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Water Pollution Prevention and Control Project
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Evaluation on Water Pollution Prevention Project Based on 3D Virtual Technology from the Perspective of Cloud Computing

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Abstract: With the discharge of domestic sewage and industrial wastewater, the quality of water source becomes worse and worse. The water pollution (WP) prevention and control project can better control domestic water and drainage. By recycling and reprocessing sewage and wastewater, it can be utilized to reduce WP incidents. The virtual technology can visualize the WP area and facilitate the relevant personnel to monitor and treat the water quality, thus improving the water quality. Therefore, this paper studied the indicator detection, process design and application effect of WP prevention and control engineering with virtual technology under cloud computing by analyzing the design of WP prevention and control engineering treatment methods and the requirements of virtual simulation design, and then analyzed the information collection effect and water quality prediction effect of WP prevention and control engineering through experiments. Through comparison, it can be seen that the index detection accuracy after using virtual technology was 23.1% higher than that before using virtual technology, and the sewage conversion rate was 22.6% higher than that before using virtual technology. In short, virtual technology can effectively improve the treatment efficiency of WP.

1. Introduction

With the sustained and rapid development of the economy, the production intensity of chemicals has increased significantly, and the chemical logistics between regions has become increasingly frequent. Accidents related to WP are often caused by unpredictable reasons, such as man-made disasters, natural disasters and some human factors. WP also has a great impact on people's life and health. Therefore, the introduction of cloud computing into the virtual system of WP prevention and control project is of great significance for the collection, prediction, processing and management of WP information.

WP prevention and control plays a positive role in environmental protection. He Yuqing constructed a global environmental quality protection convention to jointly solve the global environmental pollution control problem, and summarized the main important measures and mechanisms of environmental pollution control in various countries [1]. When Feng Kai introduced and adopted the prevention and control management mode in the municipal sewage treatment work, he chose different prevention and control management modes, which had practical significance for solving the WP problem [2]. Lee Chang-Gu alleviated performance inhibition through the ability of symbiotic organics to remove and oxidize, which significantly reduced the presence of oxidants to remove or inhibit organics [3]. Kumar Vinod also applied the heavy metal pollution index to different heavy metal contents to find out which water body was polluted more seriously, and found that there were heavy metal pollution in wetlands and rivers [4]. In order to control the hypoxia in the Gulf of Mexico, Van Meter K. J needed to make a major change in land use practices that may be incompatible with the current level of agricultural production [5]. Badar Zia Ul outlined WP, which is a weak problem of water resources management system and mechanism, and discussed the defects and weaknesses of Pakistan's water-related institutions to manage WP [6]. Wang Shuming analyzed the WP sources during the construction and operation of the coal unloading terminal of the thermal power plant in order to evaluate the water environment impact, and proposed several corresponding treatment processes [7]. The above studies have described the role of WP prevention and control projects, but they have not combined with virtual technology.

Many scholars have analyzed and studied the technologies in WP prevention and control. Azrour Mourade proposed that it is very important to design a model for predicting water quality to control WP and remind users in case of poor quality detection. He developed a model capable of predicting water quality index and water quality grade using the advantages of machine learning algorithm [8]. Ahmed Mehreen realized this by developing a more refined index, which took into account various other factors, and combined spatial and temporal changes with machine learning technology, effectively helping to estimate the water quality in all regions [9]. Muhammad Salisu Yusuf analyzed and compared the performance of various classification models and algorithms to determine the important characteristics of the water quality classification of the Jinta River in Perak, Malaysia [10]. Haghiabi, Amir Hamzeh reviewed the most advanced methods and their applications in the planning and management of hydrological and water resources systems, and also provided insights, challenges and requirements for algorithm improvement in the face of increasing complexity and uncertainty of the problem, as well as future application opportunities in the field of water resources [11]. He Xiaodong took the surface water, spring water, soil and rock in the middle of the Loess Plateau as the research object to quantify the surface WP and its main influencing factors. The hydrochemical evolution of surface water was controlled by rock weathering and evaporation crystallization [12]. The above studies have described the application of technology in WP prevention and control projects, but there are still some deficiencies in the prevention and control projects.

In order to study the application effect of virtual technology in WP prevention and control engineering, this paper analyzes the fitness function of WP prevention and control engineering through neural network algorithm, and then analyzes the index detection accuracy and sewage conversion rate of WP prevention and control engineering through comparative experiments. Through experimental analysis, it is found that the index detection accuracy of the WP prevention and control project with virtual technology has been significantly improved, and the sewage conversion rate has been greatly improved. Compared with other literatures, this paper focuses on using comparative experiments to analyze the detection accuracy and sewage conversion rate.

2. Design Demand Evaluation of Virtual Technology for WP Prevention and Control Project

2.1. Design of Treatment Methods for WP Prevention Works

In the WP prevention and control project, the specific treatment methods are designed as follows, as shown in Figure 1. The first is sewage treatment. The treatment objects include wastewater, domestic wastewater and agricultural wastewater. It is necessary to analyze its physical, chemical and biological characteristics, and select appropriate wastewater treatment methods and equipment for wastewater treatment and treatment process. Second, it needs a complete process. It includes the process of capturing large suspended solids and small suspended solids, transforming large molecular organics into small organic molecules, decomposing various pollutants, and separating sludge and water. Virtual technology collects micro-plastics from wastewater and drinking water, which can be used for quantification and rendering [13]. The third is green cleaning and secondary pollution elimination. Both the water treatment process and the by-product process are green and environmentally friendly. People should abide by the principle of sustainable development, control the whole process, and avoid secondary pollution. They also should fully realize the utilization of waste resources, and achieve the goal of efficient environmental protection.

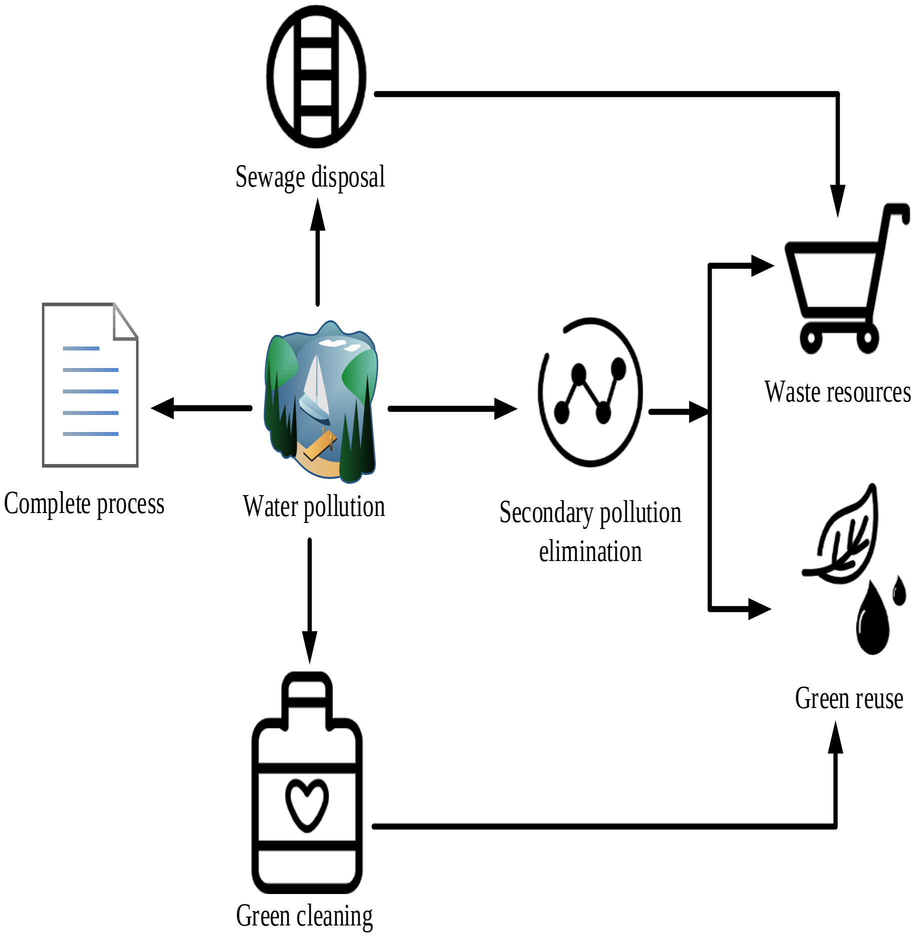


Figure 1. Specific treatment method design

2.2. Requirements for Virtual Simulation Design of WP Prevention and Control Project

Under cloud computing, virtual technology is used to analyze WP prevention and control projects. Its demand is mainly reflected in the following aspects, as shown in Figure 2. The first is the goal. The experience of water environment management is to take domestic and animal wastewater as the main management object, and select the most suitable method for treating high concentration pollutants such as organic matter, nitrogen and phosphorus in water. The second is integrity. In the water resource management experiment, there are primary physical treatment and secondary biological treatment. The whole treatment process from water supply to drainage and the treatment process of secondary pollutants generated in the treatment process are selected. The third is resource utilization. For the secondary pollutants and biogas generated in the process of water treatment, waste recovery processes such as sludge compost and biogas power generation are used to clean, and a water environment management system that runs through the clean and energy-saving production process is established. The fourth is suitability. For the types of water pollutants, the wastewater treatment process suitable for special conditions is selected. Wetlands and oxidation tanks are simple in construction, low in maintenance cost, and simple in operation and management, and the system hardly consumes energy and does not discharge any sludge. In particular, the treatment efficiency of nitrogen and phosphorus is high, and it can make full use of land, develop crops and livestock, and achieve significant economic benefits in wastewater treatment. Especially in areas without soil resources, it can effectively and intensively use wastewater.

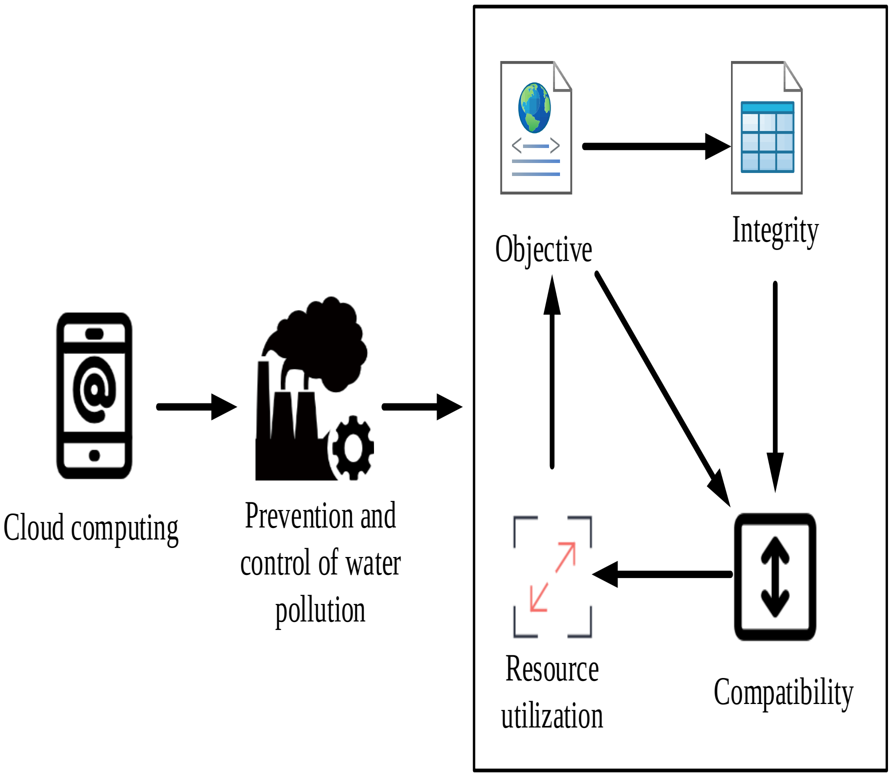


Figure 2. Requirements for virtual simulation design of water pollution prevention and control project

3. Virtual Simulation Construction of WP Prevention and Control Project

Water is an important resource for global human progress and ecological stability [14]. A virtual simulation experimental platform for water treatment is built by using cloud computing, as shown in Figure 3. The experiment includes three modules: WP detection experiment, wastewater treatment process design, and wastewater treatment system simulation operation. The block storage in the process design module implements the wastewater process planning. In addition, the operation safety and management, process modeling and operation of the wastewater treatment plant, and the treatment of typical accidents in the experiment and the whole wastewater treatment process are also trained.

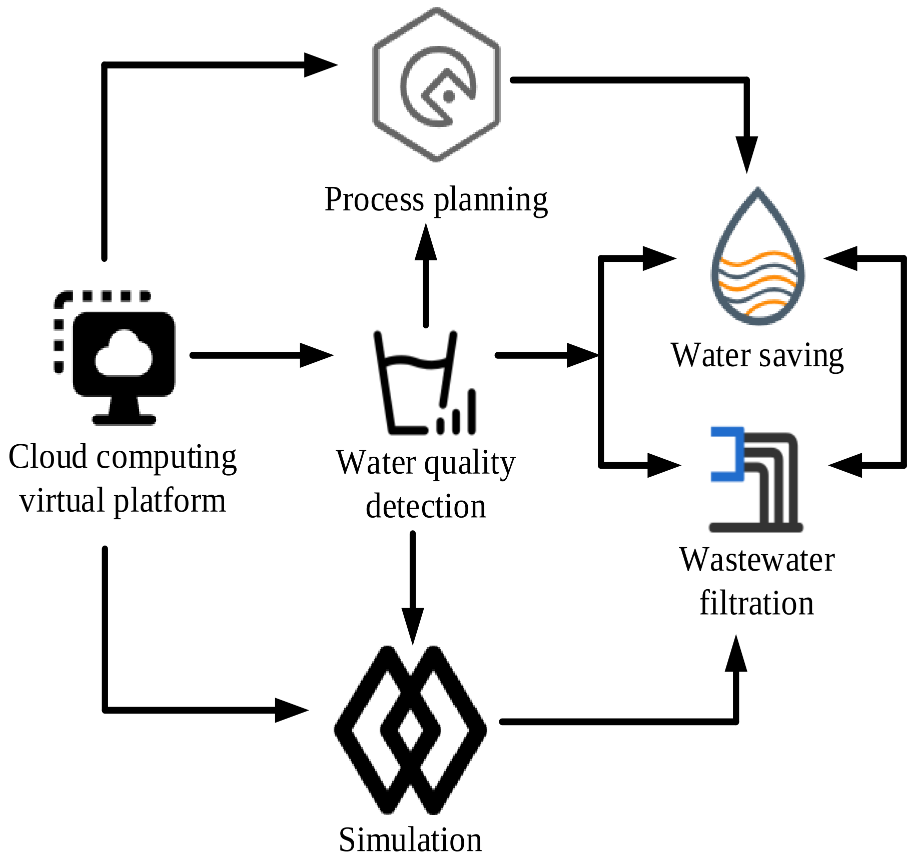


Figure 3. Virtual simulation construction of water pollution prevention and control project

3.1. WP Detection Experiment

It is necessary to establish a numerical simulation experiment model library and develop a simulation software platform to lay the foundation for the effectiveness of scientific and practical experience and improve the possibility of success.

3.2. Wastewater Treatment Process Design

The module has three typical wastewater treatment processes: municipal wastewater, wastewater filtration, and pressure and dye wastewater. Virtual and digital modeling technology is used for the disassembly and visualization of wastewater treatment plants and plants, and wastewater treatment plants are defined as "building blocks". Relevant departments can develop flexible technological processes according to the characteristics of wastewater treatment and treatment, and improve their ability with the first education concept. In this field, testers are mobilized to actively carry out experimental tests, and the block library uses modeling technology to realize the internal visualization of the processing structure. The inspector can intuitively understand the internal structure of the structure, give better play to the function of the processing unit in the overall layout, and help the inspector better understand the connection and pipeline layout between the processing plants.

3.3. Simulation of Sewage Treatment System

It is necessary to establish a simulation operation module to simulate the whole actual water treatment process. The detector uses numerical simulation to adjust the operation parameters, conduct wastewater treatment experiments, analyze the impact on the treatment efficiency, better understand the reaction mechanism and treatment process of small water treatment plants, and optimize the technical design and method improvement and innovative thinking [15]. On the other hand, the module can detect common abnormalities and production failures of some products, and let the detector monitor the whole production process in the simulation process. This module can deal with lengthy wastewater treatment, and solve complicated system problems, and problems that cannot gain experience in the whole process of laboratory wastewater treatment, which can increase the participation and understanding of testers in wastewater prevention and treatment, and stimulate their interest and educational potential.

3.4. Application of Virtual Simulation in WP Prevention Engineering

When using virtual modeling technology to design WP control projects, the following requirements must be met: the first is the standardization of data resources. According to international standards, water-saving standards and industry standards, database tables are designed for all WP data sources and standardized data interfaces are provided. Secondly, the system must be kept confidential during the development process, because the public pays high attention to data and application events related to safe WP. In addition, relevant WP accidents should also pay attention to the safety of commercial applications and the scalability of data and applications. The system is developing standardized tabular database structure and specifications to ensure rapid and dynamic data updating. In addition, the system uses component technology to develop relevant business applications, so the component-based software development method is good and ensures the scalability of the system.

In virtual modeling, the WP modeling system is divided into data layer, service layer, application layer and client layer. The data layer mainly supports the construction of the three-dimensional visualization environment of the system and the realization of the WP dynamic modeling process, including the basic geographic information and WP data required for the construction of the system. The service layer is based on data processing and integration from multiple sources, and focuses on supporting the mathematical models required for water agent modeling and WP event modeling. The application level mainly includes the basic geographic information and WP information, the basic deployment and operation of the WP dynamic modeling system, the realization of three-dimensional spatial analysis and other basic operations, mainly involving the statistical analysis of WP events. The application layer is the interface from the system to the user, which can provide various human-machine interfaces and environments for decision makers and users.

4. Application of Neural Network Algorithm in WP Prevention Engineering

In order to study the application effect of virtual simulation technology in WP prevention and control, this paper uses neural network algorithm to normalize the input and output data of water quality samples, and then determines the fitness function and actual output value of WP prevention and control engineering. First, by normalizing the sample data, people can get the incentive function of WP prevention:

$$\hat{a}_t = \frac{a_t - a_{\min}}{a_{\max} - a_{\min}} \tag{1}$$

Among them, a_t is the variable before normalization, and $a_{\max}, a_{\min}$ are the maximum and minimum values of the sample data. Then the fitness function of WP prevention and control project is calculated as follows:

$$s = \frac{1}{\frac{1}{N}\sum_{i=1}^{N}(y_i - \hat{y}_i)^2} \tag{2}$$

Among them, N is the number of water quality samples in WP prevention and control, and $y_i, \hat{y}_i$ are the expected value and the actual value respectively. Finally, the predicted actual value of water quality in the WP prevention and control project can be obtained through virtual simulation:

$$\hat{y}_i = \alpha_i^2 \left[1 + e^{-T}\right]^{-1} + \delta_i^2 \tag{3}$$

Among them, α_i^2 is the connection weight and δ_i^2 is the neural threshold for WP prevention.

5. Application of Virtual Technology in WP Prevention and Control Project

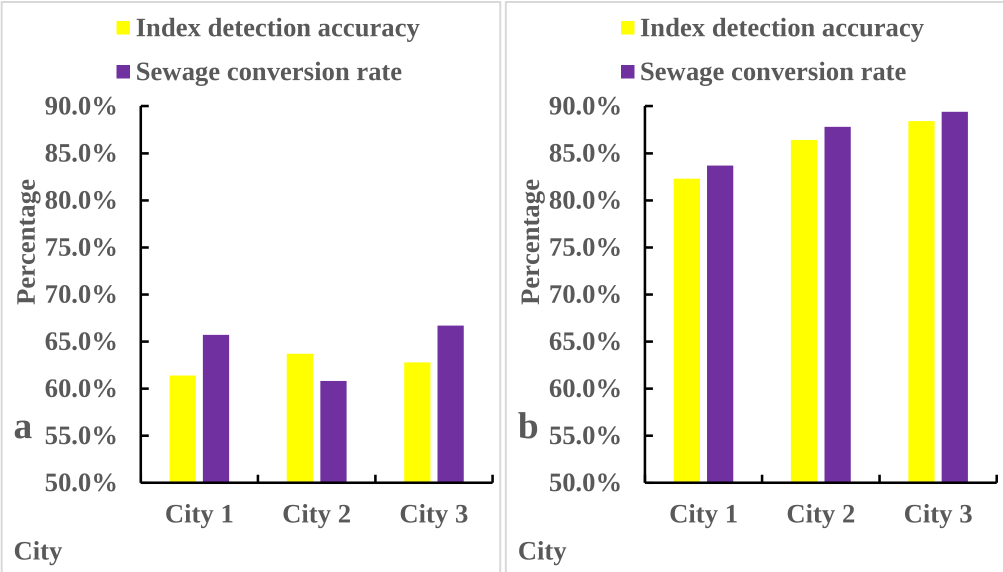
In order to study the application effect of virtual technology in WP prevention and control engineering under cloud computing, this paper analyzed the information collection effect and water quality prediction effect of WP prevention and control engineering to study the index detection accuracy and sewage conversion rate of virtual technology for WP. First of all, this paper investigated the information collection effect and water quality prediction effect of WP prevention and control projects in three regions before and after the use of virtual technology. The specific investigation results were shown in Table 1.

Table 1. Information collection effect and water quality prediction effect of WP prevention and control project before and after the use of virtual technology

	Information collection effect		Water quality prediction effect	
	Before using virtual technology	After using virtual technology	Before using virtual technology	After using virtual technology
Region 1	56%	80%	61%	84%
Region 2	51%	83%	60%	87%
Region 3	53%	78%	71%	89%

According to the data described in Table 1, before the use of virtual technology, the information collection effect of Region 1 was 56%, and the water quality prediction effect was 61%; the information collection effect of Region 2 was 51%, and the water quality prediction effect was 60%; the information collection effect of Region 3 was 53%, and the water quality prediction effect was 71%. After the use of virtual technology, the information collection effect of Region 1 was 80%, and the water quality prediction effect was 84%; the information collection effect of Region 2 was 83%, and the water quality prediction effect was 87%; the information collection effect of Region 3 was 78%, and the water quality prediction effect was 89%. On the whole, the information collection effect before using virtual technology was 53%, and the water quality prediction effect was 64%. After the use of virtual technology, the information collection effect was 80%, and the water quality prediction effect was 87%. Through comparison, the information collection effect after using virtual technology was 27% higher than that before using virtual technology, and the water quality prediction effect was 23% higher than that before using virtual technology. Under the virtual technology, the WP prevention and control project can visualize the WP status and the source of WP, facilitating the management personnel to carry out relevant data analysis.

Finally, the index detection accuracy and sewage conversion rate of the wasteWP prevention and control project with virtual technology were analyzed and compared with those before using virtual technology. The specific comparison was shown in Figure 4.



a: Before using virtual technology *b: After using virtual technology*

Figure 4. Index detection accuracy and sewage conversion rate of WP prevention and control project

Figure 4a shows before using virtual technology, and Figure 4b shows after using virtual technology. It can be seen from Figure 4a that before using virtual technology, the index detection accuracy of City 1 was 61.4%, and the sewage conversion rate was 65.7%; the index detection accuracy of City 2 was 63.7%, and the sewage conversion rate was 60.8%; the index detection accuracy of City 3 was 62.8%, and the sewage conversion rate was 66.7%. It can be seen from Figure 4b that after using virtual technology, the index detection accuracy of City 1 was 82.3%, and the sewage conversion rate was 83.7%; the index detection accuracy of City 2 was 86.4%, and the sewage conversion rate was 87.8%; the index detection accuracy of City 3 was 88.4%, and the sewage conversion rate was 89.4%.

On the whole, the detection accuracy of indicators before the use of virtual technology was 62.6%, and the sewage conversion rate was 64.4%. After using the virtual technology, the index detection accuracy was 85.7%, and the sewage conversion rate was 87.0%. Through comparison, it can be seen that the index detection accuracy after using virtual technology was 23.1% higher than that before using virtual technology, and the sewage conversion rate was 22.6% higher than that before using virtual technology.

6. Conclusion

The deep integration of virtual modeling and WP control engineering and the reconstruction of water quality monitoring system can promote the integration of modern information technology, expand the scope and depth of water quality control, increase the processing time and effect of water quality monitoring and control, and improve water quality. The application of virtual technology in cloud computing in WP accidents has to some extent met the need to grasp information in time. Users can easily and quickly access the cloud, and upload or download data anytime and anywhere. Relevant departments can timely deal with WP, control water quality, and improve water quality. In the construction of future WP prevention and control projects, virtual technology can clearly mark the WP places and conduct relevant water quality analysis to detect the source of pollution, so as to solve the problem from the source.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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