Research on Construction of Smart Sponge City Management and Control System

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Abstract

Sponge urban development mode in China rapidly in recent years, but use the wisdom of management means to sponge city management in our country's time is not long, the lack of experience, to explore the wisdom sponge urban pattern and application characteristics of control system, this paper is based on the number of twin infrastructure, derive wisdom city operation mode of the control system of sponge, This paper expounds and analyzes the main functions and characteristics of the smart sponge city management and control system, providing reference for better promotion of the smart sponge city management and control system.

Keywords

Sponge City; Digital Twinning; The Control System.

1. Introduction

"Sponge city" refers to a city that, like a sponge, has good "flexibility" in adapting to environmental changes and coping with natural disasters. When it rains, it absorbs water, stores water, seeps water and cleans water, and when it needs to "release" the stored water and use it. [1]Nearly 40 billion yuan is expected to be invested in 2015 and 2016. The construction of "sponge city" will become the key strategy to alleviate urban waterlogging and improve urban climate environment. At present, the construction of 30 pilot sponge cities has been in full swing. Intelligent sponge city integrates the management thinking of Internet + sponge city, combines the current system application of digital twin, creates a virtual model of sponge facilities in a digital way, and strengthens the ability of improving intelligent environment of sponge facilities by means of virtual and real interactive feedback, data fusion analysis, decision iteration optimization and other means. It provides intelligent management means for rational development, construction, operation and maintenance management of urban water ecology, water environment, water resources and water security. Therefore, the development and application of digital twin technology provide a reliable way for intelligent management of sponge city.

2. Related Work

2.1. Digital Twin System Concept

Digital twin concept started late in China, the earliest start systemic introduced digital twin is scholar TaoFei twin technical team and others, buaa digital 3 d model in the original digital twin basis, digital twin five dimensional model is put forward, namely the physical entity, virtual entities, services, twin data, the connections between each component[2]. This indicates that the digital twin system has a wider application space. The digital twin five-dimensional model is shown in Figure 1[3].
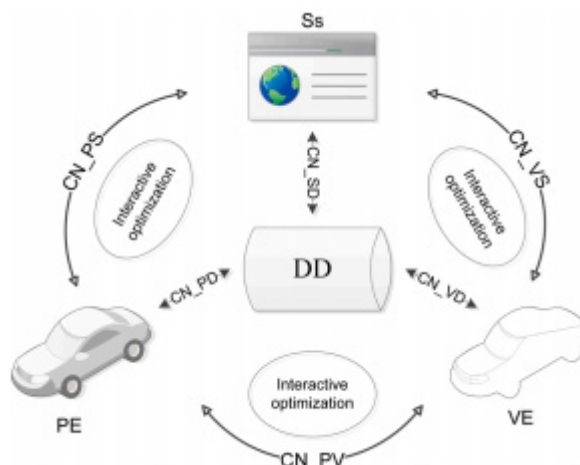
Fig 1. Five-dimensional digital twin framework

2.2. Based on the Digital Twin Framework to Establish Smart Sponge City Control System

Smart sponge city is to take it as a part of smart city, through the Internet of things, cloud computing, big data and other information technologies, all kinds of infrastructure and information facilities in smart city are coordinated with sponge city construction facilities, so as to greatly improve the management efficiency and intelligence level of sponge city [4]. This paper constructs a smart sponge city control system based on the digital twin system, which can monitor and manage the total runoff, runoff pollution and other related data in real time. At the same time, it can reasonably plan, protect and restore the original urban water ecosystem and develop the city with low impact. And intelligent control system is designed to make the sponge sponge city urban construction and operation management more efficient, the comprehensive research achievements of predecessors, wisdom sponge city control system should be comprehensive utilization of the automatic and remote monitoring technology, GIS technology, BIM technology, the Internet of things technology, cloud computing, big data technology, artificial intelligence, such as a new generation of information technology as the means, Through the Internet of Things system, water system, green space and square, roads, buildings and residential areas in sponge city are effectively connected. Through the complete evaluation index system, automatic monitoring, real-time scheduling, scientific decision-making, network office and standardized services of sponge city construction and management system are realized. For urban water security, water environment, water resources, water ecology development and utilization, governance and maintenance to provide intelligent management mode and services.
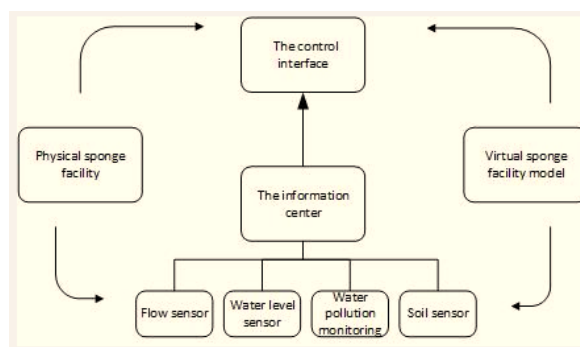

Fig 2. Topology of smart sponge city control system

2.3. Main Functions of Smart Sponge City Control System

2.3.1. Runoff and Environmental Pollution Monitoring

Sponge urban ecological regulation of the important measures for urban water facilities, monitoring and it is very important to master the basic data, data is also used as the basis of intelligent control, also facilitate to carry on the fine management, thus to require more accurate meteorological hydrological data collection, through the arrangement and reasonable distribution of sensor, important to catchment area, soil, water quality, water supply and drainage pipe network in real-time monitoring; The key is to monitor the rate of green land, annual runoff monitoring and control efficiency, annual runoff pollution control rate, pipe network leakage rate, heat island value and other basic indicators. Timely fault early warning for pumping stations and pipe networks, combined with early warning information and data feedback, multi-directional monitoring can be achieved. Meanwhile, based on the monitoring of key nodes, models for flood control and disaster reduction and water pollution prevention and control can be built, and key factors affecting water ecology, water resources and water environment can be targeted to find out.

2.3.2. Intelligent Regulation of Sponge Facilities

The virtual reality interaction system of digital twin is used to connect various sponge facilities and management facilities organically through "sensing terminal, transmission network, cloud computing center and application facilities"[5]. Virtual facility control system is simulated, simulated and optimized online. To line rain sewage drainage pipes, rainwater drainage pumping stations, water outlet, rivers, sluices entity measures issued instructions, such as the storage capacity, as well as theadjustable pollutants concentration in water quality management, to city water storage facilities for precision control, reasonable and reasonable water catchment area of rainwater and sewage emissions, catchment area; In addition, you can view the distribution, content, and status of all monitoring points in real time, accurately locate the identified sensor device faults or data alarm points that exceed the threshold, and generate a warning list using basic data to provide feedback and guide onsite maintenance.

2.3.3. Information Decision-making at the Business Layer

Information-based decision-making is mainly used in the construction of sponge facilities and emergency decision-making in the later operation and maintenance process. Load the basic indicators of construction, use the basic model for simulation, and carry out dynamic digital simulation at the same time. Compare various cost, design, construction, operation and maintenance schemes, evaluate the realizability, and realize information decision-making in the construction process. During the operations, the use of sponge wisdom city warning information to the public, the control system output emergency disposal plan, when the city waterlogging disasters occur to ensure water supply, power supply, ample supply, food, medicine, and use the wisdom sponge urban linkage control system in a timely manner and disaster relief center, guarantee adequate to evacuate residents can have a perfect logistics. At the same time, the disposal and management of dispatching information and operation information of system dispatching are recorded, which is convenient to realize tracking operation, improve the quick response to disasters and make quick decisions.

3. Characteristics of Smart Sponge City Control System

Smart sponge city management and control system is a system engineering, which requires multi-party resource integration and collaborative work.It provides a variety of intelligent services for the management of ecological water system, so as to produce a more efficient synergistic effect between human and nature or society. Smart sponge city management and control system not only inherits the consistent technical characteristics of sponge city, but also

is connected with the new generation of information technology. It is also one of the derivatives and development forms of smart city, which makes the smart sponge city management and control system have multiple characteristics. To sum up, the smart sponge city control system has the following characteristics:

(1) High system integration. Wisdom sponge city control system combined with modern means of information management, and to include large data, cloud computing, Internet of things, a new generation of information technology such as artificial intelligence, in line with the most advanced urban infrastructure management idea, to take advantage of the GIS technology in the project planning and design stage, sensing devices to comprehensive information collection of project construction site, SWMM and cloud computing technology should also be used for simulation analysis and simulation to ensure that important water ecological protection objectives such as urban flood regulation and storage, water source protection and conservation, rainwater and sewage purification and soil purification can be achieved. In the project construction stage, the cloud platform should also be used for collaborative management of the construction parties, BIM construction management technology level of construction simulation, progress, quality, cost management, real-time monitoring of the construction of each sponge facility; In the operational phase, the project need to build a wisdom sponge operation center, a comprehensive collection and monitoring the sponge in operation of the facilities of various kinds of data and information, real-time monitoring of city underlying surface, efficient fast sponge facilities for facilities maintenance and realization of the intelligent control, and for the government, enterprises and the public to provide intelligent and personalized custom services.

(2) High safety requirements. The security of the new generation of information technology is the primary research focus. Sponge city mostly involves the field of urban infrastructure, some countries shift project, these facilities with modern information technology to ensure the safety of the construction and operation, and a lot of the introduction of foreign technology in high and new technology in our country, to ensure that government agencies or business cooperation with relevant countries and regions enterprises involved in national security information is leaked, Strengthen the monitoring of the smart sponge network, prevent illegal elements from invading the network system, and avoid the situation of sponge facility management out of control.

(3) High cost. To popularize advanced technology and management concept, we should strive to achieve cost utility maximization, intelligence control system at the beginning of the promotion of city sponge must face the risk of increased costs, compared with the traditional rain sewage arrangement, the road green space construction, urban construction sponge alone increased a lot of content, assessment index will also be more rich, increases the corresponding input, The control system of smart sponge city needs to increase the cost of design and construction to upgrade the technology[6]. Meanwhile, it also needs to introduce information technology, and some intellectual property costs will be involved, such as RFID tags of the Internet of things and some rain and pollution monitoring equipment. Moreover, a new generation of smart sponge management talents needs to be trained, which is an additional cost.

4. Conclusion

To sum up, the wisdom of the twin technology based on digital city sponge control system not only needs the support of Internet related technologies, combined with virtual reality sponge facilities, realize mutual fusion and use of simulation and the actual linkage sponge facilities, visual management, the construction of the dynamic model and the integration of data information building, it can be through the means of wisdom, The resilience of the city to cope

with flood disasters and water environment deterioration should be continuously enhanced to achieve sustainable development of the city.

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