Application of Intelligent Water Conservancy Information System in Agricultural Water-Saving Irrigation

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Abstract. Water conservancy project is not only the infrastructure of national economic development, but also an important factor related to the coordinated development of social natural environment, economic environment and cultural environment. Especially with the continuous emergence of Internet information technology and Internet of things technology, a variety of advanced technologies and sensing test instruments are used to monitor regional water environment, flood disaster and agricultural irrigation, and build an information monitoring system for water quality and water regime covering regional water systems, which can realize the modern and intelligent management of agricultural water-saving irrigation.

Keywords: Intelligent water conservancy · Agricultural water-saving irrigation · Information system

1 Introduction

Although with the acceleration of national development and the improvement of industrialization speed, it has gradually become an industrialized country. But generally speaking, China is still a large agricultural country and a large agricultural irrigation country. Water is crucial to agriculture. However, there are great contradictions in the utilization of water resources in China: on the one hand, water resources are very scarce, on the other hand, the waste of agricultural water is serious. First of all, the broad masses of farmers have a weak awareness of water resources. Farmers generally believe that water is inexhaustible, and the idea of not using it for nothing is serious. Secondly, irrigation water is unscientific. China's traditional agricultural farming methods for thousands of years have a great impact on farmers, resulting in serious waste of agricultural water, which is reflected in the low water use coefficient of agricultural irrigation [1]. At present, the national average is only 0.4–0.45. In many places, the irrigation water consumption even exceeds 20 times or even higher than the national water quota. According to the current utilization rate of agricultural water, it can be simply estimated that at present, China's irrigation area is 820 million mu, of which the area of canal irrigation accounts for about 75% and the area of well irrigation accounts for about 25%. Even if calculated

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according to the utilization rate of 0.45, more than 180 billion cubic meters of water may be lost due to leakage or evaporation loss in the process of water transmission every year [2]. Thirdly, water management is extensive. Many irrigation areas do not have good water metering devices, and they lack a more accurate grasp of the water demand of the irrigation area in a certain period. Water discharge irrigation has great randomness and blindness. In addition, from the perspective of irrigation facilities, some reservoirs have no main canals and rely on river channels for water delivery; In many irrigation areas, only trunk and branch canals have been built. The canal system below the branch canal is not perfect, the matching rate is low, and the aging of the project leads to great loss of irrigation water. Therefore, it is difficult to meet the current needs of agricultural water in China, whether from the perspective of water awareness, the scientificity of agricultural water and the matching rate of agricultural water projects [3].

At present, the main problems faced by the construction and development of water conservancy projects in China have changed from the treatment of natural floods and sudden water conditions in the past to the supervision of water resources, ecological environment and water conservancy projects. Facing the general trend of the rapid development of Internet information technology, all regions have water The benefit department should make use of the Internet of things technology to make all-round parameter detection, data information acquisition and data integration analysis on the existing surface water height, underground water regime and water quality, as well as the seepage situation during the construction and operation of water conservancy projects, and put forward suggestions on the construction of intelligent water conservancy overall structure, so as to provide support for the management of water conservancy information monitoring personnel [4].

With the rapid development of computer technology, Internet of things technology has also accelerated the pace of development. Backward agriculture can also be transformed through advanced technology, and Internet of things technology can quickly solve the water shortage problem of China, a large agricultural country. Therefore, the importance of Internet of things technology in water-saving irrigation is self-evident. The popularization of intelligent irrigation control can effectively use the limited water resources, and is of great help to the production of crops. On the premise of less destruction of ecological resources, it greatly reduces the survival cost, and enables us to get better, cheaper and higher quality food. The modern intelligent irrigation system has many advantages over traditional irrigation methods: for example, it can irrigate part of the day in the dark, for example, it can reasonably control the water pan, for example, it can very well control the time. This is a very beneficial technology for Ningxia, which lacks water resources. If we make full use of the intelligent water-saving irrigation system under the Internet of things technology, it will greatly solve the big problem of water shortage in Ningxia [5].

With the accelerated development of modern agriculture, some agricultural facilities and equipment are constantly updated. Green intelligence from the perspective of the country's future development needs, the use of solar energy, wind energy and other green energy is the development trend of our country. The popularity of green energy is increasing, and it is widely used in agriculture, such as the installation of solar energy technology on insect repellent lamps, and the use of wind for water-saving irrigation.

With the deepening of green energy conservation, its application conditions are more convenient. For example, it is not affected by weather and climate, and it saves water and energy. This paper is mainly based on green energy In addition, the remote intelligent irrigation system is integrated with uwp technology, wireless communication network GPRS and computer technology. Such a system can make information more timely, more convenient for management, save a lot of manpower, establish a more scientific detection process, and provide convenience for life [6]. The research and development of remote intelligent control irrigation system through uwp technology makes use of cross platform information sharing between different platforms, eliminating information islands and facilitating information sharing, which is now known as cloud platform. In this system, the information sharing between different devices is realized, which ensures the maximum performance advantage of the irrigation system. At the same time, it is also applicable to the latest Microsoft system.

2 Intelligent Water Conservancy Information System

2.1 Overview of Intelligent Water Conservancy Information System

China is a large agricultural country, and its water consumption is often greater than that of other countries. With the increasing lack of water resources, all countries need to find effective ways to save a lot of water. Among many methods, sprinkler irrigation and micro irrigation technology can solve this problem very well. In recent years, water-saving irrigation technology in China has developed rapidly, and great breakthroughs and progress have been made in spray and drip irrigation technology, and a lot of valuable practical experience has been accumulated. Therefore, the spray drip irrigation technology is widely used in our country, and has achieved good results.

With the extensive development of computer technology in our country, more and more enterprises have implemented the transformation of management mode from people-oriented to computer-controlled. However, at this stage, China's management level is relatively backward compared with developed countries. At present, in the field of water-saving irrigation, China is still in the traditional artificial irrigation mode or the way of manually controlling irrigation, which has not yet reached the integrated control mode. Even if there is intelligent agriculture or intelligent control system, it is also a small-scale and small-scale controlled irrigation. However, the real large-scale cluster deployment in the form of Internet of things using computer control is still rare [7]. China has carried out extensive research on water-saving irrigation, such as Lai Heyuan fully exploring the role of GPS measurement and GIS technology in the survey, design and construction of efficient water-saving irrigation projects; The water management information system of Shijin Irrigation Area Based on WebGIS designed by Yang Ming; Ji Jianwei, The automatic control system of paddy field irrigation based on PLC designed by Deng Weiwei et al. "; the vegetable greenhouse automatic irrigation system based on single chip microcomputer designed by Ju Yongsheng and Li Xingkai. At present, the system is put into use in most parts of China, and has the best effect in Dalian and Beijing, and has achieved certain social and economic benefits; like the Institute of agricultural mechanization, Tianjin Institute of water conservancy science has independently developed the greenhouse drip irrigation and fertilization intelligent control system. In general, my knowledge of precision irrigation technology It is equivalent to the initial stage of advanced countries [8]. There are too few research knowledge about the whole digital agriculture and smart agriculture, the simulation technology is not advanced enough, and the research problems are not thorough enough.

Intelligent water conservancy information system is to install a variety of sensors, sensors and other hardware equipment to the reservoir outlet, water source and radioactive source area, and then generally connect these physical hardware equipment with the help of Internet of things software technology, so as to form the collection, transmission and analysis of multivariate data information in the Internet of things network. At present, the network communication technology used in intelligent water conservancy information system mainly includes GPRS CDMA. 4G and other communication technologies, as well as Internet of things technologies such as cloud computing, big data server and water conservancy monitoring software platform. By using a variety of Internet of things sensing technologies to more quickly perceive the real-time indicators of the regional water conservancy system, we can comprehensively monitor the rise of surface water, underground water regime, water environment pollution, sudden flood disasters, etc., and formulate patrol management, disaster command and emergency management plans on this basis.

In the intelligent water conservancy information system, there are usually hydrological telemetry terminal, water level gauge and open channel flowmeter Rainfall profile, water pressure sensor, conductivity sensor, temperature sensor, water turbidity sensor, radio frequency identification sensor and other equipment automatically collect information about water conservancy project operation and hydrological changes, which can help the management department grasp the transmitted hydrological data in a timely and comprehensive manner [9]. Then, the monitoring center and network software service platform of the water resources bureau will carry out distributed calculation and storage of the collected hydrological data information, and provide users with web page access, information acquisition and download services according to their personal needs, so as to complete the more intelligent management of water conservancy information and water conservancy problems in key areas.

2.2 Construction Strategy of Intelligent Water Conservancy Information System in a Region

Since the 1980s, a certain area has established a large number of water conservancy projects with important functions with the management objectives of water resources monitoring, flood control and drought relief. According to the investigation and statistics by using the water conservancy information system, a certain area is surrounded by large and small rivers and lakes, with more than 4000 water and rain monitoring points, 3 data acquisition center stations and more than 300 soil moisture stations.

A water conservancy electronic map with a ratio of 1:250000 has been built in an area. The map will reflect the real-time rain and water conditions, as well as the development of historical hydrology, flood and drought prevention, and can monitor the existing water conditions, moisture and water resources pollution. For the monitoring and early warning of hydrological monitoring, agricultural irrigation, water and soil conservation, flood control and drought relief of small and medium-sized rivers, a variety of sensor monitoring equipment will be used to carry out systematic data monitoring in different water conservancy areas through the communication network connected by the backbone network, combined with the business monitoring needs of water resources pollution, surface hydrology, water level height, groundwater change, open channel irrigation flow, water disaster and so on Statistical analysis and storage, and transmitted to the government intranet and unit business network of the Provincial Department of water resources to ensure that the water conservancy project can be built, used well and used for a long time.

To effectively allocate water resources, we need to integrate limited water resources, and the development of modern technology provides us with a very good solution, the Internet of things. The Internet of things will solve the difficult problems of water conservancy informatization, such as the low degree of monitoring automation and insufficient transmission network coverage, and will be more and more widely used in the hot issues of water conservancy informatization, such as flood and drought warning, water ecological monitoring, water conservancy facilities monitoring, water resources scheduling and so on. At present, most parts of China do not have such awareness, which leads to a large-scale waste of energy and resources. The older generation of engineers do not understand the combination of the Internet and engineering. In fact, if we can use modern technology and traditional irrigation technology, we can produce the greatest effect. In this way, on the basis of saving money, labor and energy, On the other hand, it is also a kind of awareness of environmental protection. Therefore, in view of the rise of the Internet of things, we should not rule it out, but should accept its advantages, and then apply it to agriculture and water conservancy in combination with China's national conditions.

Through the application of Internet of things technology, the difficult problems of water conservancy informatization, such as low degree of monitoring automation and insufficient transmission network coverage, have been well solved, which greatly reduces the administrative cost, improves the work efficiency, and has remarkable benefits. The era of Internet of things is an era of high information development. Everything common around us can be connected with the Internet. The water conservancy project is the key to government affairs and the livelihood of the people. Reasonable combination of Internet of things technology can improve efficiency within a certain range, so as to effectively plan limited resources. While the water conservancy business is developing rapidly with the help of IOT technology, we can also further expand and extend it. For example, through IOT technology, we can automatically connect the supervision and governance of exploration, construction, safety, environmental protection, police and water conservancy industry, and realize the seamless link of information through IOT, so as to form intelligent big data and bring the development of water conservancy into a new stage of development.

3 Composition of Farmland Water Conservancy Information System

3.1 Underground Water Regime Monitoring System

The underground water regime monitoring system uses modern communication, computer, digital network and electronic technology to realize the remote automatic measurement and reporting of dynamic information (water regime) of water resources. The system is divided into subsystems such as water regime detection, signal transmission, data transmission and analysis and processing. It has the characteristics of high scientific and technological content, high precision, strong stability and timeliness. It realizes the unmanned collection and automatic measurement and reporting of groundwater monitoring data, and improves the work efficiency and office automation level, At the same time, it is also convenient for water administrative departments and earthquake monitoring and management departments to timely and accurately grasp the real-time situation of water resources, so as to provide a reliable scientific basis for water resources allocation and earthquake prediction. The application of the system makes the city's water resources management and monitoring step into a fast, accurate and efficient track, which will produce huge economic and social benefits [10]. The groundwater regime monitoring system relies on GPRS network, and the staff can view the groundwater regime data in the monitoring center.

The monitoring management software of the monitoring center can realize remote data collection and remote monitoring. All monitored data enter the database and generate various reports and curves. The underground water regime monitoring system consists of four parts: monitoring center, communication network, intelligent liquid level transmitter and solar power supply scheme.

3.2 Video Monitoring System

The video monitoring system consists of local monitoring system and video service system. The local monitoring system is mainly composed of camera PTZ decoder (it is composed of PTZ lens control, video encoder and other equipment to complete the collection, processing and transmission of video information on the project site, accept the monitoring and control instructions of remote users, and execute the control of camera lens and PTZ to obtain image information from different angles, different directions and different effects. The video service system is mainly composed of video management server, data management server and media It is composed of server, video client and other equipment and relevant software to complete the functions of video information reception, processing, storage, deployment, on-demand and playback. At the same time, it manages the users of video client to meet the video monitoring needs of users in different regions, different levels and different monitoring requirements.

3.3 Meteorological Monitoring System

The mobile automatic weather station adopts integrated design and is a multi-element automatic weather station specially developed and produced for microclimate observation, mobile weather observation post, short-term scientific investigation, seasonal ecological monitoring, etc. It can measure conventional meteorological elements such as wind direction, wind speed, temperature and humidity, air pressure, rainfall, solar radiation, solar ultraviolet, soil temperature and humidity, and automatically calculate and store wind cold index, et transpiration evaporation and temperature / humidity / light / wind index according to the aerodynamic method in micro meteorology. This kind of meteorological station has become the most comprehensive microclimate observation station for measuring meteorological elements in China. The structure of the terminal controller is shown in Fig. 1.

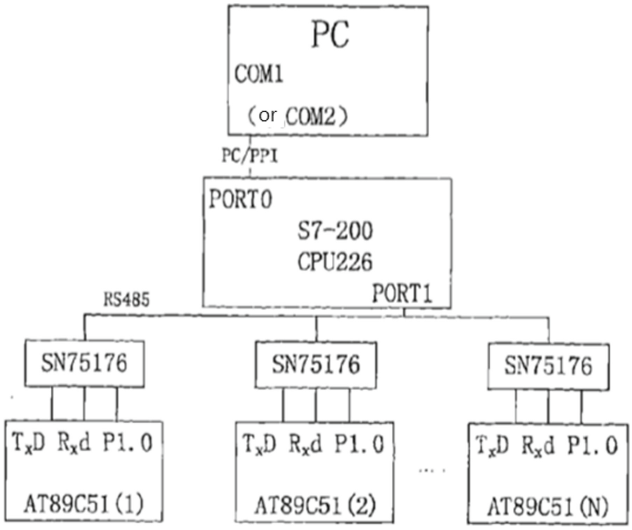

Fig. 1. Structure of terminal controller

3.4 Greenhouse Intelligent Irrigation Management System

The greenhouse precision irrigation system takes the root layer soil moisture as the control index, controls the root layer soil moisture according to different growth stages of crops, and determines the irrigation time and irrigation quota. The whole irrigation control system is composed of upper computer software system, regional control cabinet, shunt controller, transmitter and data acquisition terminal, which is organically combined with the water supply system to realize intelligent control. Transmitter (soil moisture transmitter, flow transmitter, etc.) will monitor the irrigation status in real time. When the soil moisture in the irrigation area reaches the preset lower limit, the solenoid valve can be opened automatically. When the monitored soil moisture content and liquid level reach the preset irrigation quota, the solenoid valve can be closed automatically. The solenoid valve of the whole irrigation area can also be scheduled to work in turn according to the time period. Irrigation can also be controlled manually Irrigation and collection of soil moisture. The whole system can coordinate the work, implement rotation irrigation, fully improve the efficiency of irrigation water, save water and electricity, reduce labor intensity and reduce labor input cost.

4 Specific Application of Intelligent Water Conservancy Information System in Agricultural Water-Saving Irrigation

4.1 Application in Pollution Monitoring of Water Environment and Resources

In the process of water quality monitoring of the water resources monitoring system, water departments in different regions often use the water turbidity sensor of the water resources measurement and control terminal to obtain the amount of water resources from rivers, lakes or reservoirs. With the water conservancy monitoring software platform as the center, the water intake flow, pump / valve status and equipment power supply are automatically controlled, and the measurement of water intake is remotely controlled. For example, there are a large number of lakes in Hubei, Hunan and other areas. For the monitoring of lake water quality and water environment pollution, multiple water intake points in a certain area are often determined first, and then the wireless network communication network, water intake equipment and intelligent detection software are used to monitor the acidity, alkalinity, pH value, solids, chlorides, nitrogen and phosphorus pollutants, sulfur compounds and heavy metals of the water environment. After detecting that a variety of water pollution indicators exceed the standard, corresponding management measures shall be taken to control them.

4.2 Application in Surface Hydrology and Water Level Height Monitoring

There are many large and small rivers and lakes in different regions of China. The main purpose of dams built on rivers and lakes is to adjust the height of water level and control the change of water temperature. Then, in the face of flood disaster, a variety of sensing equipment are used for timely early warning, so as to reduce the loss of personnel, economic property and so on. For example, the water conservancy department needs to monitor the river water level, flow velocity, flow and rainfall change in unit time in real time, automatically alarm the monitored abnormal data, and automatically open the drainage and drainage ports by the dam body. Through the coordinated operation between different modules in the system, it is convenient for the staff to timely adjust the monitoring plan and the treatment plan of flood disasters, The implementation flow of the system topology is shown in Fig. 2.

It can be seen from Fig. 1 that the pressure type 1 float water level gauge and ultrasonic / Radar water level gauge are mainly used to obtain the data information of multiple hydrological monitoring points, including important areas and locations prone to flood disasters, and then collect the multivariate data through the hydrological telemetry terminal. Then by using GPRS CDMA. 4G and other communication technologies will transmit the received hydrological monitoring data resources to the water conservancy monitoring software platform, which will make processing and decision-making of surface hydrology and water level height.

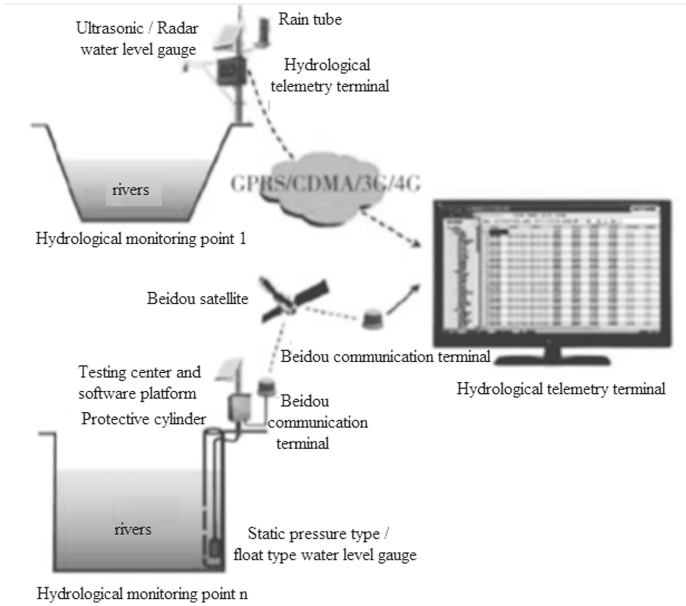

Fig. 2. Topology flow chart of hydrology and water level height monitoring system

The irrigation area module is mainly divided into three parts: irrigation area information, irrigation volume and equipment control. The interference of abnormal physiological functions of plants caused by water shortage is called water stress. Yang Yanfen, Du Taisheng and other examples have done relevant research on the change of soil moisture content during the growth of different crops. Through a large number of data research and summary, they found that the change law of crop water demand depends on the soil moisture content. Crops can grow healthily only when the moisture content in the soil is not lower than the value of water required by crops. Therefore, it is particularly important to master soil moisture content and crop water demand threshold.

Irrigation area information: it mainly displays the soil humidity and soil temperature in real time according to the soil humidity sensor and temperature sensor, displays the basic information of the irrigation area, analyzes the content of soil nitrogen, phosphorus and potassium in real time, and the soil temperature and humidity sensor. Through the computer display screen, it can intuitively display the temperature and humidity and solar sunshine of the test field in China, so as to facilitate the continuous understanding of observers or staff. Then take corresponding measures according to different changes. For example, selecting irrigation area 1 can add and delete temperature and humidity sensors and nitrogen, phosphorus and potassium sensors. Secondly, it can display the current soil temperature, humidity and the status of nitrogen, phosphorus and potassium in real time. The significance of this function lies in the unlimited addition of sensors.

Irrigation volume: mainly for irrigation volume, duration and periodic operation, it can automatically control the upper limit and lower limit of soil humidity. It can set the upper limit and lower limit of soil humidity according to different crops and local soil conditions, the time to start irrigation and the date of circulation. Note: when the upper limit and lower limit of soil humidity are set to 0, it means that the solenoid valve is manually controlled, The significance of this function is that it can achieve regular and quota irrigation according to different crops.

5 Conclusion

Using the intelligent information interaction technology of the Internet of things, this paper puts forward a complete construction scheme of water conservancy information system, and forms a water conservancy business service module with perfect functions around the monitoring directions of water environment pollution, surface hydrology or water level height, groundwater level or water temperature change, open channel irrigation water level and flow, which can solve the information problem of the development of regional water conservancy industry.

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