The Construction of Modern Horticulture Training Room and Its Application on the Internet of Things

Xiulian Lin, Junhong Zhong, and Zhenyu Xu(✉)

Huizhou Engineering Vocational College, Huizhou 516023, Guangdong, China
hitusa@126.com

Abstract. With the rapid development of the new generation of information technology, the Internet of Things, big data and artificial intelligence are also expanding in the field of facility gardening. However, in terms of the current situation, modern horticulture teaching in secondary vocational schools has been lagging behind, especially in the training of talents in emerging industries, and the lack of rural scientific and technological team ability and other factors, these factors have seriously restricted the development of the whole planting industry. In this paper, intelligent horticulture technology is adopted to solve the difficult problems in modern horticulture technology teaching. By building an intelligent horticulture Internet of Things platform, the integrated horticulture training system can quickly and accurately feedback environmental factors, and provide training guarantee for training modern horticulture technology talents.

Keywords: Modern gardening technology · Integrated gardening training room

1 Background

1.1 Introduction

The national "14th Five-Year Plan" proposes to "accelerate the development of smart agriculture", and smart gardening is an important part of smart agriculture and one of the important ways to realize rural revitalization. For a long time, the modern horticultural technology major of secondary vocational schools has actively adapted to the needs of reform and economic construction, and has achieved considerable development. It has trained a large number of professional and technical personnel for the planting industry in my country, especially in rural areas. The modern horticultural technology major of our school has played a pivotal role in cultivating professional and technical talents in Guangdong's planting industry.

With the popularization of modern information technology applications and the continuous deepening of education mechanisms and teaching reforms in my country, the teaching modes and teaching methods of secondary vocational schools increasingly rely on modern education technology with network technology and multimedia technology

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as the core [1]. Modern educational technology is also regarded by more and more schools as an important way to carry out teaching reform and improve teaching quality [2].

In recent years, our people's living standards have been continuously improved, and people's requirements for the quality of horticultural products have also been continuously improved. With the continuous progress of agricultural science and technology and the continuous adjustment of the layout of the agricultural industry, the quality of modern horticultural technical personnel training is particularly important.

Modern gardening technology is a major with strong practicality [3]. Due to factors such as limited equipment, it has brought many difficulties to the teaching of this major in schools. Only by using information technology and teaching resources, can we keep up with technological updates without increasing the investment in hardware equipment, ensure the training of students' learning skills and operation, and ensure the quality of teaching.

1.2 Integrated Gardening Training Room

In recent years, the rapid development of new generation information technology, the continuous expansion of the Internet of Things, big data, and artificial intelligence in the field of facility gardening has opened up a broad space for the high-quality development of smart gardening. Based on the integration of emerging mobile Internet, Internet of Things, cloud computing and other technologies, Smart Horticulture realizes the intelligent perception of the horticultural production environment by deploying various types of sensor nodes and wireless communication networks in different locations in the park. Intelligent early warning, intelligent decision-making, intelligent analysis, expert online guidance and other functions realize the visual management, precise planting, and intelligent decision-making functions of horticultural production. The user login interface is as follows (Fig. 1):

Fig. 1. User login page

The construction of our school's integrated horticulture training room includes an edible fungus cultivation base (including independent seed production room, sterilization room, processing room, cultivation room on the first floor, a total of 600 m^2, with seed production, processing and other related equipment.), Greenhouse (including 700 m^2 of flower cultivation greenhouse, 700 m^2 of vegetable cultivation greenhouse), 300 m^2 of horticultural student entrepreneurship and insect specimen exhibition center, the training room through the Huizhou Vocational College of Engineering Smart Horticulture Cloud Platform, the whole process of monitoring edible fungi, Flowers, vegetables and other production processes.

The platform can grasp the information of horticultural crop seedlings in real time through the remote monitoring system of the Internet of Things, and can realize functions such as data acquisition, data storage, data resource management, data mining, data calculation, and data visualization. The platform can not only regulate and control horticultural production, but also record and analyze the dynamic changes of horticultural planting, breeding process and circulation process, and through data analysis, formulate a series of regulation and management measures to promote the orderly and efficient development of horticulture and improve Horticultural production efficiency and product quality.

Relying on the smart gardening cloud platform, it provides data support and decision-making services for the whole process of gardening production. Before horticultural production, the historical data collected by the horticultural information perception system based on the Internet of Things is used to predict and apply to scientific production; in horticultural production, video and image-based pest monitoring systems and intelligent control of horticultural greenhouses can be used The system realizes real-time monitoring of horticultural products, achieves scientific planting, improves production efficiency and product quality; after horticultural production, through the production process traceability function in the horticulture cloud platform, the entire production process of horticultural products can be traced to facilitate management People and consumers understand and track production information.

Fig. 2. Real view of the base

The system includes 6 modules, namely the base reality, IoT monitoring, historical data, water and fertilizer system, alarm management and traceability system. They are briefly described as follows (Fig. 2):

Base Reality Module
Add the real map of the base and the name of the area through the background, and the user can log in through the platform account to view their own real map and the location of the area. You can drag the sign of the area with the mouse, and click the icon to enter the IOT monitoring interface of the area.

IoT Monitoring Module
The IoT monitoring module has 5 secondary menus on the left, which are data center, control center, parameter setting, video center and picture center. Click this module to enter the data center by default. There is a choice of production area at the bottom of the first-level menu, and you can choose to view the data, video, control equipment, etc. of the corresponding area (Fig. 3).

Fig. 3. IOT monitoring page diagram

The secondary menu includes: data center, control center, parameter setting, video center, and picture center (Fig. 4).

In the data center, select the production area and block to view the real-time sensor data of the current block and the most recent day, week, and month data curve, and can export the data to a table.

Control center, display all the controlled equipment information of the selected block. The device can be remotely controlled by clicking the device switch on the page, and the real-time data of the sensor in the corresponding area can be seen at the top (Fig. 5).

Fig. 4. IoT monitoring-data center diagram

Fig. 5. IoT monitoring-control center

Parameter settings are mainly used to remotely configure the parameters of automatic operation on the local intelligent control cabinet. For example, if you configure the start value of fan 1 in the landscape area, click Save after modification, then the start value is saved successfully; click start, it means fan 1 Enter the automatic operation mode, when the field value reaches the start value, the fan 1 will be automatically started (Fig. 6).

Video center, used to display video information in the greenhouse. The video can be viewed in 1 split screen, 4 split screen, 9 split screen, 16 split screen, 36 split screen, full screen, etc., to view video information.The dome equipment can be controlled by PTZ. Areas that can be controlled by PTZ: landscape area one and two, soil planting

Fig. 6. IoT monitoring-parameter setting

area left and right, substrate cultivation area one and three, water and ertilizer control area (Fig. 7).

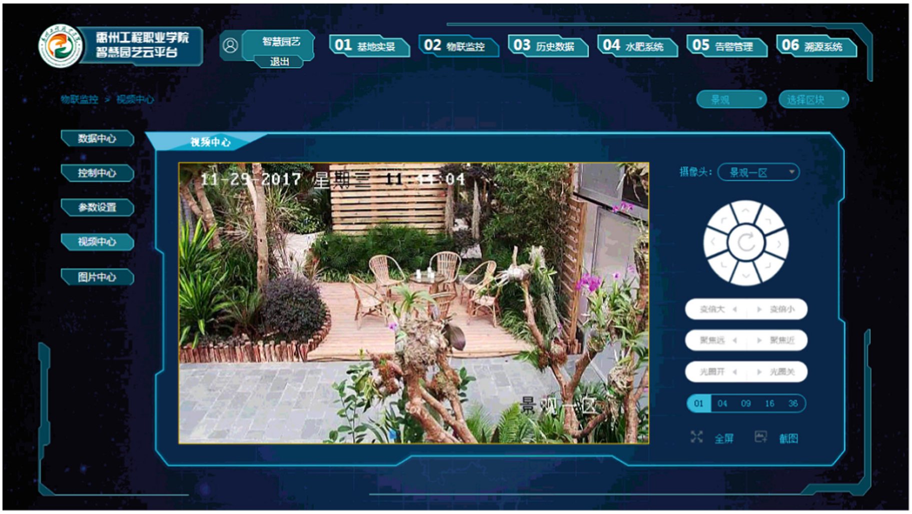

Fig. 7. IOT monitoring-video center

Picture Center, used to view the picture information captured by the video. It can be viewed according to block and time (Fig. 8).

Fig. 8. IOT monitoring-picture center

Historical Data Module

According to their needs, users can view the historical data of the sensors they want to view according to the day, week, and month (Fig. 9).

Fig. 9. Historical data

Water and Fertilizer System Module

The interface of the water and fertilizer system is used to remotely configure the operating parameters of the local water and fertilizer machine, such as viewing the operating status, manual automatic switching, remote configuration of automatic irrigation parameters, and automatic sequence parameters (Fig. 10).

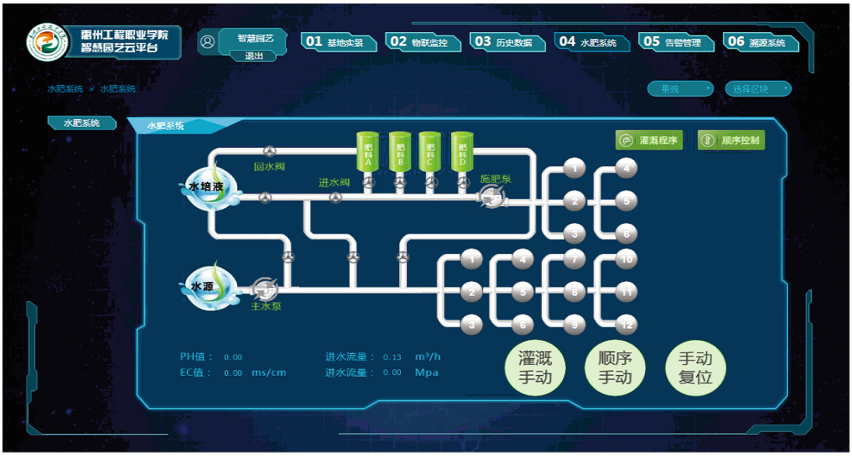

Fig. 10. Main interface of water and fertilizer system

Alarm Management Module

Add the real map of the base and the name of the area through the background, and the user can log in through the platform account to view their.

The alarm management module is used to view the alarm information when the sensor data exceeds the upper and lower limit values (Fig. 11).

Fig. 11. Alarm management

Traceability System Module
Click the first-level menu, the triangle icon on the far right side, you can directly enter the traceability management system. There are two traceability methods for horticultural species: two-dimensional code scanning and RFID reading, which can be used by users (Fig. 12).

Fig. 12. Traceability system

The above is the basic interface display of the integrated gardening training room of Huizhou Vocational College of Engineering. The platform is essentially an integrated gardening training monitoring and control system. The following article will systematically discuss the construction of the integrated gardening training room.

2 Gardening Information Perception Based on the Internet of Things

2.1 Data Collection and Transmission of Smart Gardening Platform

In the smart gardening cloud platform, the Internet of Things technology is mainly used in the collection and transmission of data information. According to the needs of the horticulture training business, the data information in each greenhouse control device is collected and transmitted to the network cloud platform. This is the entire The data source of the information platform. Smart horticulture management data collection is achieved by arranging various sensor nodes in a large-scale, multi-regional orchard. These front-end collection devices together form the entire local area network, and the network composed of wireless sensors is the wireless sensor network WSN. A large number of sensors together form a network to realize rapid monitoring and alarming of information inside the observation area.

In smart gardening management, there are many types of sensors that can be applied, including temperature and humidity sensors, photosensitive sensors, infrared sensors, and smoke sensors. The system transmits various data information to the cloud platform in real time through sensors. The cloud platform realizes remote control of the automatic control device through processing algorithms. If the automatic control device fails, the cloud platform will remotely send the corresponding failure information to the maintenance personnel for reference. The smart gardening cloud platform collects, counts, and analyzes the data information of each Internet of Things terminal in time, controls the automatic control device according to the plan formulated in advance, records the user's usage, maintenance and other data, and provides usage suggestions.

The data information generated by the sensor must be transmitted to the data center through wireless communication technology. At present, the more wireless communication technologies used in the field of smart gardening management mainly include Wi-Fi, Bluetooth, and ZigBee. Wi-Fi is a wireless expansion technology based on Ethernet, which solves the 100-m network communication problem. It has a wide range of applications but high power consumption. Bluetooth technology is a communication technology of 2.4G short-distance communication, and the communication distance is within 10 m. With the characteristics of low power consumption, it is generally suitable for scenarios such as mobile medical equipment and wearable devices. The disadvantage of Bluetooth technology is that the chip is expensive, easy to be interfered by other electronic devices, and the transmission distance is short, so the application in the field of smart gardening management has not yet been popularized. The ZigBee technology protocol is mainly used for low-speed and short-distance signal transmission, which can connect tens of thousands of wireless devices. This technology has stable signal transmission, low cost and simple operation, and is suitable for use in smart gardening scenarios. However, with the rapid development of information technology, people's communication needs have risen sharply, so low-power, wide-range, and long-distance IoT communication connections have become a development trend. The Internet of Things technology can be developed based on the mobile cellular networks that telecom operators have built on a global scale, but the development of Internet of Things equipment based on cellular mobile communication technology has the disadvantages of high cost and high power consumption, so the main application scenarios of its communication network It is still communication between people. Therefore, in order to meet the needs of more and more long-distance IoT communication connections, we have introduced LPWAN (low-power Wide-Area Network, low-power wide-area network) technology.

2.2 Overview of LPWAN

LPWAN has the characteristics of low bandwidth, long distance, low power consumption, and a large number of connections. The applied communication technology can be divided into two according to the different working frequency bands: One is LoRa, SigFox and other technologies that work in unlicensed spectrum, and the other is LPWAN that is supported by the 3GPP protocol and works on the spectrum authorized by operators. Communication technologies such as EC-GSM, NB-IoT and other technologies should be developed based on 2/3/4G cellular communication networks [4].

GSMA has made data estimates in recent years that by 2025, the number of connections for LPWAN applications will account for 60% of the total number of connections in the entire Internet of Things industry, which will directly accelerate the development of the Internet of Things industry, and the prospects are very promising. LPWAN technology and industry began to develop rapidly in 2015. The domestic market LPWAN industry scale reached 550 million yuan. By the end of 2020, the number of LPWAN networking equipment reached 231 million units, an increase of 110% compared with 2019. According to statistics in 2020, the total number of equipment developed for domestic LPWAN networks will reach 190 million, more than three times that of 2015, and the LPWAN market will reach 3.01 billion yuan, which is nearly six times that of 2015. In addition, not only has the potential for development in the industrial market scale is huge, but the LPWAN industry chain is also rapidly being completed. Chip technology, technical standardization, and market application pilots are all making good progress. Operators all play an important role in the process of completing the industrial chain [5].

2.3 LoRa Overview

LoRa (LongRange) is an ultra-long-distance wireless transmission scheme based on spread spectrum technology adopted and promoted by Semtech in the United States.

In terms of global LoRa IoT technology development, the LoRa Alliance was initiated by Semtech in the United States in March 2015. It is an open, non-profit organization. Since its establishment, there have been more than 500 members, and it has become one of the largest and fastest-growing alliances in the technical field. Members come from all over the world, including multinational communications companies, equipment manufacturers, system integrators, sensor manufacturers, startups, and semiconductor companies, etc., to promote LoRaWAN as a leading open global standard and realize a secure, carrier-class Internet of Things LPWAN connection. On January 28, 2016, ZTE and Semtech signed a strategic cooperation agreement at the Shenzhen headquarters, and jointly initiated the establishment of the China LoRa Application Alliance (CLAA) with nearly 20 partner manufacturers. In July 2018, Tencent joined the LoRa Alliance and announced plans to establish a LoRaWAN network with local partners in Shenzhen to provide LoRaWAN integrated solutions for various IoT applications and end users; in September 2018, Semtech and Alibaba Cloud IoT officially signed a licensing agreement to obtain the authorization of LoRa IP, and released the first LoRa system chip ASR6501, which comprehensively promoted the development of LoRa IoT technology [6].

LoRa uses linear spread spectrum modulation technology, which maintains low power consumption characteristics and significantly increases the communication distance. Terminals with different spread spectrum sequences will not interfere with each other even if they use the same frequency to transmit at the same time. Therefore, the equipment developed on this basis It can receive and process data from multiple nodes in parallel, greatly expanding the system capacity. The LoRa gateway can provide more than 20,000 terminal connections; the coverage distance of a single LoRa gateway is usually in the range of 3–5 km, in a complex urban environment It can surpass the traditional cellular network, and the open area is even as high as 15 km or more, and the distance of 100 km can also be successful under certain conditions. LoRa transmission is based on the asynchronous ALOHA protocol, and nodes can sleep long or short according to specific application scenarios. In the working mode, LoRa has low requirements on the signal-to-noise ratio, and the signal power is therefore very low. Battery power can last for several years to more than ten years. The overall cost of the LoRaWAN module is around US$8–10, which is about half of the price of cellular LTE modules such as NB-IoT. The higher the complexity of the NB-IoT network, the higher the costs related to intellectual property rights (in terms of authorized frequency bands), which increases the total cost of NB-IoT. The upgrade of NB-IoT to advanced 4G/LTE base stations is more expensive than LoRa deployment through industrial gateways or tower-top gateways. As the market becomes more mature, the cost of LoRa technology is expected to drop further. The threshold of LoRa can be self-organized network is slightly higher. From the bottom terminal to the gateway to the server to the application server, it must be developed by itself, and the gateway must be set up by itself. If the amount of terminal equipment in the area is large, you can choose LoRa to deploy the network. Controllable, safe and controllable, without third-party routing and forwarding.

LoRa has three working modes: ClassA, ClassB, and ClassC.

(1) Class A: The terminal sends first, and a receiving window is opened for a period of time after sending. The terminal can receive only after sending. That is to say, there is no restriction on the uplink, and the downlink data can only be received by the terminal when the uplink packet is sent up. (Lowest power consumption)
(2) Class B: The terminal and the server negotiate the opening time and when the receiving window will be opened, and then receive at the agreed time. Multiple packets can be received at one time. (The second lowest power consumption)
(3) Class C: The terminal opens the receiving window at any time other than sending. It consumes more energy, but the communication delay is the lowest. (Highest power consumption)

2.4 Smart Gardening Information Collection

LoRa (LongRange) is an ultra-long-distance wireless transmission scheme based on spread spectrum technology adopted and promoted by Semtech in the United States.

The hardware construction of smart gardening IoT devices includes multiple modules. The core data information collection is mainly through various sensors, including soil moisture sensors, temperature and humidity sensors, etc. These IoT devices sense all kinds of real-time data information in time, and then transmit them after collection. Mainly through the LoRa module, its data transmission protocol has the characteristics of low use cost, low power consumption, and long transmission distance, making it widely used. The power supply of the smart gardening equipment is mainly supplied by the power board, including wireless nodes and sensor control modules; the core control module of the smart gardening equipment is the MCU, and each sensor sends the collected data back to the control center through the communication module, and at the same time, the smart gardening management The staff of the system can remotely control these IoT devices through various sensor networks.

Sensor nodes are sub-nodes in the entire network. During network deployment, these IoT devices are mainly operated through the network, including device sleep, sensor node wake-up, and data information sending operations; sensor nodes complete the association and measurement of measurement targets through the network. Measurement of parameter information. Generally speaking, these IoT devices are in sleep mode at the beginning of their work. When the system is turned on for debugging or enabled, the system platform can remotely wake up these sensor nodes. The first operation of the wake-up operation is to initialize the sensor nodes. After the operation, follow the requirements to find the relevant protocol stack and join the network. The system judges whether these devices have successfully joined the network. If it is unsuccessful, the system management will give a corresponding prompt. If the sensor node can successfully join the network, it can complete the collection of temperature, humidity, smoke and other data information in different areas of the agricultural park. When a sensor node is working in a normal state, the phase status needs to be fed back to the gateway node of the sensor node's network. The gateway node is responsible for the management and supervision of the entire sensor network. According to the settings of the system administrator, the different sensor nodes in the network are monitored. Allow or deny the operation, and finally transmit the data information gathered by the sensor node to the background server.

3 Smart Gardening Information System

3.1 System Construction

The basic network facilities of the smart gardening cloud platform are the basis for implementing the application of the smart gardening cloud platform, including infrastructure, support platforms, application systems and other parts. The basic network facilities of the smart gardening cloud platform mainly include the following three construction contents: First, basic software and hardware facilities. It mainly includes data cloud storage, cloud computing and exchange physical equipment and cloud environment, as well as wired and wireless network infrastructure; the second is the support platform. Built on basic hardware and software facilities, it mainly provides database systems, data exchange platforms, and geographic information systems and video systems that support special application functions. The third is application cloud platform. Including specific business systems such as cloud platforms, cloud data centers, and cloud applications, it is the core layer for the realization of the entire smart gardening system business. All business systems are uniformly deployed in the form of software applications, and users can access at any time through computers, tablets, mobile phones and other networked devices.

The smart gardening training system adopts a combination of technologically advanced wireless sensor network technology, ARM embedded technology and wireless sensor technology. Through the data collection of the intelligent agricultural remote monitoring system, it can accurately grasp the indicators of the internal environment of the greenhouse. To control the corresponding system control devices (fans, humidifiers, heaters) to smoothly control the changes in the internal environment of the greenhouse, maintain it in a relatively stable and suitable environment, and provide a suitable growth environment for horticultural crops. The front-end sensor control system will self-adaptively complete the adjustment of the greenhouse's internal environment according to the pre-set program flow, without human control.

In the technical realization of the collection and transmission of the smart gardening system, the gateway node needs to initialize the entire system in the early stage of work, and then needs to complete the information scanning and the establishment of a new network, and is responsible for the management and operation of the sensor nodes in the entire network. The sensor node sends a request to the gateway node according to the business needs. The gateway node needs to judge the addition of the sensor node based on the resource configuration and business needs. If it is not required, it will reject it. If it is allowed, it needs to set the corresponding sensor node. Network address, and receive the data information sent by this sensor node, gather the data of different sensor nodes in the network and send it to the back-end smart gardening management system.

The horticultural greenhouse intelligent control system extends the network from the desktop to the field, makes the intelligent greenhouse online in real time, and realizes the integration of the greenhouse and the data world. Combining real-time sensor data and traditional planting experience, so that horticultural experts can remotely view various data in the field (temperature, humidity, light, precipitation, crop growth video recording) at any time to determine whether the optimal crop growth conditions have been reached, You can also use the remote video screen system to set up a fixed-point timing camera function on the cloud platform to take multiple photos of the seedling process, fruit tree and fruit growth process at the same angle every day. In the process of long-term accumulation, the photos of the same latitude are passed through time and space. The evolving form is automatically generated on the platform through the model, and by clicking to play, you can understand the growth characteristics of the seedling process, the fruit tree and the fruit growth process, and provide favorable data support for scientific research. Smart horticulture is a modern horticultural production method that can fully improve horticultural production efficiency and reduce waste of horticultural resources and farmland pollution.

The data center of the smart cloud platform establishes a complete information system for the growth process of horticultural crops. Through this information system, the planting process is made more scientific, intelligent and refined. Enable managers to access the cloud platform data center through PC or mobile terminals, easily obtain the real-time growth environment of crops, and make intelligent management decisions on the crop growth process through the acquired data. The construction of the cloud platform data center is mainly based on the basic big data of four application modules: one is based on the training room real scene fixed point to capture the record of the crop growth process; the second is the environmental big data based on the cloud platform; the third is the operation process of the crop growth process The traceability basic data; the fourth is the big data of the insect situation based on the cloud platform.

3.2 System Application

The smart gardening system obtains network map data (map data is optional) and combines panoramic map technology to display the real gardening scene in the park on the cloud platform. The user can click on the real-time real-time map of any gardening planting area through the map navigation function., Combined with the cloud real scene online system, mark the cloud real scene camera point on the panoramic map real spot location, and you can view the real-time picture in the area in real time.

The smart horticulture system connects the environmental monitoring data obtained by the sensors to the cloud platform in real time through a large number of environmental monitoring sensors arranged in orchards and seedling greenhouses. Through long-term and multi-dimensional data accumulation, the data chart is visually displayed while building the future The trend prediction model for the possible development of the environment, combined with the pest database and the changes in the data structure during the pest occurrence process, predicts the occurrence of pests and diseases. Users can view the status information of various smart gardening equipment through the Internet through the computer and mobile terminals, and can remotely control and monitor the relevant automatic control facilities in the smart gardening training room in real time, and process and analyze the gardening business.

The smart horticulture system adopts a cloud platform-based environmental data collection, transmission and storage construction plan. By arranging a large number of soil moisture, soil conductivity, soil PH and other sensors in the park, it is used to observe the park air temperature and humidity, wind speed and direction, carbon dioxide, and rainfall., Light radiation and other data parameters that have an impact on crop growth, are transmitted to the cloud server through the network and the data is stored and processed. The horticultural information perception module completes the function of querying and visualizing horticultural environmental data. Horticultural experts can view the data change curve of weather or soil moisture by selecting different park monitoring points, and input the specific time interval that they want to view, so as to facilitate querying different monitoring points The historical data and historical data trend chart of the data, the data is automatically uploaded every one minute by the system, and the historical data automatically generates the historical data trend chart in units of days.

The alarm setting in the gardening information perception system is mainly to set the alarm range of the system. By selecting different monitoring points and different sensors, you can set different threshold ranges for different monitoring points. There is no need to alarm within the effective range. When the sensor detects When the relevant index exceeds the threshold range, the system will send out an alarm system on the main interface to notify the relevant personnel of the park to deal with it in time.

4 Conclusion

In today's society, the labor force is in a downward trend, and people's demand for various intelligent systems and services is increasing. This has led to an increase in the types and functions of system data, and the need for more staff behind it. Many, traditional manpower is gradually unable to meet such a large amount of demand. However, due to the rapid development of intelligent technology, people's pursuit of automation becomes possible. This article breaks the limitations of traditional automation equipment using smart gateways as the system, combined with the extensive application of the Internet of Things and big data analysis technologies in its fields, and has made an IoT smart cloud platform for gardening management, which has changed the traditional gardening affairs management. The composition structure of the smart gardening cloud platform has been constructed to achieve efficient management and operation. Use data mining related algorithms to mine and analyze various data information collected by front-end Internet of Things equipment, complete the analysis of crop growth trends, smart agriculture-related equipment failure rates, etc., and enhance the value of existing data information. Through the study of the system, students can truly “learn by doing, doing while learning, and learning by doing”, organically integrate theoretical teaching and practical teaching from space, system, and information, and complete the combination of professional theory Expansion of practical knowledge. Through this system, innovating the teaching management model, greatly improving teachers’ application of information technology and network means to solve teaching problems, is conducive to stimulating and cultivating students’ potential and creativity in the information environment, and promoting their professional and vocational skills.

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