

On site real-time monitoring system based on Internet of things

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Abstract. The Pearl River Delta water resources allocation project is a water conservancy project with the largest investment, the longest water transmission line and the widest water receiving area in the history of Guangdong Province. It is a strategic project to improve the water security in the Great Bay area of Guangdong, Hong Kong and Macao. It is a water transfer project with the highest water transmission pressure and the longest shield tunnel in the world. It is a long-distance deep tunnel water transmission project in the core area of the Pearl River Delta, It is also an ecological water distribution project in the Pearl River Delta.

Keywords: Water conservancy, AI, Structure.

1 Introduction

The Pearl River Delta water resources allocation project is a water conservancy project with the largest investment, the longest water transmission line and the widest water receiving area in the history of Guangdong Province. It is a strategic project to improve the water security in the Great Bay area of Guangdong, Hong Kong, Macao and the world

The water transfer project with the highest water transfer pressure and the longest shield tunnel is a long-distance deep tunnel water transfer project in the core area of the Pearl River Delta and an ecological water distribution project in the Pearl River Delta. There are the following engineering difficulties:

The line crosses many multi-channel river networks[1]. The project line crosses the core urban agglomeration in the Pearl River Delta, as well as many rivers, lakes, seas, railways and highways. It is difficult to select the site. It needs to cross 61 villages and railways subways in operation (under construction / Planning), 23 expressways / urban expressways, and 16 rivers with a river width of more than 100m.

The hydrogeological conditions along the project are extremely complex. The geological conditions are extremely complex[2], the environment is sensitive, the delta river network is dense, the soft foundation is deep, the stratum fluctuates and changes, and the engineering geological and hydrogeological conditions are complex; Dense

ground buildings, crisscross underground infrastructure, high requirements for deformation control, difficult construction and high risk.

The lining structure of water transmission pipeline is very complex[3]. The water pressure inside and outside the water transmission pipeline is high, and the tunnel lining design is difficult. At present, the lining structure design of deep buried high-pressure water conveyance shield tunnel lacks mature theoretical basis and successful cases at home and abroad.

It is difficult to select wide head water pump and supporting equipment[4]. Restricted by water source conditions and other factors, the variation range of water delivery flow of the project ranges from 20 m³ / s to 80 m³ / s. coupled with the resistance variation factors of long-term operation of the pipeline, the pump system needs to adapt to the head variation range of 16 m to 48 m, so it is difficult to select the type.

Large diameter steel pipe has high difficulty in anti-corrosion, transportation and installation. The diameter of water transmission steel pipe reaches 4.8m, and the manufacturing, transportation, installation and anti-corrosion processes are complex and technically difficult.

Reservoir resettlement in the core area of the Pearl River Delta is difficult. The core area of the Pearl River Delta has developed economy, dense population and scarce land resources, which makes it difficult to land acquisition and resettlement; There is a huge amount of waste slag from the excavation of the project, it is difficult to land acquisition of the waste slag yard and disposal of waste soil.

It is difficult to overhaul long-distance underground pipelines[5]. During the maintenance period of long-distance deep buried water conveyance tunnel, it is difficult to drain, ventilate and traffic, and it is difficult to operate and maintain.

2 Objectives and ideas

Project construction period. Build the overall structure of the "Pearl River Delta smart water conservancy project", build the business management system during the construction period, carry out on-site real-time supervision application based on the Internet of things and on-site intelligent management (see Fig. 1), realize the monitoring of people, machines, materials, methods and environment on the construction site, and monitor the construction progress, construction quality, project contract, project investment, project safety, project design Digital, information-based and intelligent management shall be realized during the construction period such as material procurement.

By integrating engineering monitoring, geological monitoring, on-site video, engineering data and other engineering construction related data, form big data for construction management, carry out intelligent analysis and auxiliary decision-making, and provide technical support for ensuring construction safety, scientifically controlling construction progress, ensuring engineering construction quality and improving the level of engineering construction management.

Project operation and maintenance period[6]. On the basis of inheriting the engineering data and application architecture during the construction period of the project, build an intelligent management architecture for dispatching and operation of the "Pearl

River Delta smart water conservancy project", and build a digital and mobile application support platform in combination with the key infrastructure construction of the "Pearl River Delta smart water conservancy project", so as to realize the digitization of all elements of water source project, data interconnection and sharing and intelligent application.

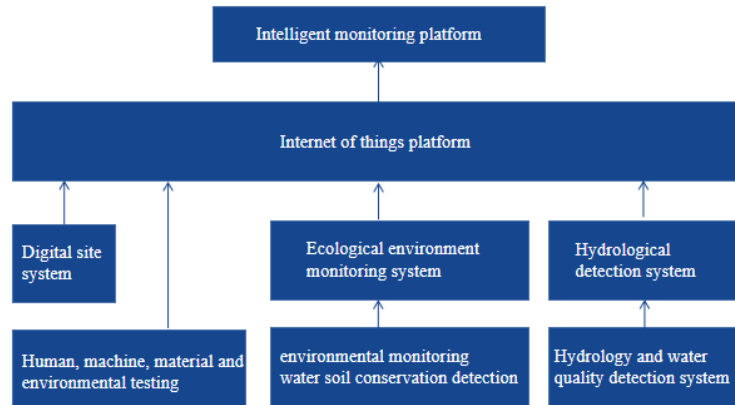


Fig. 1. Internet of things platform

By integrating various information resources such as water conveyance automatic monitoring, video monitoring, engineering safety monitoring, water regime and water quality monitoring, and making full use of technologies such as big data analysis, communication network, video monitoring, intelligent optimization decision-making, automatic control, remote sensing, geographic information system and three-dimensional simulation, a safe and practical Efficient and reliable three-dimensional visual intelligent dispatching decision support system for project operation management and water resources dispatching can realize all-round scientific management such as dynamic monitoring, prediction and early warning, decision and dispatching, improve the ability of water resources allocation, disaster prevention and safe and economic operation, and ensure the sustainable and stable development of regional economy and society.

3 Overall demand analysis

3.1 Digital China, smart society

Moving faster to make China a country of innovators. expand the implementation of major national science and technology projects, highlight key common technologies, cutting-edge leading technologies, modern engineering technologies and disruptive technological innovation, and provide strong support for building a strong country in science and technology, quality, aerospace, network, transportation, digital China and smart society ". As one of 172 major water conservancy projects for water saving and supply, the Pearl River Delta water resources allocation project is an important water

conservancy infrastructure in China. In the process of construction and management, it is necessary to adopt intelligent ideas, break through key technologies, meet the requirements of national innovative development and high-quality development, and provide strong support for Digital China and intelligent society.

3.2 Comply with the innovative development of water conservancy

Innovation is the driving force to lead the development of water conservancy and the strategic support to realize water conservancy modernization. In 2018, the Ministry of water resources clearly stated that by 2035, the modern water conservancy infrastructure network will be basically completed, the modern water treatment system will be basically formed, the water security guarantee capacity will be greatly improved, and the modernization of water conservancy will be basically realized. As the backbone project of modern water conservancy infrastructure network, the water resources allocation project in the Pearl River Delta faces the new situation and new requirements. In the construction process, it needs innovative development, further improve the management ability, improve the project quality, enhance the work efficiency, improve the execution ability, coordination ability and innovation ability, and keep up with the pace of water conservancy innovation and development in the new era.

3.3 Comply with the top-level design of intelligent water conservancy

The construction of smart water conservancy project is the focus and breakthrough of promoting water conservancy modernization, and the water resources in the Pearl River Delta

The configuration project needs to accelerate the construction of the Pearl River Delta smart project and strive to improve the level of project informatization. Build a full life cycle water conservancy project monitoring system with full factor dynamic perception to realize dynamic monitoring and comprehensive perception of water transmission lines and engineering facilities information; Build a high-speed ubiquitous engineering Internet of things to realize the interconnection of information of all participants in the project; Strengthen the construction of engineering data center and computing and storage capacity, build the infrastructure cloud of water resources allocation project in the Pearl River Delta, centrally store and manage the information of all elements of the project, and realize the coordination and sharing of all participants; Build an intelligent project management and decision-making platform to improve the intelligent management and decision-making ability, level and efficiency of water conservancy project construction and operation; Strengthen the construction of information security management and information disaster recovery system, ensure network information security, and strive to create conditions for the implementation of intelligent water conservancy demonstration.

4 Overall architecture design

In the preliminary design report, relevant planning has been made for the construction of the perception system, but according to the smart water.

According to the new requirements, there are still deficiencies in perception ability and intelligence level, and the level of intelligent perception needs to be further strengthened. By adopting new technical means and methods such as robots, UAVs, remote sensing satellites and Beidou Positioning, dynamically monitor and collect project related data in real time, collect, intelligently identify and analyze remote sensing images, video data and monitoring data, establish intelligent sensing means, and improve the sensing ability under complex conditions of water resources allocation project in the Pearl River Delta. In the whole life cycle of engineering design, construction and operation and maintenance, for the whole project objects such as hydraulic buildings, tunnels, pipelines, pump stations, gates, shield machines, tower cranes, construction personnel and construction environment, and for the whole management activities of engineering construction and engineering operation and maintenance, realize the dynamic perception of safety, quality, progress, investment, environment, water regime, water quality and other factors in the whole process, comprehensively and dynamically. Timely and accurately obtain the operation status of hydraulic buildings, electro-mechanical equipment, engineering personnel, engineering machinery, engineering materials, engineering environment and transported water body, so as to ensure the agile response to the engineering construction and engineering operation status.

Build a comprehensive and high-speed interconnected engineering information network, realize the high-speed interconnection and transmission of the network with full cycle, full object, full space-time and full coverage, and form an industrial control network, business network and Internet.

In the preliminary design report, optical fiber communication is used as the main communication mode, satellite communication and wireless intercom are used as emergency communication modes, which has high-speed and reliable communication conditions. According to the new requirements of smart water conservancy, the network communication system in the Pearl River Delta water resources allocation project needs to connect all elements in the Pearl River Delta smart project to provide transmission services for data transmission. Therefore, in addition to the above transmission methods, it should also combine 5g, Beidou satellite, industrial Internet and other communication technologies to realize the full coverage of the network of the Pearl River Delta water conservancy project. Build a water conservancy project information network covering the whole project to ensure the smooth transmission and timely delivery of monitoring information, management information, video information, project scheduling scheme and industrial control instructions of the whole project object, and ensure the rapid transmission and aggregation of IOT monitoring, business management, analysis and prediction data at different levels.

Build innovative and collaborative smart applications, realize collaborative linkage and information sharing of business applications, and improve the intelligent level of water conservancy projects in the Pearl River Delta.

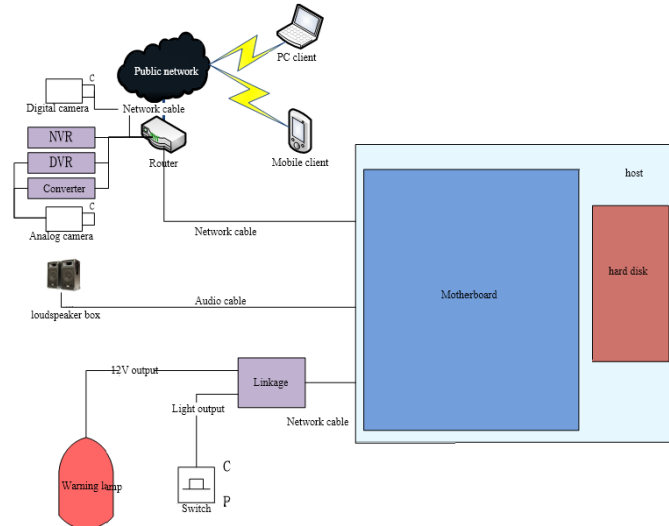


Fig. 2. IOT hardware device network

In the preliminary design report, the application systems in the construction period and operation and maintenance period are designed, but the application of data fusion between various systems is not shown, and there is a lack of support for the in-depth application of BIM, GIS and other technologies. According to the new requirements of smart water conservancy, in addition to the preliminarily designed application system, the smart application of collaborative innovation should integrate, mine and analyze all kinds of information resources under the support of the brain of the water conservancy project in the Pearl River Delta, fully cooperate with all parties in the construction period, operation and maintenance period and various application systems, and explore the application of BIM + GIS, electronic signature, smart site and other technologies.

The application of the whole life cycle of water resources allocation project in the Pearl River Delta realizes the refinement and accuracy of project construction management and operation. Based on the business support, service support, auxiliary decision-making and comprehensive operation and maintenance capabilities of the engineering brain, we will promote the refinement of engineering supervision, coordination of dispatching, automation of engineering operation and real-time emergency disposal, and promote a significant leap forward in the modernization level of water resources allocation project management in the Pearl River Delta.

Establish an engineering digital portal to realize the unified management, safe entrance and information release of the water resources allocation engineering information system in the Pearl River Delta.

In order to realize the sharing of information resources of water resources allocation project in the Pearl River Delta, promote the process of project informatization, better provide managers, business personnel and the public with information on project construction, management and services, accept public supervision, absorb public opinions, establish a good image and develop online business processing, according to the new

requirements of intelligent water conservancy and the needs of project operation management, Add new engineering digital portal, including Web engineering digital portal and mobile engineering digital portal. The engineering digital portal is mainly used to integrate the business application system in the project construction period and operation and maintenance period, extract and display relevant information, realize information release, public viewing of transactions, comprehensive information query, three-dimensional simulation and visual display, and provide users with unified login management to realize one login and access everywhere.

5 Conclusion

With innovation as the driving force, service as the main line, demand-oriented and application as the core, the project strengthens the application of new technologies such as blockchain, cloud computing, Internet of things, mobile Internet, big data and artificial intelligence, builds a big platform, forms big data, sets up a big system, provides big services, actively carries out ubiquitous Internet, service integration and intelligent application according to safe and practical The principles of being advanced and reliable, integrating resources, intelligent decision-making, unified planning, step-by-step implementation, unified standards, full sharing, unified deployment and ensuring operation and maintenance, accelerate the construction of smart water conservancy projects in the Pearl River Delta and lead the modernization of water conservancy projects.

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