



# **LORA Communication-based Data Acquisition and Wireless Irrigation Control System Solutions**



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# Chapter 1 Project Overview

## Project Background

China is a large agricultural country, and farming is the most widespread planting method in traditional agriculture in China. Based on the wide distribution of agricultural fields, high labor cost, long time consuming, crippling and untimely collection of farming information, the emergence of new IoT planting has made traditional agriculture begin to transform to precision agriculture and smart agriculture.

The traditional farmland environment management system has a lot of cable laying, cable exposure, long communication lines and other problems, thus leading to time-consuming and power-consuming networking, weak anti-interference ability and construction difficulties. With the rapid development of electronic technology and wireless communication technology, long-range wireless data transmission is also used in agricultural production.

At present, most of the agricultural environment monitoring using ZigBee, WiFi and other wireless communication technology, but in the face of the vast territory, the distribution is not concentrated, the natural environment of agricultural applications, its communication distance, power consumption, anti-interference and network scale limitations. LORA can spread farther than other wireless methods with the same power consumption, realizing the



unification of low power consumption and long distance, and expanding the communication distance 3-5 times than traditional wireless communication RF with the same power consumption, which can be applied in agricultural field management to effectively save manpower and material resources and realize remote intelligent management in agriculture.

## Construction Goals

The general goal of the construction of data collection and wireless irrigation control system solution based on LORA network communication is to achieve intelligent management of agricultural production by using LORA wireless transmission technology to remotely monitor the soil moisture and meteorological environment closely related to crop growth, remotely and intelligently control the field irrigation solenoid valve, and realize remote and precise irrigation, in response to the wide distribution of agricultural fields, many monitoring points, and difficulties in wiring and power supply.

### System architecture:

The whole solution combines the actual environment of agricultural fields, divides agricultural fields into several areas, adopts LORA wireless networking, multi-point, long-distance, distributed principle, and installs the corresponding equipment in different areas, the specific architecture is as follows.

LORA collector, LORA wireless irrigation controller and LORA gateway use **LORA wireless networking communication**. The communication distance is up to

3km line-of-sight.

2. The LORA gateway device can communicate with **32 LORA controllers** within the effective communication distance, and send wireless control commands for the LORA controllers to execute actions, while collecting **64 elements of environmental monitoring data**.

3. The LORA gateway device uploads the collected environmental monitoring data to the monitoring software platform as 4G/RS485/Ethernet.

4. The whole system supports **remote control, timing control, automatic control** and other work modes, data in real time in the computer side, cell phone APP side views and other functions.

## 1.3 Design Principle

According to the environmental characteristics of agricultural fields, as well as the status and direction of the development of LORA wireless communication technology at home and abroad, and drawing on the experience of excellent domestic and foreign intelligent agricultural construction projects, with "advanced technology, practical system, reasonable structure, low cost and easy maintenance" as the guiding principle, the entire program follows the following principles.

- **Low power consumption:** Due to the working environment in which the sensor nodes need to be battery-powered, energy is limited to ensure the normal operation of the system hardware and proper transmission distance, and power consumption should be minimized and battery life extended.



- **Long Distance:** Due to the vast geographical area of farmland site, the limitation of communication distance and the influence of environmental factors such as obstacle blockage makes the transmission quality deteriorate and affects the data transmission distance, which requires wireless communication with strong anti-interference ability and long communication distance to improve the network coverage.
- **Easy to extend:** Node data can be uploaded wirelessly to the gateway, while ensuring network capacity, which should reduce networking difficulties, improve networking efficiency, be flexible in use, and be able to expand to more application areas.
- **Reliable and stable:** Only a stable running system can ensure the smooth operation of data transmission, and the role and significance of the monitoring system can be reflected. The overall solution has been designed with stability and reliability as the first goal at all levels, from solution architecture to product design.
- **Better system efficiency:** The solution design is based on the importance of improving the overall operational efficiency of the system as much as possible, and choosing more suitable products and more suitable technical solutions to achieve it.
- **Flexible hardware configuration:** Users can upgrade and replace the controlled hardware devices at will without replacing the software.
- **Easier to use and maintain system:** Program design according to the project



construction rules and so on to choose the appropriate monitoring products and technical solutions to achieve, and strive to make the system easier to use and maintain, reduce the management and maintenance costs of customers using the monitoring system.

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## Chapter 2 Project Introduction

### 2.1 Introduction to the LORA data acquisition and wireless irrigation control system

For the characteristics of LORA wireless communication, the solution of **data acquisition and wireless irrigation control system** based on LORA network communication uses the **ultra-long-range, low-power LORA wireless transmission technology based on spread spectrum communication, intelligent sensor network technology, anti-interference technology and automation control technology**. The traditional environmental data collection equipment is upgraded and transformed to build an intelligent and efficient monitoring and control management system, relying on various LORA sensor nodes and wireless communication networks deployed in the field to achieve intelligent sensing, intelligent alarm and intelligent analysis of the field environment, providing accurate monitoring, visual management and intelligent decision-making.

**LORA data collection and wireless irrigation control system consists of LORA wireless collector, LORA wireless irrigation controller, LORA gateway and agricultural four conditions measurement and reporting platform.**

Through **LORA wireless spread spectrum communication technology**, the environmental temperature, humidity, illumination, soil moisture and other



parameters collected by the LORA collector are transmitted to the **LORA gateway**, which is then uploaded to the cloud platform via 4G/Ethernet to analyze and process the environmental data information. The set threshold or human intervention operation is used as the control condition for irrigation equipment operation to achieve **intelligent irrigation**, which changes the previous problem about the contradiction between transmission distance and power consumption of farm management system.

The system adopts **LORA wireless networking technology**, which is very easy to deploy for construction, considerate in details and convenient for capacity expansion. The monitoring software platform is also very user-friendly, with friendly interface, simple operation and comprehensive functions, which is convenient for users to invest in the project according to their own needs and investment budget, and will not cause wasteful duplication of investment.

## 2.2 System Topology



## 2.3 System Advantages

### ■ Concentration so professional

Our company has been focusing on environmental monitoring industry for many years, striving to provide customers with the best and most cost-effective environmental monitoring products and solutions, and is a well-known manufacturer in the environmental monitoring industry. We have a complete range of products and solutions, supplying 300+ regions and serving 110k+ customers worldwide.

### ■ LORA wireless transmission without wiring

Unlike traditional wired signal transmission, the system uses LORA wireless output method, which **eliminates the need for wiring** and enables **wireless connection** between measurement points and gateways, avoiding problems



such as massive cable laying, cable exposure, and long communication lines.

The reason for using LORA wireless communication technology is its long distance data transmission capability, its communication distance can reach up to 3,000 meters of line-of-sight and can penetrate 3~4 floors indoors. LORA technology has the characteristics of **high performance, long distance, low power consumption, support for large-scale networking, ranging and positioning**, which makes this solution an ideal technology choice for large-scale promotion and application of IoT.

#### ■ **Intelligent Control**

Support **remote manual control, automatic control, timing control** and other irrigation modes, and remotely realize the on/off control of the solenoid valve in the irrigation system. Meet the needs of accurate water control even in the case of unattended, saving manpower and water resources.

#### ■ **Provide a free cloud platform with powerful features**

The platform adopts professional database, which is stable, reliable and easy to expand, supports software and hardware hierarchy, and supports multi-level user management authority. With multi-level alarm mode, it supports voice, SMS, email and on-site sound and light alarm mode. The cloud platform automatically collects the data collected by LORA gateway and displays it on the platform page through GPS map, list, icons and curves to meet the users' multi-dimensional and multi-level view of real-time monitoring information.

### ■ **NFC configuration parameter**

All devices in the system support the mobile phone "NFC configuration software" and equipment touch, fast and easy to configure parameters, read real-time values and equipment status, to improve the convenience of user access to data.

### ■ **Unified management across regions**

Through the establishment of a unified monitoring and management station, multiple devices and information distributed in different areas are fully digitalized and centrally monitored and managed to meet the unified supervision needs of the modernized measurement points.

### ■ **Remote management**

The system supports a variety of control methods on Web side and mobile APP side. It supports remote viewing of real-time data, online analysis of historical data, online viewing of operation records, remote issuance of commands to modify valve status and working mode, etc.

### ■ **With a wealth of automatic alarm mode**

The system supports mobile phone, SMS, e-mail and other alarm methods, and has a variety of alarm methods can be selected to meet the needs of most users.

### ■ **Wide range of application**

The system can be widely used for environmental data collection and intelligent irrigation in agricultural fields, greenhouses, landscaping, scenic spots, etc.



### ■ High integration of software and hardware

The system hardware and software products according to the needs of industry development, keep pace with the times, constantly update the corresponding products, eliminate obsolete and redundant functions, and constantly integrate effective new functions, so that the product has a higher and higher degree of integration, to provide customers with more cost-effective products.

### ■ Unique features to fit customer needs

The LORA data acquisition and wireless irrigation control system integrates many of the more practical functions with customer requirements, and can also be customized to support them. From the customer's point of view of use, it makes application and maintenance as easy and hassle-free as possible.


# Chapter 3 Project Solution Design




## 3.1 Environmental Data Collection Subsystem

### 3.1.1 LORA Wireless Sensor

Various environmental data acquisition is mainly done by various LORA acquisition devices. Such as **LORA temperature and humidity sensor, LORA soil sensor, LORA illumination sensor, LORA 485 sensor**, etc. Using various sensors to collect air temperature and humidity, soil temperature and moisture, illumination, carbon dioxide and other environmental indicators of the farmland, and **upload data to the monitoring software platform through the LORA gateway.**

LORA sensors adopt LORA wireless communication protocol, communication not only to avoid mutual interference between measurement points in the process of signal transmission, but also to avoid the traditional wireless equipment communication transmission distance is too short, lack of penetration, high power consumption problems.

Style	Device Name	Model
	<p>LORA Temperature and Humidity Sensor</p>	<p>RS-WS-LORA-2-*</p>

	<p>LORA Soil Sensor</p>	<p>RS-TR-LORA-2-*</p>
	<p>LORA Illuminance Sensor</p>	<p>RS-GZ-LORA-2-200000</p>
	<p>LORA 485 Sensor</p>	<p>RS-485-LORA-2</p>

### 3.1.2 Functional Features

- Adopting LORA spread spectrum technology communication, the farthest communication distance with LORA gateway can reach up to 3,000 meters line-of-sight and can penetrate 3-4 walls.
- Built-in battery can be replaced, universal 3.6V lithium sub-battery, 5min upload once data can be used continuously for 3 years.
- It can monitor its own power, signal and real-time data and upload it through LORA wireless communication.
- IP65 protection level for long-term outdoor use.
- LORA 485 sensor can connect all of our RS485 type transmitters (CO2, wind speed and direction, solar radiation, rainfall, etc.) to the collector via the 485 bus. Up to four 485 type devices can be connected and the data can be



uploaded to the LORA gateway in real time.




## 3.2 Wireless Irrigation Control Subsystem

The monitoring software will analyze the soil water requirement through the data collected and uploaded by each sensor, and then send wireless control commands to the **LORA wireless irrigation controller** through the **LORA gateway** to control the solenoid valve of the relevant node to water automatically and stop watering when the set threshold value is reached.

It supports a variety of irrigation control modes such as **remote manual control, automatic control and timing control**, realizing the irrigation system to **open or close the valve automatically** according to the remote command,

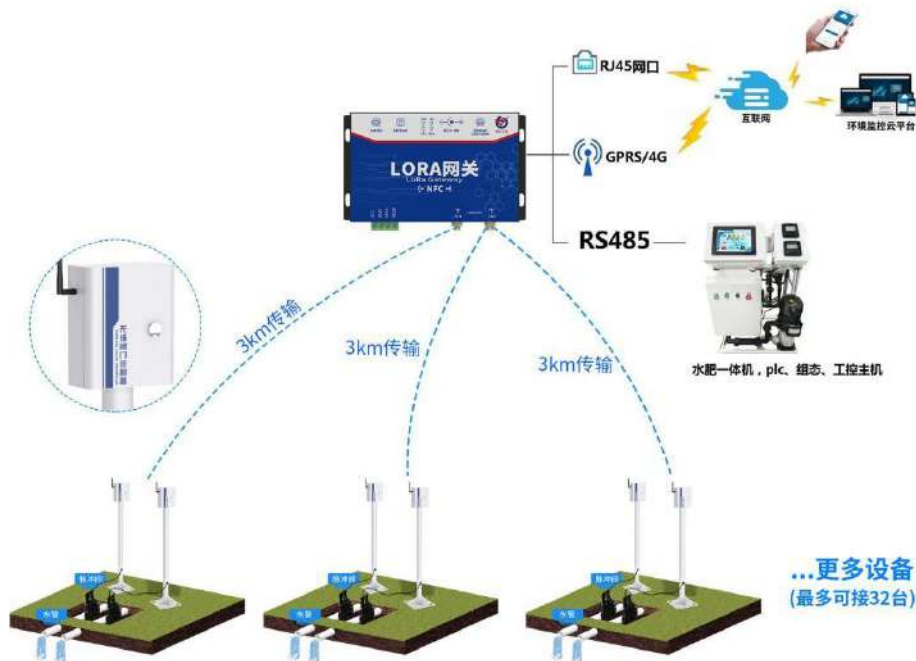
so as to control the irrigation pipeline, satisfying the demand of accurate water control even in the unattended situation and saving human resources; in addition, the soil moisture value can be collected through our network type collection terminal and uploaded to the back-office system, so that different watering strategies can be set according to the different requirements of crops for watering, realizing personalized watering and saving water resources.

### 3.2.1 LORA Wireless Irrigation Controller

Style	Device Name	Model
	<p>LORA Wireless Irrigation Controller</p>	<p>RS-WIC-*</p>

**LORA wireless irrigation controller (RS-WIC-\*)** is a new type of valve controller developed by our company based on **LORA wireless spread spectrum communication technology**. The product shell is strong, waterproof, anti-theft, adopting LORA wireless communication technology, **the communication distance can reach up to 3000 meters**, through the pulse or relay output signal to control the irrigation valve switch, with our LORA gateway it can be provided with our company's pulse valve to complete the

platform-based remote manual, automatic, timing open/close remote control functions, to achieve intelligent linkage of various systems, accurate irrigation.



### 3.2.2 Functional Features

- Adopting LORA wireless spread spectrum communication technology, the transmission distance can be up to 3,000m line-of-sight.
- It can be used with LORA gateway to achieve manual, automatic and timed operation on the platform.
- Battery power supply and 10~30V DC wide voltage range power supply are available.
- Battery-powered for 3-4 times daily control and 3-4 years of life.
- The shell is strong, waterproof and anti-theft.
- Uploads its own power, signal, and real-time data via LORA wireless communication.

- It can be configured by mobile phone configuration software "touch NFC configuration", read the controller real-time data, valve switch test, etc.

Convenient and fast.


- IP65 protection for outdoor use.

### 3.2.3 Technical Parameters

Parameter Name	Range or Interface
Communication Method	Lora Spread Spectrum Communication
Maximum Communication Distance	Sight Distance 3000m
Relay Output Load Capacity (Optional)	3A 30V-DC/255V-AC
Pulse Output (Optional)	±9V (Duration: 20ms/80ms)
Power Supply (Optional)	DC10-30V or lithium sub-battery power
Control Response Time	<2S
Device Configuration	NFC, Neutral configuration software available
Protection Level	IP65

## 3.3 LORA Gateway

### 3.3.1 Product Overview

Style	Device Name	Model
	LORA Gateway	RS-LG-100/200-*

**LORA Gateway (RS-LG-100/200-\*)** is a product launched by our company in order to solve the use environment of agricultural fields, orchards, medicine gardens, and parks with difficult power supply, vast areas, high wiring costs and high maintenance costs. Using LORA communication technology, data can be uploaded to the **agricultural four-factor measurement and reporting platform** in real time via Ethernet port, 4G wireless and 485 wired.

### 3.3.2 Functional Features

- DC 10~30V wide voltage power supply. Field can be powered by power adapter or solar power system.
- Metal sheet metal shell with self-shielding, high anti-interference capability and more stable operation on site.
- With communication and operation indicators, you can easily determine equipment problems on site.



- Adopt LORA spread spectrum communication technology, multi-channel communication, enhance link communication stability, increase penetration and transmission capability.
- LORA communication distance can reach up to 3000m line-of-sight and can penetrate 3~4 floors indoors.
- With our LORA wireless irrigation controller, the control response can be achieved within 2S by switching the valve on and off.
- Up to 32 LORA measurement points and 32 LORA wireless irrigation controllers can be connected to our company at the same time.
- The communication process uses a unique encryption technology to ensure that it is not listened to, ensuring reliable control and eliminating false actions.
- The device has three different data upload methods, Ethernet, 4G and RS485, which users can choose according to their needs.
- With remote upgrade function, the function can be customized on site for remote upgrade.
- With 1 RJ45 network port for uploading monitoring data to remote monitoring software platform.
- With 1 multi-functional 4G communication interface, simply insert a mobile phone card to upload data to the remote monitoring software platform.
- With 1 Modbus-RTU slave interface for external monitoring host, PLC, configuration screen or configuration software.

### 3.3.3 Technical Parameters

Parameter Name	Range or Interface	Description
Power Supply	DC 10~30V	DC wide voltage power supply
Power Consumption	1w	
Device Configuration	NFC	Using the neutral phone APP "Touch NFC Configuration" to configure the gateway parameters
Communication Interface	RJ45 Network Port	Uploading data through the network port (ETH Only)
	4G	Upload data via 4G (4G Only)
	RS-485 Slave Interface	Data upload via RS485
	LORA Communication	Communication with LORA measurement points by LORA communication
Data Upload Interval	5-65535 S	Default 20S

LORA Communication Distance	Indoor penetration of 4 walls or 3 floors	Outdoor open area gateway and temperature and humidity measurement point communication distance can reach more than 3000 meters
	Open Area $\geq$ 3000 meters	Interior penetration of 4 common walls or 3-story concrete floor slabs



# Chapter 4 Agricultural four-factor measurement and reporting platform

## 4.1 Platform Overview

The agricultural four-factor measurement and reporting platform adopts advanced information acquisition system based on Internet of Things, artificial intelligence, big data, Internet and other technologies. Users can access the platform through various channels such as WEB on PC and APP client to realize remote management functions. Users can monitor and manage important parameters affecting crop growth such as meteorological environment and soil moisture of each node in real time, and realize remote manual, timing and automatic IOT irrigation system based on the platform.



## 4.2 Function Introduction

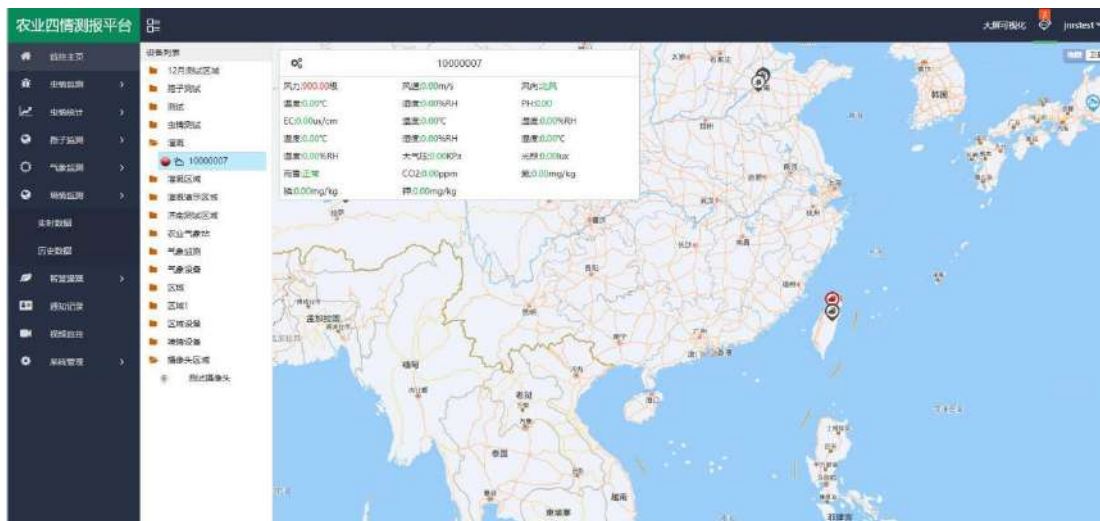
### 4.2.1 Large Screen Visualization

It can cast screen display, automatic refresh, scrolling all equipment information, clear and intuitive data, easy for administrators to view the system.



### 4.2.2 Real-time Data Monitoring

The platform supports real-time viewing of all data of the measured environment. Data can be reflected through electronic map interfaces, lists, etc. The electronic map interface has the advantage of allowing the user to visualize the data and the relative location of the sensors, while the list is more convenient for the user to compare the data.



【实时数据首页展示】

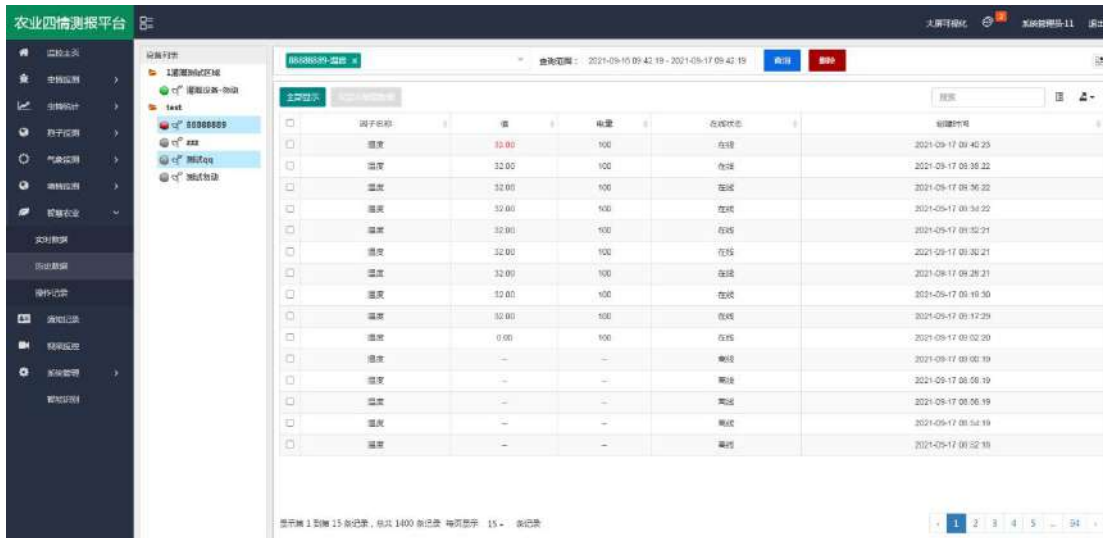


【实时数据列表展示】

### 4.2.3 Historical Data Query and Export

Equipment information of each monitoring point, equipment monitoring data, historical data can be queried through the system. Alarm data will be displayed in red, support generating data graph, with single or multiple factor data storage/query/export data function, and support PDF, excel and other data format export. It can also export important information such as the time period

of data query, query data account, equipment power, and equipment online status.



The screenshot displays a web interface for monitoring agricultural equipment. The main content area shows a table of historical data for a specific device (ID: 88088591-222). The table columns include: 设备名称 (Device Name), 值 (Value), 电量 (Power), 在线状态 (Online Status), and 报警时间 (Alarm Time). The data shows various temperature readings (e.g., 32.00, 31.00, 32.00) and power levels (e.g., 100, 100, 100) over time, with status changes between '在线' (Online) and '离线' (Offline). The interface also includes a search bar, a date range selector (2021-09-10 09:42:19 to 2021-09-17 09:42:19), and a pagination bar at the bottom (1 to 15 records, 1400 total records, 15 records per page).

【历史数据列表查看】

#### 4.2.4 Over-limit Alarm

When the monitoring value exceeds the preset alarm value, the equipment is offline or the equipment power is low, the system can provide alarm to the platform, such as SMS alarm, telephone alarm, email alarm and other alarm methods, and make a good event record for calling and analysis.

It supports all monitoring factors alarm upper and lower limits, warning upper and lower limit settings, for SMS, ringing, WeChat, e-mail alarm mode and has a special alarm contact management list, easy to quickly query, add, delete when the alarm contact changes.



## 4.2.5 Video Monitoring

It supports the installation of cameras and sensors in the field, the data monitored by the sensors can be superimposed on the monitoring screen through the video character super imposer, and its interface displays all the information to avoid repeated switching and realize remote monitoring.

## 4.2.6 Intelligent Remote Control

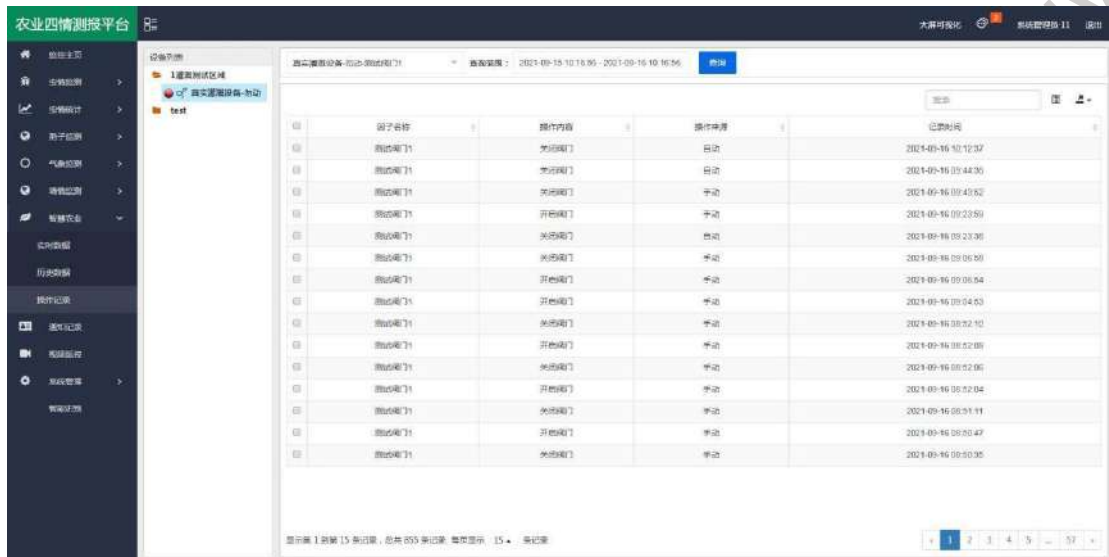
The working mode or state of the valve can be modified remotely based on this platform, supporting three working modes of manual, timing and automatic control.

The current valve can be set to manual mode by clicking on confirmation in manual mode;

Conditions can be added in automatic mode and the control factor will perform a trigger action when the set conditions are met;

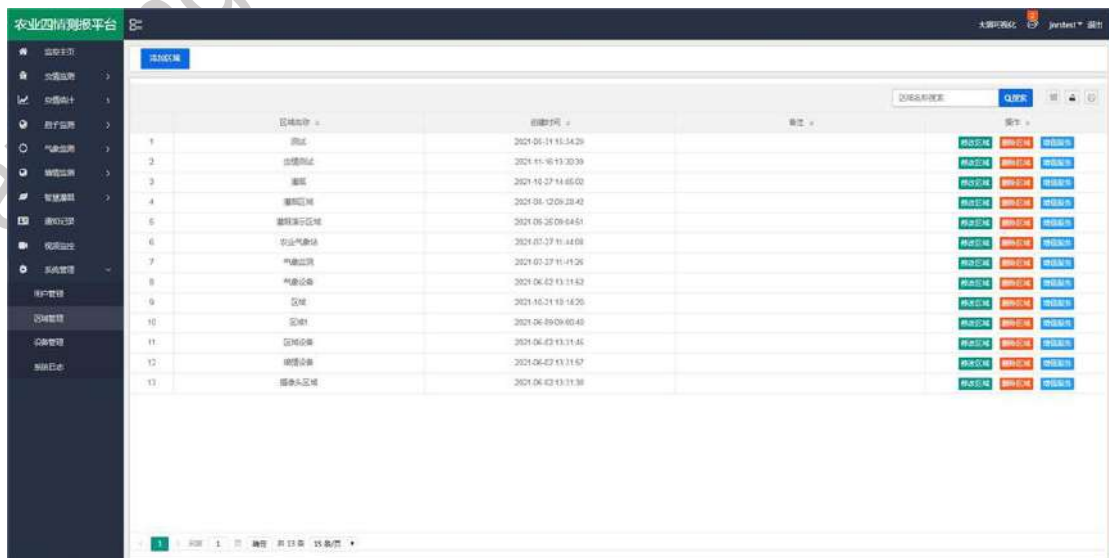
The timing mode includes the fixed point mode and the week mode. The fixed

point mode can select a certain day of the month at a certain time and minute, and the week mode can select seven days from Monday to Sunday. Both two modes can add a time point, and when the time is up, a trigger action will be executed to control the valve opening and closing.



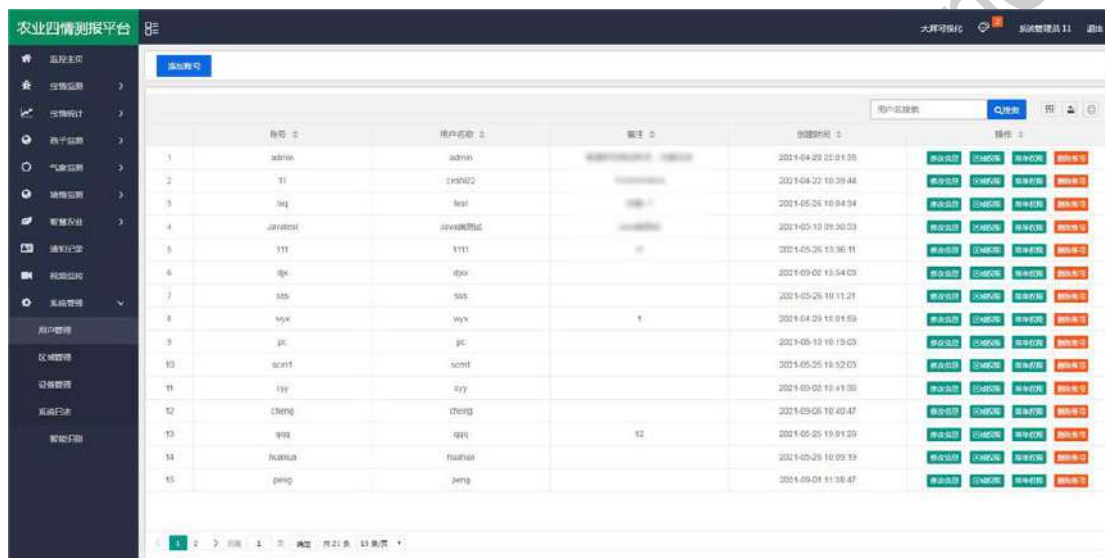
## 4.2.7 Regional Management

Area-based unified management of equipment and environmental status in the area.



## 4.2.8 Permission Management

It supports account hierarchical management, adds sub-accounts according to the actual requirements of the project, and assigns different management rights to achieve a clear division of labor in project management. Users can define different user roles and give different permissions to manage the roles.



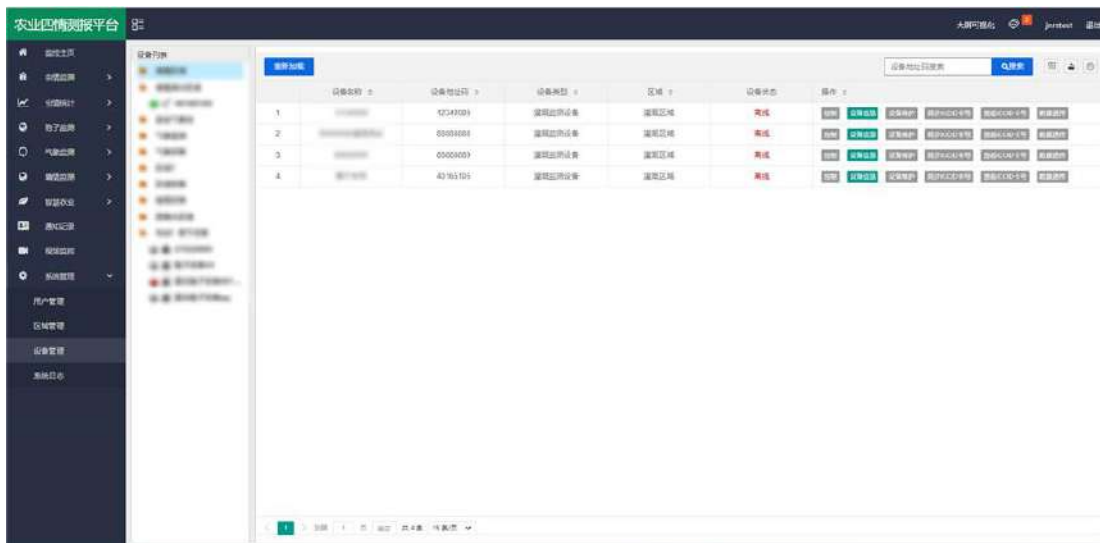
The screenshot shows a web interface for 'Account Management' (账号管理) within the 'Agriculture Four-Condition Monitoring Platform' (农业四情监测平台). The interface includes a sidebar with navigation options like 'Home', 'System Settings', 'Statistics', 'User Management', etc. The main area displays a table of users with columns for ID, Username, Password, Role, and Creation Time. Each user entry has a set of action buttons for management.

ID	用户名	密码	角色	创建时间	操作
1	admin	admin	系统管理员	2021-04-29 22:01:55	修改密码 重置密码 删除用户
2	tl	123456	系统管理员	2021-04-29 10:25:44	修改密码 重置密码 删除用户
3	hq	1234	系统管理员	2021-05-26 10:04:34	修改密码 重置密码 删除用户
4	jarvis	jarvis1234	系统管理员	2021-05-19 09:30:03	修改密码 重置密码 删除用户
5	111	1111	系统管理员	2021-05-26 13:36:11	修改密码 重置密码 删除用户
6	qk	qk	系统管理员	2021-09-02 13:54:09	修改密码 重置密码 删除用户
7	555	555	系统管理员	2021-05-26 11:11:21	修改密码 重置密码 删除用户
8	wyx	wyx	系统管理员	2021-04-29 11:01:59	修改密码 重置密码 删除用户
9	jk	jk	系统管理员	2021-05-19 10:19:03	修改密码 重置密码 删除用户
10	scwl	scwl	系统管理员	2021-05-25 11:32:03	修改密码 重置密码 删除用户
11	xy	xy	系统管理员	2021-03-03 11:41:55	修改密码 重置密码 删除用户
12	cheng	cheng	系统管理员	2021-03-03 11:40:47	修改密码 重置密码 删除用户
13	qq	qq	系统管理员	2021-05-25 13:01:09	修改密码 重置密码 删除用户
14	huahua	huahua	系统管理员	2021-05-26 11:09:19	修改密码 重置密码 删除用户
15	ping	ping	系统管理员	2021-09-01 11:38:47	修改密码 重置密码 删除用户

【账号管理】

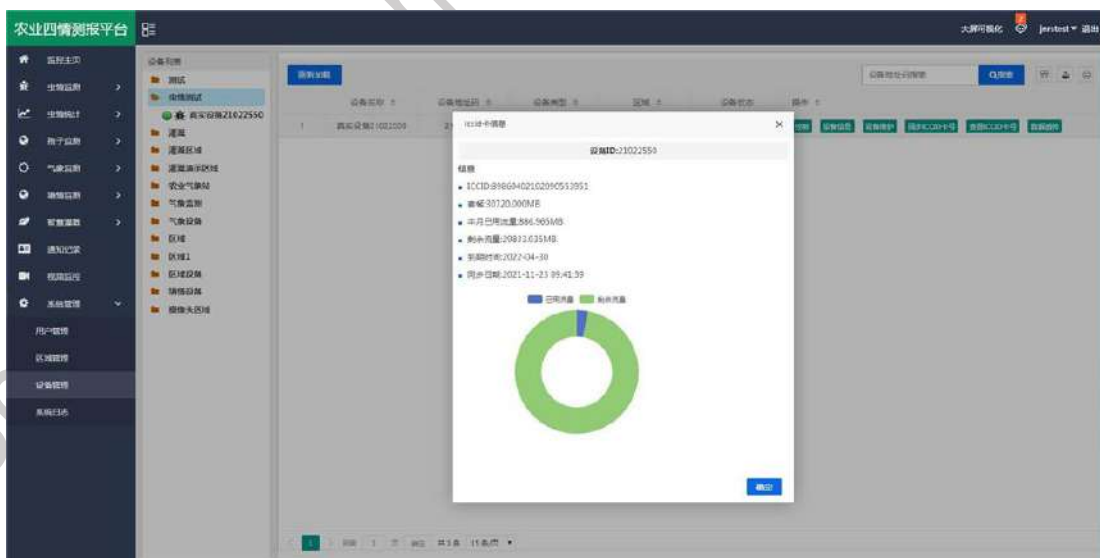
## 4.2.9 Equipment Management

Realize the setting management function of environmental collection equipment, soil moisture monitoring equipment, video monitoring equipment and wireless irrigation system in the access system.



## 4.2.10 Mobile Data Alert Function

Obtain the card number of 4G iot device in real time on site, automatically analyze the remaining mobile data of the card number, expiration time warning reminder, let project managers recharge timely to prevent projects from coming to a halt due to carrier cancellation when the mobile data card expires.





## 4.2.11 Secondary Development

The cloud platform provided by our company is completely free, the interface is completely neutral, and supports secondary development by users.

## 4.2.12 Different Interfaces

For users with small-scale applications, cloud platform provides configurable different interfaces with private domain name resolution, customers only need to spend a few dollars to purchase a domain name, you can have your own private login link after successful filing. It supports custom icons, color schemes, and landing page styles.

## 4.2.13 Mobile App

For the convenience of mobile users monitoring data, we launched the "Soil Sensor" mobile APP, which makes it easy for users to monitor in real time 24 hours a day. Users can log in the cloud platform with their account password and control thousands of devices with one click. It supports video view, equipment failure/abnormality alarm, offline alarm function, real-time data view, historical data curve view, mobile control valve switch, and automated irrigation.



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## Chapter 5 Conclusion

The solution of data acquisition and wireless irrigation control system based on LORA networking communication realizes real-time acquisition, monitoring and remote control of environmental parameters of agricultural planting sites based on ultra-long-range and low-power LORA wireless transmission technology of wireless spread spectrum communication. It has the advantages of long communication distance, high stability, low cost and easy construction, and can be widely used for wide-range information collection and remote control in agricultural fields, greenhouse, landscaping and other fields, with broad application prospects.