. WiFi (Wireless Fidelity), also known as wireless fidelity technology, is similar to Bluetooth technology. It is widely used indoors and is limited by distance. At present, the official WiFi standards are divided into IEEE802.11a, IEEE802.11b, etc., and the frequency bands used are around 2.4 GHz and 5 GHz. This technology has obvious advantages and is widely favored by the users.

In order to connect terminal devices such as smartphones to the cloud, a cloud computing platform is designed. The system cloud computing platform provides device networking based on the ESP8266 WiFi module, and transplants the GAgent program to the WiFi module to provide a medium for devices to access the cloud computing platform to ensure the normal data forwarding. The projects and data nodes contained in the greenhouse are created in the developer center and virtual devices are added, and then the APP is installed to bind the virtual device. After the APP communicates with the virtual device, the APP can query the value of each environmental parameter in real time and control the output status of each node of ZigBee. With the advancement of the "Internet +" wave, the system development mode has undergone qualitative changes. Traditionally, the development of IoT projects needs to be based on building servers. In order to meet the needs of developers, the concept of cloud servers has emerged. For example, Alibaba Cloud, Baidu Cloud, T-Link Cloud, Gizwits Cloud, etc., their models are similar, they are all external services, with these clouds, developers can solve project needs according to cloud servers, which largely solves customer needs, and provides a broad practice platform for developers. Different cloud platforms have inconsistent development functions. Alibaba Cloud focuses on data analysis, Baidu Cloud focuses on big data storage, and Gizwits is committed to IoT development. On the one hand, for this system, Gizwits fit the theme; on the other hand, in terms of overall performance, Gizwits platform is free to use, and can integrate and develop various interactive interfaces such as WeChat applet, computer client, and mobile APP with powerful functions, so this system uses Gizwits as the Greenhouse development cloud platform. The sensing data collection layer of the Gizwits platform framework mainly includes various environmental monitoring sensors to complete the collection of agricultural field environmental information. The transmission control layer is mainly responsible for sending the greenhouse environmental parameters collected by the terminal sensors to the cloud computing platform. The transmission control layer uses the ESP8266 WiFi module as the medium and is based on the TCP/IP communication protocol to realize the wireless transmission of the environmental parameters of the greenhouse to the cloud computing platform, and realize the storage, analysis, and statistics of the environmental parameters of the greenhouse through the Gizwits cloud platform. In addition, the transmission control layer also needs to transmit the remote control instructions of the Gizwits cloud server to realize the remote control of the water pump, exhaust fan, shading curtain, etc. The user access layer realizes the remote control function of the above-mentioned greenhouse field equipment through intelligent devices such as

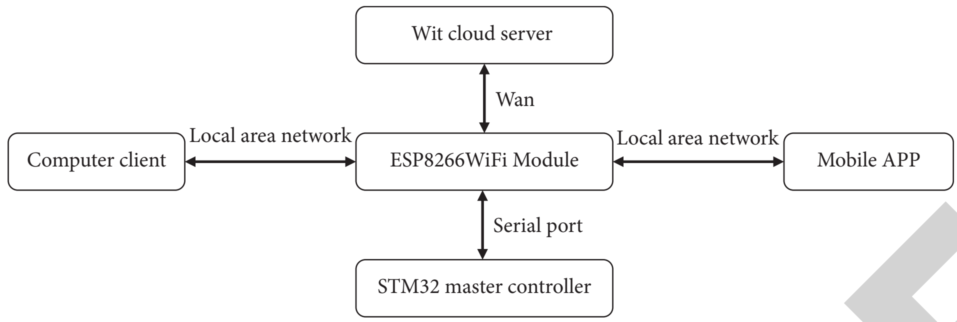

Figure 8: Gizwits platform framework.

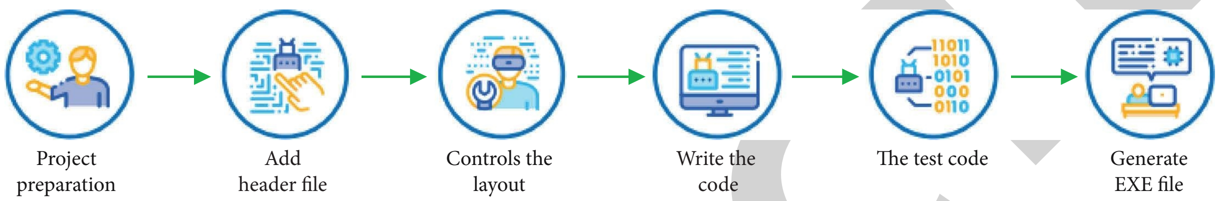

Figure 9: The development flow chart of the host computer.

computer client and mobile APP. The main framework of Gizwits platform is shown in Figure 8.

In the smart agricultural management system, an extension type is designed to realize transparent transmission of fixed-length data points to solve the problem of large data volume. The system uses extended data points to realize the data transmission between the STM32 main controller and the mobile phone APP. The data sent and received by the main controller is output to the serial port, and the working status and environmental parameters of each node of ZigBee are displayed on the TFT liquid crystal.

A product named "Data Transparent Transmission" is created in the personal project of Gizwits official website. After the data point is created, in the independent MCU solution under MCU development, another platform is selected to download the MCU engineering package. After the engineering package is downloaded, the system will use the Gizwits serial port protocol porting. After the porting is successful, the project name is changed to "IOT_Passthrough." The required driver files are added in the project to be applied in the LCD liquid crystal screen, and the path of the driver files are added after the addition is completed [17].

3.5. Design of the Upper Computer Monitoring Platform. The host computer monitoring platform of the wireless visualized smart agricultural management system mainly realizes two functions: real-time query of environmental parameters of greenhouses and remote control of agricultural field terminal equipment [18]. In this system, the computer monitoring software uses MFC as the development environment, Visual Studio 2015 as the debugging platform, and performs programming through C++. The computer hardware configuration requirements are Windows7. The development process of the host computer platform based on MFC is shown in Figure 9.

Before the development of the host computer, the engineering preparation is required first. The engineering preparation includes the addition of header files and library files. In the wireless visualized smart agriculture management system, both header files and library files are designed and developed according to system functions. Part of the information is shown in Table 1.

All header files and library files in the table need to be copied to the host computer project directory, and the above header files must be included in the corresponding.cpp or.h files of the MFC project. The library file CyAPI.lib needs to be added to the additional dependencies of the project. Because the development computer is Win7 64-bit operating system, the corresponding 64-bit library file is selected for this design. After all the preparations are ready, the layout of the controls can be carried out. The layout of the system controls mainly includes the appearance and position design of the control buttons and display ports. The program is written by C++, and the code can be tested when the compilation is correct. When the test result achieves the expected goal, the exe executable software of the entire project is generated.

The upper computer monitoring platform of this system has complete functions, mainly including the password login interface, the system main control interface, the real-time change display interface of environmental parameters, the threshold setting interface, and the weather forecast acquisition interface.

4. Analysis of Results

4.1. System Network Test. In order to verify the stability of the network operation of the wireless visualized smart agricultural management system, the system communication function needs to be tested before the system is officially put into greenhouse applications. The debugging method is: open the network debugging assistant, select the test

Table 1: Documents related to the host computer.

Upper computer file	Filename	Path
The header file	CyAPI.h, cyioctl.h	C\Cypress\Cypress suite \inc
The library files	CyAPI.lib (64-bit system)	C\Cypress\Cypress suite \lib\X64
The library files	CyAPI.lib (32-bit system)	C\Cypress\Cypress suite \lib\X86

protocol type as TCP/IP communication (consistent with the communication method between the host computer and agricultural field equipment), set the remote host address as 192.168.43.221, and set the remote host port as 8080. The TCP/IP test command is sent through the monitoring interface of the upper computer, and the network debugging assistant receives the command sent by the upper computer normally, indicating that the communication is successful. The test results show that there is no abnormality in TCP/IP communication, and the system network can operate normally.

4.2. Environmental Quantity Test. In order to verify the reliability of the environmental quantity detection function of the smart agricultural management system, a number of greenhouses were selected for testing in June 2019 in a city, and the test content was the environmental parameters of each day in the greenhouse. A set of measuring equipment was placed every 10 m in the greenhouse, the environmental parameters were recorded every 1 h, and the average value was taken [19]. Figures 10 and 11 are the average change curves of greenhouse environmental parameters in June 2019.

The climate type of this area is subtropical monsoon climate, and the climate is changeable. According to the meteorological data of the Bureau of Meteorology, the region has less sunshine hours from February to April, and more sunshine hours from July to September. In addition, the annual average temperature is between 16.2 and 19.9°C, with a maximum of 40.4°C in July. Figure 10 shows that the light in the greenhouse maintains a high value, close to 100lex. As the night falls, the light value shows a downward trend. At the same time, the temperature fluctuates between 20 and 35°C. When the illumination increases, the indoor temperature shows an upward trend; when the illumination value decreases, the indoor temperature decreases [20].

The air humidity in this area is relatively high, which is maintained at 67% to 84% all year round. Affected by the rainy season, the “southern wind days” often referred to by locals will appear in March and April, when the relative humidity of the environment will be close to 100%. The average annual rainfall in this area is about 1300–2000 mm, and the average annual rainfall days is about 180 days, which is one of the areas with more rainfall in my country. The seasons of rainfall are concentrated in spring and summer. The rainfall in spring and summer is not much different. In some years, the rainfall in spring will be more than that in summer. Figure 11 shows that the average humidity value of the air in the greenhouse fluctuates between 55% and 62% in one day in June, and the soil humidity changes to a certain extent, which is basically maintained between 45% and 50%.

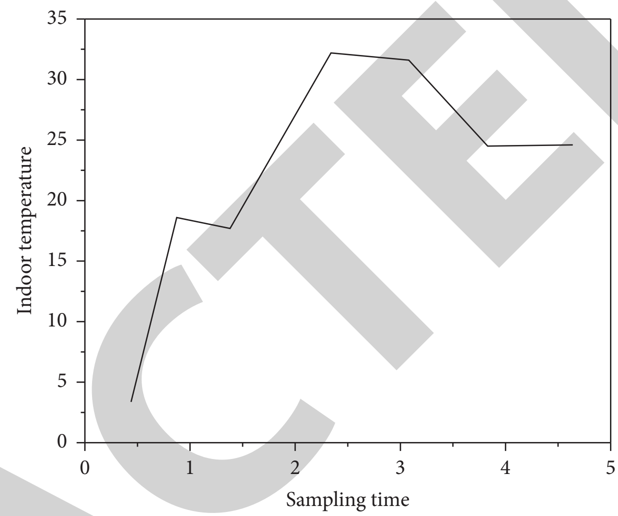

Figure 10: Change curves of light and indoor temperature.

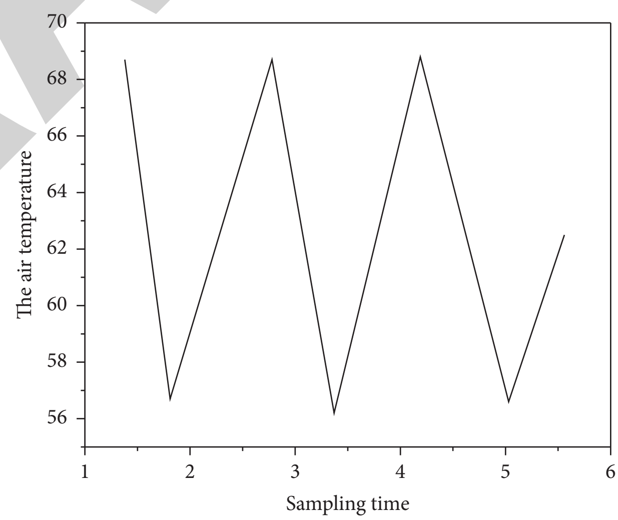

Figure 11: Change curves of air humidity and soil humidity.

When the air humidity value rises, the soil humidity value increases; when the air humidity value decreases, the soil humidity value decreases. Since the process of soil absorbing air moisture is relatively slow, this follow-up characteristic presents a certain delay effect.

4.3. The Functional Stability Test of the Visualization System. In order to verify the stability of the wireless visual smart agricultural management system, the working stability of each ZigBee node and the response sensitivity of each output terminal, the working performance of each smart terminal was tested through the APP visualized interface. The system

Table 2: Lighting system response time.

Number of tests	On	Off
1	1.25	1.48
2	2.02	1.98
3	1.33	1.23
4	2.45	2.12
5	1.55	1.34
6	1.65	2.46

Table 3: Irrigation system response time.

Number of tests	Start	Stop
1	2.14	2.75
2	1.65	1.63
3	1.02	0.88
4	2.48	3.06
5	1.59	1.64
6	1.95	2.05

Table 4: Ventilation system response time.

Number of tests	Start	Stop
1	0.97	1.55
2	1.48	1.37
3	1.61	1.59
4	2.31	1.42
5	1.96	1.44
6	1.56	1.02

Table 5: Daylight system response time.

Number of tests	Start	Stop
1	1.28	1.18
2	2.18	0.84
3	5.12	1.87
4	3.27	2.45
5	1.45	1.12
6	1.37	1.33

test parameters are set as follows. The upper limit of soil moisture is 55%, the upper limit of atmospheric temperature is 30°C, and the lower limit of illuminance is 20lex.

Through the operation of the intelligent device visual cloud computing platform, the execution status of each output end of the system is tested, and the test response time of each ZigBee node is obtained by sorting out the data, as shown in Tables 2 to 5.

It can be seen from the analysis of the test parameters that under the control of the visualized management system, when the system sends control instructions, the response time of each output terminal is basically between 1 and 2 s, and the response of each output control unit has high sensitivity in general. Affected by the network delay, the test data of the fourth group is large. Under the condition of the network delay, the response sensitivity of each output terminal of the system decreases accordingly.

5. Conclusions

A wireless visualized smart agricultural management system based on WSNs is developed, and it is designed through hardware platform, software process implementation, ZigBee-WiFi dual-protocol fusion communication, and cloud computing platform construction. The system realizes the environmental quantity detection of the greenhouse, the intelligent control of each node of ZigBee, and the intelligent decision-making of each output terminal, and the visual display of the environmental quantity parameters. It also realizes the visualization of the environmental quantity of the greenhouse and avoids the blindness of traditional agricultural activities effectively. The realization of ZigBee intelligent terminal control effectively saves a lot of manpower and material resources. The establishment of the WiFi cloud computing platform is connected with the intelligent equipment to realize the intelligent online control of the greenhouse. The test results show that the system has stable working performance, high response sensitivity, easy operation, and high degree of visualization. It realizes the wireless, visualization, and intelligence of greenhouses, which has a broad application prospect.

Data Availability

The labeled data set used to support the findings of this study can be obtained from the author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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