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Research Article

Water Conservancy Automation Monitoring System Based on VR Image Video and Internet of Things

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With the rapid development of science and technology and the widespread application of automatic control and wireless transmission technology, water conservancy automation monitoring system plays an important role in agricultural water conservancy and the automatic water conservancy monitoring system can conduct automatic water conservancy irrigation and monitor the growth of crop, greatly improving the efficiency of water resources management. However, there is still a certain gap between China and developed countries, mainly reflected in the two aspects of imperfect information resources and low level of data analysis and application, there are still technical deficiencies, and the training of high-end talents is relatively scarce, so there is still a big gap. The purpose of this article is to study the water conservancy automation monitoring system based on VR image video and the Internet of Things. This article first analyzes virtual reality technology and introduces Unity3D, the development engine of virtual reality, then introduces the Internet of Things and its key technologies, studies the classification of existing water conservancy automation systems, and then details the use of C/S Structured water conservancy automatic monitoring system. On this basis, this article combines VR and IoT technologies in the experimental part to design and implement a water conservancy automation monitoring system. Experimental results prove that the system designed in this article has certain theoretical and practical value for the development of water conservancy informatization. In this article, by creating 1000 concurrent users, the performance of the designed system is tested, and the response time of this system is 3.4 seconds.

1. Introduction

With the rapid development of the national economy, people's living standards have greatly improved, and society's demand for water resources has increased in both quantity and quality. However, due to the vast territory, large population, and obvious monsoon climate characteristics of the East Asian continent, the main feature of the monsoon climate in East Asia is the rotation of the monsoon and the obvious seasonal change in precipitation, uneven spatial and temporal distribution of precipitation, and complicated underlying surface conditions, drought and water shortages, flood disasters, soil erosion, and water pollution are still frequent in China. Therefore, the consequences are more serious. In the face of the severe water shortage and water pollution problems, people should take active actions to cherish every drop of water, adopt water-saving technology, and prevent and control water pollution and afforestation.

The proposal of digital water conservancy has gradually made people realize that informatization is the main trend of economic and social development in today's world. The frontier research field of the digital conservancy is the digital watershed. Although the digital earth is an important technical background proposed by the digital water conservancy, the natural extension of the digital earth is not the digital water conservancy but the digital river basin. Water conservancy automation refers to the full use of modern information technology, in-depth development, and extensive use of water conservancy information resources in the field of water conservancy engineering, strengthening project quality management, promoting information and digital data collection and processing, including the historical process of collection, transmission, and processing the water storage; service and remote monitoring of water conservancy facilities will comprehensively improve the efficiency and benefits of water conservancy projects.

Guan's team believed that considering the compromise between conflicting goals in water conservancy projects in an uncertain environment is a difficult task. They proposed two new piecewise functions, namely, double exponential function and quadratic function, to simulate the relationship between the construction quality of the project and the limit time, and developed a fuzzy multimode discrete time cost-quality-tradeoff model project. The highest quadratic function must be quadratic. The image of the quadratic function is a parabola that is parallel to the symmetry axis or coincides with the y-axis. The biexponential function refers to the function formed by raising the exponential function to the exponential function, which generally grows much faster than the same exponential base number exponential function. The model solves the NP-hard problem and uses particle swarm optimization to obtain the optimal solution; NP-hard refers to the problem in which all NP problems can rule within the polynomial-time complexity [1]. Damgrave believed that virtual reality (VR) is a manual copy of potential reality or conditions of use, enabling users to experience and/or modify and/or interact with it. These computer-simulated environments are mainly experienced through the perception of vision and sound. The VR system has the following key features: 3D representation and perception of real-time spatial interaction presence and immersion. VR handles real-time integration between computer simulation environments and human interaction. The VR environment stimulates the correct feeling at the appropriate time, thereby stimulating the user to experience the assumed reality or the use conditions [2]. Shancang et al. team believed that the Internet of Things (IoT) will support the connected Internet of Things with new features. They systematically reviewed the definition, architecture, basic technologies, and applications of IoT. First, they introduced various definitions of the IoT; second, they discussed emerging technologies for implementing the IoT. Third, it discusses some unresolved problems related to the application of the IoT; finally, the main challenges and corresponding potential solutions that the research community needs to solve are studied [3].

This article first analyzes the VR technology and its characteristics and describes the VR development engine Unity3D, then analyzes the IoT and its key technologies, then studies the classification of existing water conservancy automation systems, and details the use of the C/S structure of water conservancy automation monitoring system. The Client-Server (C/S) structure usually adopts a two-layer structure. The server is responsible for data management, and the client is responsible for interacting with users. On this basis, this article combines VR and IoT technologies to design and implement a water conservancy automation monitoring system. This article proves through experiments that the system has certain theoretical and practical value for the development of water conservancy informatization. The system has a highly interactive, safe access mode and fast response speed and is conducive to processing a large amount of water conservancy information data.

2. Proposed Method

2.1. Virtual Reality. Virtual reality (VR) is a new technology that has emerged in recent years. It combines computer technology, multimedia technology, image technology, simulation technology, and various electronic technologies to form a new technology in the computer field [4, 5]. Simply put, virtual reality (VR), where the scenes and characters seen are all fake, is to put your consciousness into a virtual world. Augmented reality (AR), where the scenes and characters seen are part true or part false, is to bring virtual information into the real world. VR technology is a computer simulation system that can build and let people experience the virtual world. The virtual world it builds has a strong simulation effect. VR technology is a very challenging interactive technology. VR technology includes computer, electronic information, and simulation technology; its basic implementation is the computer simulation of the virtual environment to give people a sense of environmental immersion. With the continuous development of social productivity and science and technology, the demand for VR technology in all walks of life is increasingly strong. The conceptual model of VR is shown in Figure 1.

2.1.1. The Composition of Virtual Reality. VR technology includes not only helmet, data gloves, and data clothing but also all related technologies and methods with natural simulation and real experience characteristics [6, 7]. It is very necessary to construct a harmonious human-machine environment that is closely similar to the objective environment, transcends objective time and space, can be immersed in it, and can be controlled in it [8]. In recent years, the first live 9DVR experience hall built based on VR technology has been realized. Since its completion, the first live 9DVR experience hall has had a great influence on the film and television entertainment market. This experience hall can make the viewer feel like being in a real scene and immerse it in the virtual environment created by the film. Real experience and natural human-computer interaction are its most important goals. A system that can partially or fully achieve this goal is called a VR system. A typical VR system should include the following five parts: virtual world, computer, VR software, and input and output devices. The composition of VR is shown in Figure 2.

2.1.2. Features of Virtual Reality. Immersion, interactivity, and imagination are the three basic characteristics of VR technology [9, 10]. In the VR system, people's leading role is further emphasized from only observing the processing results from the outside of the computer, to immersing in the

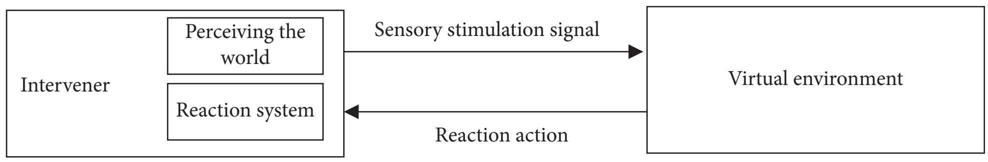

Figure 1: Conceptual model of virtual reality.

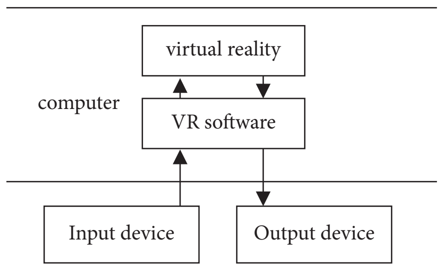

Figure 2: The composition of virtual reality.

virtual environment constructed by the computer, from using only the keyboard and mouse to interact with the single-dimensional digital information in the computing environment to the multidimensional information environment interaction [11, 12].

Immersion, also known as presence, refers to how much the user feels as the protagonist in the simulated environment. The ideal simulation environment should make it difficult for users to distinguish between true and false so that users can devote themselves to the three-dimensional virtual environment created by the computer. Everything in the environment looks real and sounds real, and movement is real; even everything that smells, tastes, etc. is real, just like in the real world.

Interactivity is the user's operability of objects in the simulated environment and the natural degree of environmental feedback (including real-time). For example, users can use their hands to directly grab virtual objects in a simulated environment. At this time, the hands feel like they are holding something; they can feel the weight of the object. Objects in the field of view can also move immediately as the hand moves.

Imagination emphasizes that VR technology should have a wide imagination space and widen the scope of human cognition and not only can reproduce the real existence environment but also freely conceive the objective nonexistent or impossible existence environment.

Since the initial characters of the three features of English words are immersion, interactivity, and conceptualization, they are all I, so these three features are also collectively referred to as 3I features.

2.1.3. Unity3D. Unity3D was originally a game engine because it has virtual 3D scenes, physics engines, 3D sound, and other virtual reality engines and is used as a development engine by many virtual reality developers at home and abroad, including VR shopping, education, tourism, sports, and real estate [13, 14]. Unity3D supports models exported by 3D modeling software, such as 3DMAX, which can be easily imported into Unity3D projects and can be readjusted in Unity3D to modify the model directly in the Unity3D interface. In Unity3D's development mode, the visual model in the interface is used as the main drag and drop, and the program code is used as a script to supplement the complexity of the software and speed up the development cycle. So Unity3D is not only a 3D modeling software but also a game development engine and a VR graphical development software. Uniyt3D supports both C# and JavaScript programming languages. Developers can quickly write program scripts and assign them to model objects through a graphical interface. With a convenient editor, VR software can be developed in a short time.

(1) View of Unity3D. Scene view: the scene view is an interactive view. All objects, environments, and cameras in VR are edited in this view, and they can be simply panned, dragged, and enlarged by the mouse. In the scene, the camera is equivalent to the human eye. When the system is running, the content that the user sees through the screen comes from the camera. In the scene view, the camera can be moved, which is convenient to find the most suitable perspective and increase the reality of the experience. The sky box and lighting have a very large auxiliary effect on the experience when the software is running, and it is also very important to edit them in advance.

Game view: when testing the running effect, you will use the game view. The scene you see here is the same as the game running time. With its help, the developer can quickly lay out and preview the scene. The camera is the user's eye. When you need to switch scenes frequently, modify the weight value of each camera. The larger weight will be displayed first, and the lower weight will not be displayed, which is great for fast switching scenes. FPS can evaluate the rendering effect when the scene is running. Usually, developers will print it to the upper left corner and optimize the rendering while observing it. When the game is running, the changes will not take effect; developers can debug the program at run time.

Hierarchical panel: the hierarchical panel displays all objects in the scene in the form of a tree list. It has a one-to-one correspondence with the objects in the scene view. Both of these panels can delete objects. The hierarchical panel also has a role in setting the hierarchical relationship between objects. In Unity3D, if the relationship between two objects is a parent-child relationship, the child objects will also move when the parent object moves. For example, if the camera is set as a subobject of a bicycle when the bicycle moves, the camera will also follow the movement, and the two objects are relatively stationary, but when the camera makes a selection, the bicycle will not follow the selection. With this feature, you can simulate a person riding a bicycle operation.

Project panel: the project panel is a mapping of local folders. After importing the resource folder, they can be managed in the project panel. Virtual objects are generally saved in Prefab format. When an object appears multiple times in a virtual scene, each style can be different. Their parent only needs to save one, which can facilitate the management and utilization of resources. There is a search button at the top of the panel; you can quickly search for materials and textures, saving search time.

View panel: after selecting an object in the hierarchy bread or project panel, you can view the detailed properties of the object in the view panel, such as coordinates, rotation, and zoom, as well as detailed parameter settings. The script in Unity3D generally adopts the custom mode by default; drag and drop the script into the inspection panel, and the game parameter setting can be performed. The view panel also supports the preview function. For textures and materials, you can preview them before deciding whether to add them to the view.

(2) Features of Unity3D. As a powerful VR engine, Unity3D can use our many features to optimize our development process during development. Its characteristics are as follows:

External resource import function: Unity3D can make simple modifications to the model, but it is still much worse than no professional modeling software. Unity3D provides a powerful external resource import function, and popular modeling and animation software, such as models and animation files exported by tools such as 3DS MAX, Maya, and Blender, can be well integrated into Unity3D, using its own editing tools. Make simple modifications to achieve the best results.

Physics special effects: Unity3D has a physics engine, imitating Newtonian mechanics, using parameters such as mass, gravity, speed, and friction to set different gravity parameters for an object; you can clearly see the different changes. Unity3D has a built-in PhysX physics engine developed by NVIDIA, which can accurately and conveniently develop the required physical special effects, which improves the development efficiency.

Script support: script is a key language for Unity3D to achieve interaction. It is different from general development languages. Scripts act like hearts in virtual reality scenes, controlling the movement of objects, the movement of characters, sunrise and sunset, and changes in behavior. Unity3D supports three scripting languages: C# is one of the most widely used. The function of the C# game script inherits from MonoBehaviour class, which can be run in Unity3D. Like native C#, it has object-oriented programming and network communication programming.

Particle system: realistic scenes and smooth running of the system are important criteria for measuring the virtual reality engine. Unity3D integrates the particle system, which can simulate realistic effects such as heavy snow and flames, eliminating the need for complex programming. The particle system continuously deforms and moves, the old particles are destroyed, and new particles are generated to form a dynamic particle effect. The particle system has been integrated into Unity3D and can be quickly set up directly during development.

Delayed rendering: delayed lighting systems can improve rendering performance. Even if hundreds of point light sources are created in the scene, now only a small amount of performance loss is required to complete this complex task. Delayed lighting uses a G buffer. For some reused effects, there is no need to generate them again. Reading from the buffer area can quickly complete the rendering effect without too much additional performance loss.

2.2. Internet of Things

2.2.1. Internet of Things. The IoT is a device that uses information sensing equipment such as wireless network sensing technology, radio frequency identification technology equipment, laser scanners, global positioning systems, and other digital and networking objects and connects the Internet to any item through a specific network protocol, and it can carry out the information interaction between objects, objects, people, and people and finally form a network of intelligent identification, positioning, tracking, management, and monitoring of items [15, 16].

2.2.2. Internet of Things Architecture and Key Technologies. The IoT enables objects to possess certain wisdom through the realization of communication between people and things, which is a unique value embodiment of the IoT and a new feature [17, 18]. The architecture of the IoT includes a perception layer, a network layer, and an intelligence layer, that is, comprehensive perception of objects, transmission and sharing of sensed information, and intelligent processing. How to promote the better development of the IoT at this stage and apply the advanced technology of the IoT to all aspects of life requires that we can master the key technologies in the IoT system.

(1) Key Technologies of Perception Layer. The perception layer realizes the basic recognition of objects and an extensive collection of data. There are the following four key technologies. RFID radio frequency identification technology is a noncontact automatic identification technology with convenient operation, small identification error, and strong anti-interference. It consists of a tag that can store information, a reader that reads and writes the tag data, and an antenna that receives the transmitted signal. RFID technology uses radio frequency to automatically identify communication objects and perform contactless two-way communication. When the tag is outside the range of the reader, it is in a dormant state, and once it enters this range, it will be activated, and the information will be transmitted through the antenna. The reader will decode and enter the received information and then transmit it to the computer system for processing.

WSN (Wireless Sensor Network) technology is composed of a large number of miniature wireless sensor nodes deployed in the monitoring area, and these nodes will form a network system through wireless communication to realize the perception, collection, and processing of object information in the monitoring area, and transmit the information to the monitor.

GIS (Geographic Information System), which is based on geographic data, supplemented by a computer system, manages geographic data and can provide management information systems for all industries to manage maps and assist decision-making services.

GPS (Global Positioning System) is a positioning method that combines modern communication technology, satellite positioning, and navigation. It can realize real-time, uninterrupted, and accurate navigation and positioning. GPS can be combined with a communication network to monitor and track items in circulation.

(2) Key Technologies at the Network Layer. The middle layer of the IoT architecture is the network layer, which is mainly used to realize the important layers of data exchange, information transmission, information feedback, routing, and system control between the perception layer and the intelligent layer. After the data information is transmitted from the perception layer to the network layer, the network layer can integrate the received data information and transmit it through mobile communication technologies such as 3G/4G/5G or wireless network communication technologies such as WIFI. The main technologies are 3G/4G/5G mobile communication technology, WIFI technology, LAN technology, and Internet technology.

(3) Key Technologies of the Intelligent Layer. The last layer in the architecture of the IoT is the intelligent layer, which can provide services for users and improve user satisfaction with its powerful information processing capabilities and intelligence. The main technology is cloud computing technology, which is a supercomputing model that uses its intelligent data storage, computing, and search capabilities to transform resources into a form of service and then improve it for users, reducing operating costs.

2.3. Water Conservancy Automation Monitoring System. Water conservancy automatic monitoring system is an inevitable product of technological development and technological progress [19]. The so-called automatic monitoring of water conservancy is the process of analyzing and judging important data that needs real-time monitoring and mastering in water conservancy work through hardware presets and software programming so as to automatically make control actions [20, 21]. The system replaces the physical work of water conservancy workers or a part of auxiliary mental work.

Water conservancy automation monitoring system is generally divided into six major parts: dam safety automatic monitoring system, rainwater condition automation monitoring system, gate automation monitoring system, pump station automation monitoring system, hydropower station automation monitoring system, and farmland water conservancy automation monitoring system [22, 23]. The water conservancy automation monitoring system that has been built and put into use generally adopts a C/S structure. The system structure is roughly divided into monitoring center subsystem, on-site monitoring terminal subsystem, and data transmission channel subsystem.

The monitoring center subsystem is the core of the entire system, generally including the monitoring host (server or industrial computer), output devices (printers, audio equipment, and monitoring large screen), system software, and databases [24, 25]. The system operator monitors the system data in real time through the operating platform software. The monitoring platform software is mainly for database design, R&D of control service programs connected to the on-site monitoring terminal subsystem, and R&D of user-side service modules. The monitoring subsystem generally makes full use of data fusion, integration and management technology, data search and query technology, and network communication technology to keep the control service program connected to each monitoring terminal, 24-hour uninterrupted operation, providing information collection and control such as flow soil moisture, and can save the collected information directly to the database. The system operator can conveniently perform data management, query, statistics, compilation, and output on the data in the database through the user service module and can control the on-site monitoring terminal subsystem through the control service program to realize manual collection and real-time collection.

The on-site monitoring terminal subsystem is generally various sensors, such as water level gauge, rain gauge, soil moisture sensor, and camera. These sensors convert all kinds of monitoring data into standard signals, such as analog signals, 485 serial port signals, optical signals, transmit them to communication terminals, and then transmit them to the monitoring platform of the monitoring center subsystem through the data transmission channel subsystem for data processing and storage. Most water conservancy monitoring data transmission channel subsystems are mainly wired data channels, and wired data channels are mainly divided into electrical signal data channels and optical signal data channels. The electrical signal data channel is divided into an analog signal and a digital signal. The analog signal is mainly a video analog signal and 4–20 mA communication analog signal, and the digital signal includes RS-485, RS-232, and video digital signal. The optical signal mainly refers to the signal transmitted in the optical cable. Because the optical cable has a multimode and single mode, the optical signal also has a multimode optical signal and a single-mode optical signal. A single-mode optical cable is suitable for systems with long communication distances, while a multimode optical cable is suitable for systems with distances within 3 kilometers. Optical signal transmission speed is fast, and the channel bandwidth is the widest among all communication channels. Therefore, optical cables have always been the first choice for important main communication channels, such as intercontinental optical cables and national main communication optical cables. However, optical signals can only be compiled and accepted by mainstream communication equipment after they are converted into standard digital signals by optical transceivers or photoelectric switches. Therefore, optical signals are an extension and auxiliary transmission method of electrical signals.

3. Experiments

3.1. Data Collection. A hydropower station is a third-level hydropower station with an installed capacity of 2×2000 KW. Water sources mainly come from irrigation and drainage, flood discharge in flood season, and water supply from water conservancy projects. The reservoir has completed the danger elimination and reinforcement project, which will not only ensure the irrigation water in the area is effectively guaranteed but also make the social and economic benefits of the construction of the hydropower station prominent. The data in this article are derived from the data generated during the daily operation of the hydropower station.

3.2. Experimental Environment

3.2.1. Development Environment. The development environment of the experiment in this article is divided into hardware environment and software environment, including server and development tools. The development environment configuration is shown in Table 1.

3.2.2. Component Equipment. Because the equipment is mostly electronic products, the monitoring computer room should be far away from strong magnetic fields, pollution sources, and dust; install the fire alarm device in the computer room, the fire extinguisher should be placed in a convenient place, and the entrance should be kept clear. The system components designed in this article are shown in Table 2.

3.3. System Architecture. The water conservancy automation system can be divided into a monitoring center unit (including communication network and monitoring management software part), local monitoring unit (working condition observation and hydrometeorological monitoring), video monitoring unit, and lightning protection unit. The overall functional structure of the water conservancy automation system is shown in Figure 3.

The water conservancy automation system mainly includes water and rain data collection system, dam safety monitoring system, gate monitoring system, video monitoring system data collection, transmission, management, and historical data statistics, to achieve a comprehensive information query system, to achieve local area water conservancy management information query, basic functions such as information output and data export, provide information query for remotely connected superior departments through remote transmission software, and provide data basis for water conservancy scheduling.

4. Discussion

4.1. System Function Module

4.1.1. Hydrometeorological Monitoring Module. Hydrometeorological monitoring is an important basis for dam safety monitoring of water conservancy facilities, water regime forecast, flood control safety monitoring, operation of water conservancy facilities, water resource utilization, and regional flood control and drought prevention and command dispatching. According to catchment area and the terrain characteristics of water conservancy facilities, the construction of the dam before water rainfall regime monitoring stations, meteorological and hydrological database, collection and processing module and information monitoring technology, network technology, computer technology to the water conservancy facilities (reservoir, hydropower, irrigation area, river basin, river, lake) site of water level, rainfall, wind direction wind speed, pressure, temperature, and flow rate, such as the automatic real-time data acquisition, transmission, and storage. Timely and accurately obtain the water and rain information in the monitoring area, and make corresponding alarms based on the early warning value to provide a decision-making basis for the management center's water-related scheduling. The hydrometeorological monitoring module is shown in Figure 4.

It can be seen from Figure 4 that the hydrometeorological monitoring system mainly includes three modules: real-time hydrometeorological data monitoring, rainfall monitoring, and flow monitoring. This article shows the real-time monitoring page of hydrometeorological data. The module includes three measuring points: the measuring point of the water discharge tower, the measuring point of the main dam, and the measuring point of the reservoir area. It can be seen from the monitoring data that the water level measured by the water discharge tower of the reservoir is 190 meters, and the rainfall during the period is 3.5 millimeters. The measured flow of water from the main dam was 20 cubic meters per second. The rainfall in the reservoir area during the measured period was 5 mm.

4.1.2. Dam Safety Monitoring System. The dam safety monitoring system is mainly responsible for collecting, processing, and storing the monitoring data of the local collection unit, that is, the osmometer and other sensors, providing data support for statistical analysis of the data, so that the system can analyze the data to complete the construction of the mathematical model, scientifically realize the dam safety model, and do a good job of dam safety operation and management. At the same time, make corresponding alarms based on the early warning value, and provide a decision basis for the management center's water conservancy-related dispatch. The dam safety monitoring system is shown in Figure 5.

Table 1: Development environment configuration.

Hardware environment	Server CPU	Core i5
	Processor RAM	8 GB
	Client CPU	Core i5
	Processor RAM	8 GB
Software environment	Operating system	Windows 10
	Development language	C#, Java, JavaScript, Python
	Development tools	Unity3D development engine, Eclipse, PyCharm, Navicat
	Background database	MySQL

Table 2: Components.

No	Device name	Quantity
1	Server	1
2	Video surveillance station	1
3	Console	1
4	Sensor	Several

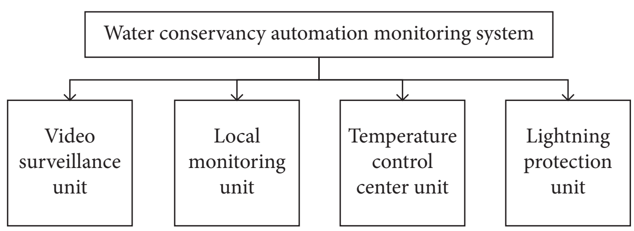

Figure 3: Overall functional structure of water conservancy automation system.

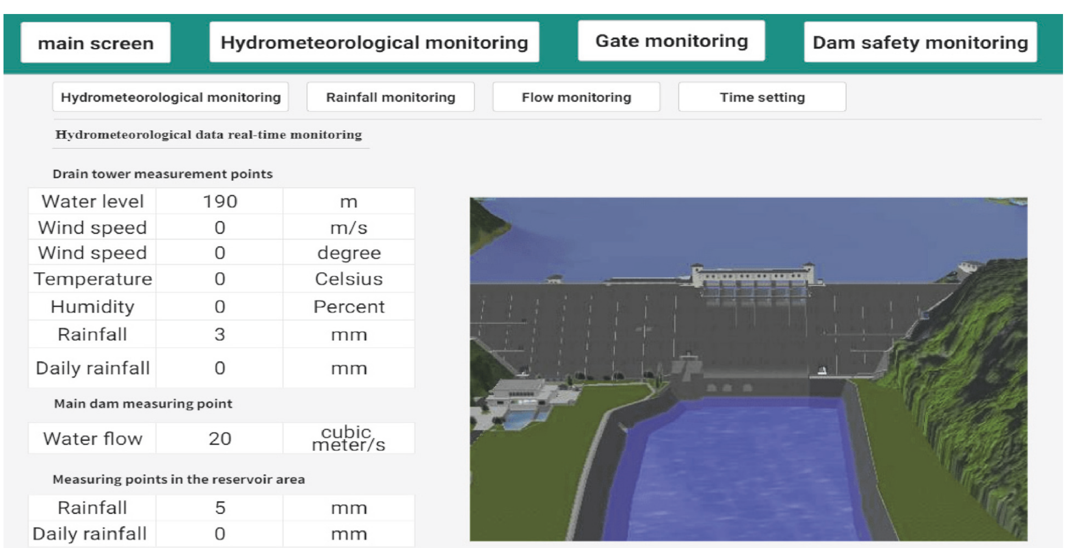

Figure 4: Hydrometeorological monitoring module.

As shown in Figure 5, after entering the dam safety monitoring screen, the user can check the seepage pressure status of each section. The system realizes the alarm by setting the upper limit of seepage pressure. The main functions of the dam safety monitoring system are safety monitoring information query, dam safety monitoring, and dam operation safety analysis. Among them, the safety monitoring information query mainly includes querying various monitoring information of the safe operation of water conservancy facilities, dynamically displaying the data collected by the water facility safety monitoring system and the real-time monitoring system and generating

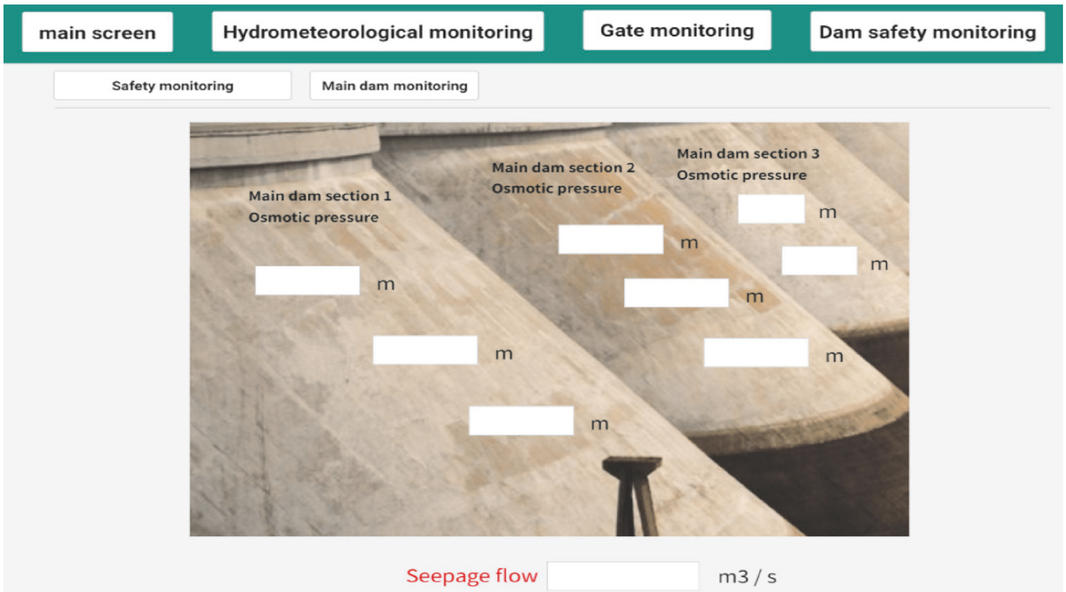

Figure 5: Dam safety monitoring system.

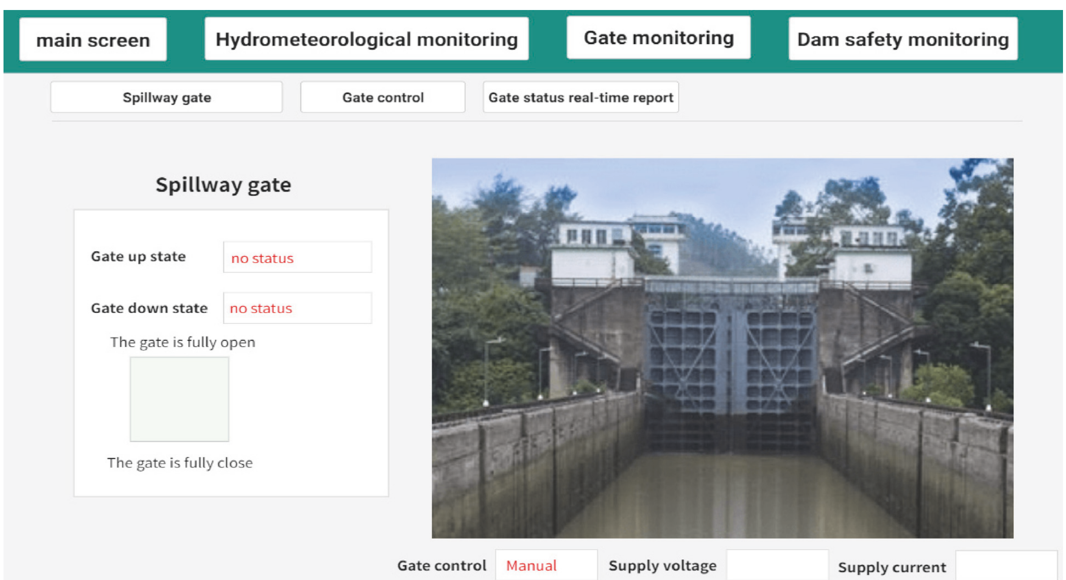

Figure 6: Gate monitoring system.

corresponding process curves; dam safety monitoring mainly includes the safety of water conservancy facilities. The monitoring system and real-time monitoring system combine to realize automatic control processes such as flood discharge process monitoring; dam operation safety analysis mainly includes the design standards of water conservancy facilities, rain conditions, construction conditions, water conservancy facilities, dam safety monitoring, and history of water conservancy facilities. The stability analysis of the database and the dam analyzes the safety of the dam and warns of possible dangers.

4.2. System Function Module and Performance Test

4.2.1. Gate Monitoring System. The motor switch is controlled by triggering the PLC input and output module, and the opening data collected by the travel switch is used to realize the remote control of the water conservancy facility gate. Users can make scheduling decisions based on the above water and rain conditions and dam monitoring and collection data and send gate switch commands through the management center computer to automatically realize gate monitoring and management. The gate monitoring system is shown in Figure 6.

Table 3: System performance test results.

User	100	200	300	400	500	600	700	800	900	1000
Server CPU usage (%)	8.81	18.12	20.1	22.23	27.9	30.34	31.23	40.18	49.33	56.37
Server RAM usage (%)	9.14	22.11	24.54	26.94	26.21	29.04	34.45	39.11	51.33	57.13
Response time (s)	0.1	0.2	0.25	0.37	0.8	1.2	1.7	2.0	2.5	3.4

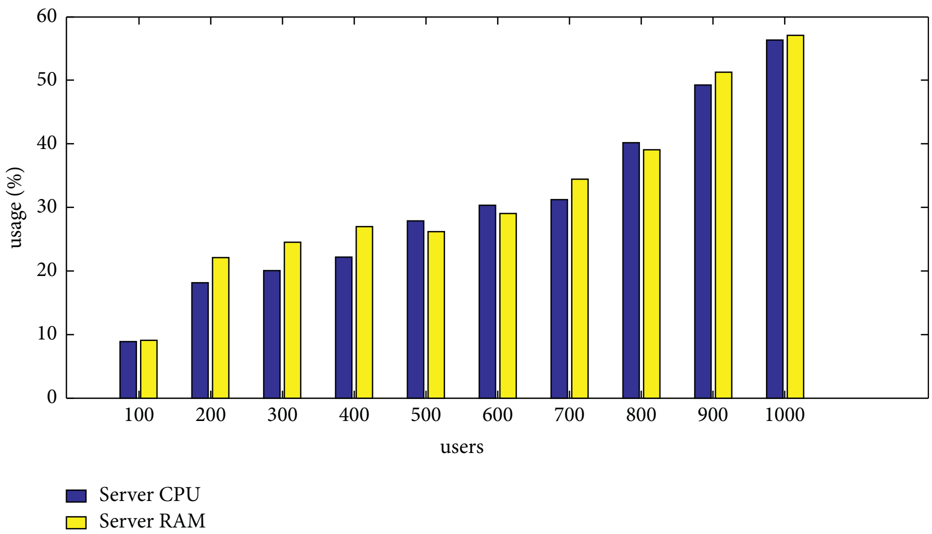

Figure 7: System performance test results.

As shown in Figure 6, the gate control screen displays the lift of the gate in an animated way through the effect simulation diagram and displays the opening value in real time; in the gate control area, the gate can be automatically raised and lowered to the desired position by setting the opening value. The gate monitoring system is a system that remotely monitors the gate up or down status, opening status, and fault alarm status and provides a good man-machine interface display through graphics. The gate monitoring system is also based on the basic data of the local collection unit and the realization of all functions. All come from the local collection unit platform.

4.2.2. Analysis of System Performance Test Results. The performance test of the system is to test whether the real performance of the system can meet the requirements of users. The main concern is whether the response time of the entire system, CPU, and RAM utilization rate can reach the standard under the busy usage of collective users. The water conservancy automation monitoring system designed in this article is tested on the server with the LoadRunner tool. The system performance test results are shown in Table 3 and Figure 7.

As shown in Table 3 and Figure 7, when related to business operations, the average response time of the system is within 3 seconds; if a large number of statistical data analyses take place, the average response time is allowed within 5 seconds. When the number of concurrent users is 1000, the CPU usage of the application server and database server must not exceed 60%, and the memory usage cannot exceed 60%.

5. Conclusions

(1) This article uses VR and IoT technology to design the main structure of the water conservancy automation monitoring system and discusses the realization of its main functions. The design and application of this system are of great significance to the reliable, safe, accurate operation of water conservancy systems and the automation of water conservancy projects. It also provides a reference for the automatic operation of urban flood control systems and sluice systems.

(2) The performance test of the water conservancy automation system is carried out in this article. The system module test results are all passed. The performance test shows that the response time reaches 3.4 seconds when the number of virtual users reaches 1000, which shows that the throughput has reached $1000/0.75 = 1333$, far exceeding the concurrency requirement of the system, should meet 1000 users to access the same time, and will not crash; the system reaction time can be within 5 s.

(3) Although this article implements a water conservancy automation system based on VR and the IoT, it needs to further improve the immersion of the system. One of the outstanding advantages of VR technology is that it can give participants a sense of immersion, thus improving the efficiency of management. The higher the immersion of the system is, the greater the help to the manager is, and the more focused the manager's attention is; thus, it is possible to achieve more efficient results.

Data Availability

This article does not cover data research, and no data were used to support this study.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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