Intelligent decision-making system for realizing the automatic control of Yangzhuang sluice based on the internet of things technology

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Abstract—Yangzhuang sluice is located on the Gaoyou Lake control line of the Huaihe River into the Yangtze river and was built in May 1970. Due to the inherent insufficient design and historical reasons, Management Office has been using manual operation scheduling management of the sluice gate. The safety risks are large and the scheduling accuracy is not high. In order to further improve the comprehensive scheduling performance of sluice and enhance the scientific level of scheduling management, establish automatic control system, automatic control to realize power distribution system and gate, meet the requirements of “unattended, less people on duty”, and build sluice management system based on the Internet of Things system, realize the automatic monitoring and management of sluice, which is also the development demand of modern water conservancy.

1. Introduction
Engineering operation monitoring and scheduling of the gate station, comprehensive monitoring of water environment, comprehensive management of unit business, peripheral security and sustainable utilization of engineering facilities need the information gate station as the guarantee, and automation and informatization are the key to improve the level and efficiency of the gate station management. Gaoyou city entry Yangtze river waterway management office as a watershed management unit, is the front position of flood control and drought relief, flood warning and rapid response[1], which needs to use automation technology and information technology to comprehensively improve its own management level. The project takes Yangzhuang diffuse sluice as a pilot project and adopts the Internet of Things technology to realize the architecture of automatic control and information system. It mainly includes: engineering automation control, video monitoring, access control, gate station operation situation monitoring, rainwater situation monitoring, water conservancy project 3 D visualization and other gate station information collection system and advanced application system.

2. The research basis of applying Internet of Things technology
In the article “Intelligent water conservancy system based on Internet of things”, Rui Xiaoling and others pointed out that intelligent water conservancy system based on internet of things technology integrates all kinds of cutting-edge Internet of things technologies into one system, and can combine them organically, give full play to the efficiency of each subsystem.

According to the research and application of multi-agent decision system for gate station scheduling under the Internet of Things environment of Wang Wenming, the intelligent dispatching
system of water conservancy gate station based on Internet of things and MULTI-agent decision technology is realized by using Internet of things decision support technology for gate station and river water level of Lianyungang.

3. System design
Through the organic integration or development of various subsystems including automatic control, safety monitoring, water and rain conditions, gate monitoring, video monitoring, 3 D visualization, and office automation, Establish an automatic control and information system for gate station engineering. Using advanced and practical Internet of Things technology, automatic monitoring technology, video monitoring technology, security monitoring technology, Realize real-time monitoring, monitoring and management of Yangzhuang sluice site. Basically reached the management level of few people on duty and unattended on duty[2]. The resource sharing and scientific dispatching are realized, and the economic and social benefits of the gate station are brought into full play.

4. System framework
“Yangzhuang sluice automatic control and information system” is based on the research and demand analysis, combined with the current development trend and application maturity of information technology, for the management of automation, standardization, digital and fine management of the gate station, the development and application of the project system. In general, the system development adopts the design idea in line with the Internet of Things system architecture and the current advanced “cloud, pipe and end” integrated system architecture in the industry.

4.1. “Cloud”
“Cloud” refers to the application of cloud computing at the gate station established by the management office. The core of the construction is to uniformly manage and schedule a large number of computing resources connected by the network, and form a computing resource pool in the management office to realize on-demand services.

4.2. “Management”
“Tube” refers to intelligent pipelines. By undertaking the comprehensive platform and information application upward, the user system and user terminal of the gate station provide users with collaborative service from the underlying network to the upper information application[3], and provide high-speed intelligent channel for the management office in different scenarios of the gate site, office and mobile office.

4.3. “End”
“End” as a service carrier covering the end user, is the Internet of Things connected sensor network layer and transmission network layer, realize the data collection and send data to the network layer equipment [4], it includes gate engineering automation control system, all kinds of sensors, cameras, access control, etc., responsible for data collection, preliminary processing, encryption, transmission and other functions [5].

5. Gate station information management software architecture
On the basis of considering the existing information system of the management office, adopts program development and deployment. The system structure includes data access layer, business logic layer and performance layer to realize “high cohesion and low coupling”, reduce the coupling between modules and enhance the maintainability and scalability of the system [6]. The system logic composition is mainly composed of support layer, data layer, service layer, business application layer and display layer. The development of the system is supported by relevant technical standards and
regulations, safety and operation and maintenance, including the logic layers of data collection, data storage, business application and user application [7].

The gate station information management software architecture generally adopts cloud 3D GIS technology architecture, cloud 3D GIS technology based on SOA service framework and distributed deployment framework, providing high concurrency, high reliable, scalable 3D geographic information services. System interface: establish central database according to the provincial water conservancy standard database and leave interface for superiors. The technical system framework can be divided from bottom first into software infrastructure layer, geographic information data layer, geographic information service layer, and geographic information application layer.

(1) Software infrastructure layer. It mainly includes various types of operating systems (Windows and Linux).

(2) The Geographical Information data layer. It mainly includes geographic information resource repository, geographic information resource metabase, and geographic information service metabase. The geographic information repository is responsible for storing all kinds of geographic data (vectors, grid, 3D model, multimedia, etc.). Geographic data resource metadata of various geographic data; and geographic information service metabase is responsible for recording all kinds of online geographic information service metadata to facilitate service discovery and calling. The layer also includes spatial data engine systems, distributed database systems, and distributed file systems.

(3) Geographic Information service level. Including online geographic information service system, intelligent service collaborative system, geographic information catalog service system, and resource production system. This layer realizes the integration, processing, service release and other operations, based on all kinds of geographic data, provides online geographic information services through geographic information Web services and service application systems, and provides the efficient retrieval function of online geographic information services.

(4) Geographic information application layer. Application layer is based on various industry applications of basic SDK, rich client API, and mobile API. This layer provides the GIS access proxy API to access the geographic information services provided by the cloud to achieve the goal of reducing development costs and shortening the development cycle.

6. Reconstruction design of communication and computer network system

6.1. Reconstruction of the control room

Adding Computer Network Equipment and circuit in conference room, Adding two gate station information management application servers. A large-screen graphics workstation is added to the conference room. The server can improve the hardware resource configuration according to the system performance and redundancy requirement, the storage capacity of the server is currently estimated to be ≥2 TB, late capacity can be dynamic expansion.

6.2. Network section

The system network topology is connected to the special network, connected with the existing automation, information system and video monitoring system, and the control room and Yangzhuang sluice local equipment use ring network to ensure real-time communication. A fixed public network IP is added in the machine room of the management office as the (reserved) wireless monitoring station and the mobile terminal public network access node.

(1) The automatic control subsystem. The new building set of automatic control system (including 1 monitoring software) in Yangzhuang sluice, mainly control the 26-well gate, distribution device, etc. The new building new set of field monitoring equipment, including: gate level meter (opening meter), upstream and downstream water level meter, gate engineering safety monitor and other equipment.

(2) Intelligent video monitoring system. The new building set of intelligent video monitoring system was built in Yangzhuang sluice, and the new building set of face recognition access control system was built.
(3) One set of information management software of gate station. One set of gate station information management software will be built in Yangzhuang sluice, including 1 set of PC version of gate station information management software (control center software), 1 set of gate station information visualization large screen software, 1 set of 3D visual touch screen software, and 1 set of APP version of gate station information management software.

7. Application effect
Through the construction of sluice station standardized database and gate monitoring software data integration system, can intuitively express the change of Gaoyou lake water regime, provide decision making basis for scientific accurate scheduling, realize the sluice station and Gaoyou lake intelligent real-time monitoring management, real-time monitoring management, intelligent scheduling management, plan management and other based the Internet of things of intelligent semantic decision support technology[8].

Through the construction of video monitoring, access control, automatic water and rain information monitoring points, the system realizes the global information resources (hardware, software, network and data) sharing [9], the system can really play a decision support role in the gate station operation management and command scheduling decision-making, greatly improve the management office in
water conservancy engineering safety, water and rain monitoring ability. Management office according to the water and rain situation information, using computer methods for analysis and comparison, put forward reasonable gate automatic, semi-automatic operation control plan, emergency disposal plan, etc., realize scientific scheduling, do timely find problems, make decisions, solve problems, to ensure the safe operation of the project and the local people's lives and property safety [10].

8. Conclusion
Based on the internet of things system architecture construction gate management information system, management office reached the “one picture” and “one table” information management level, can timely and accurately formulate scientific and reasonable sluice scheduling scheme, realize the proposed sluice station control scheme, greatly enhance the efficiency and accuracy of staff operation Sex, gradually realizes the new gate station project scheduling management mode with “computer management mainly, manual assistance”, realizes the intelligent operation management, provides modern means for the accurate scheduling, rapid response and scientific decision-making of the management office, and improves the management efficiency.

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