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River Water Pollution Prevention and Monitoring System Based on Internet of Things Cloud Platform

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Abstract: Smart Cloud Internet of Things is a public-oriented Internet of Things access platform, committed to providing convenient access, storage and display for network enthusiasts and developers, and also providing more Internet of Things applications for developers. This paper proposes an Internet-based river pollution monitoring and treatment technology. It is mainly composed of hardware detection system, electronic patrol inspection system and remote video real-time monitoring system. The hardware test part involved in the invention includes a processing and control unit, a module, a water quality sensing and transmission unit, and an ultrasonic cleaning element. The system is composed of water temperature probe, dissolved oxygen probe, conductivity probe, turbidity probe, flow rate probe, etc. The power conversion device provides all the power. Its advantages are that users can monitor the water quality of the river in real time, transmit images in real time, observe the river in real time, and display the river condition intuitively. Through the analysis of experimental data, this paper evaluates the evaluation value of various indicators of sewage according to the online detection of chemical oxygen demand (COD). It is easier to use COD online detection. Through the satisfaction analysis of COD online detection and manual detection efficiency, it is found that the efficiency of COD online detection is 18.87% higher than that of manual detection.

1. Introduction

At present, Qinghe River and Fanhe River basins are still under manual monitoring, supplemented by network monitoring. However, due to their location in cold regions, numerous tributaries and high population density, to achieve comprehensive monitoring, not only requires a lot of manpower and material resources, but also requires a lot of manual monitoring. It is difficult to ensure that the measured results are within the allowable error. Therefore, the sewage pollution sources of Qinghe River and Fanhe River basins must be monitored in real time.

Relevant personnel analyzed the application of Internet technology in real life, and proposed the corresponding algorithm model on this basis. Jiang Weipeng proposed the technology of Internet of Things in home remote control. Through mode management and cost-benefit analysis, he used remote control technology to analyze large-scale data [1]. Bakhtiar Fariz Andri proposed a cloud platform service by analyzing the limitations of computer storage today. The cloud platform has subscription function and security performance. Compared with the average merchant service, the cloud platform data transmission is faster [2]. Yang Jie analyzed the reasons for the shortage of parking space resources caused by the number of vehicles in cities with large population, and proposed the Internet intelligent parking system to predict and classify the location of vehicles [3]. Tan Liang analyzes the control of users, reduces the scalability of applications, and proposes a blockchain user access framework and a unified management platform. First, collect user data, then decentralize and change the characteristics of the blockchain, and design an intelligent access control system, which reduces the scalability of applications and ensures the privacy and reliability of data [4]. Internet technology can be seen everywhere in the field of life. For example, it can achieve water recycling through Internet technology, or increase the efficiency of sewage treatment and reuse, to achieve the goal of conservation and sustainable development.

The situation of river pollution is very serious. It is of great practical significance to strengthen the monitoring and control of river pollution. Zhang Xiaoran believes that a large amount of money should be invested in the fault area to improve the reliability and scalability of governance [5]. Hoske Mark T analyzes the image, extracts the image features using neural network technology, and classifies the image, which meets the characteristics of short delay and high transmission efficiency of the Internet of Things platform, and realizes image transmission and processing. This research helps to apply image processing technology to water pollution prevention and control, and improve the treatment level through water pollution monitoring images [6]. Sarkar Basis has developed a cloud-based Internet of Things integration platform, broadening the application scope of the Internet of Things [7]. However, the above scholars rarely apply the Internet of Things to the sewage treatment process, and the research results have limitations.

The above research has only carried out a separate study of the Internet of Things cloud platform and the river water pollution prevention and monitoring system, without combining the two. Although these studies have some reference, they are more or less insufficient to demonstrate the conclusion, and have some room for improvement. In order to understand the research on the river water pollution prevention and monitoring system of the Internet of Things cloud platform, this paper analyzes the river water pollution prevention and monitoring system, analyzes the experimental data, evaluates the various indicators of sewage through COD online detection, and compares the satisfaction of COD online detection and manual monitoring. This paper has reference significance for other fields of future research.

2. Monitoring and River Water Pollution Prevention and Control

2.1. Current Situation of River Water Pollution Prevention and Control

River water pollution refers to the pollutants in the river water, which reduces the use value and energy of the river water to a certain extent. Before that, the pollution situation of rivers in the country was severe, and all major rivers were affected by non-synchronization. Relevant personnel use cutting-edge sensing technology and modern data platform to monitor and observe data and improve the monitoring efficiency of water quality [8]. Relevant personnel make water pollution analysis index report by collecting river water pollution samples and using relevant technology to conduct feedback analysis on water pollution. The mathematical model is analyzed by using the mathematical model and the least square method, as well as the maximum likelihood estimation and Poisson distribution method. Analyze the impact of environmental changes on industrial water pollution by controlling variables [9]. In order to ensure the supply of water, experts who study water pollution adopt the method of timely monitoring and checking water quality, adopt intelligent water quality monitoring system, control water quality parameters and analyze water quality [10]. The prevention and control of river water pollution is shown in Figure 1.

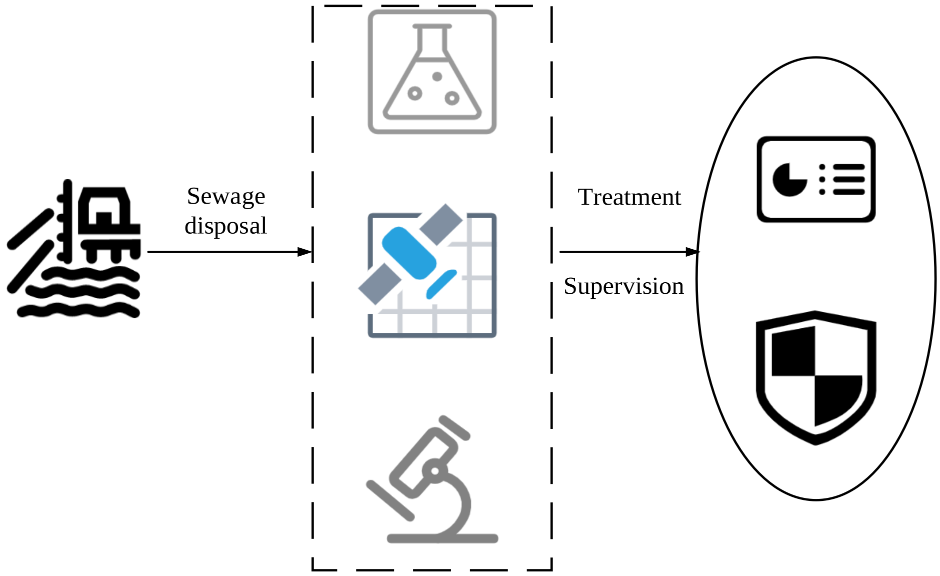


Figure 1. Principle of prevention and control of river water pollution

2.2. Influential Factors of River Water Pollution

Wastewater produced by various industries has caused serious impact on surface water. Wastewater includes production wastewater, circulating cooling water, flushing wastewater and mixed wastewater of sewage. Due to the difference of its industrial nature, the quality of sewage produced is also different. This kind of sewage is generally large in discharge, high in pollutant content, difficult to treat and harmful to the environment. There is a large gap between the pollution index of some sewage and the national standard. Due to the periodicity of its production, the quantity of its sewage has also changed greatly. Secondly, urban rainwater and domestic wastewater would have a certain impact on the surface. According to the source of sewage, domestic sewage mainly includes domestic sewage in residential water areas, domestic sewage in hotels and restaurants, and domestic sewage in entertainment places.

With regard to the analysis of influencing factors of river water pollution, relevant scholars introduced a model based on deep learning to predict water quality factors. The proposed model improves the prediction accuracy. Comparative analysis shows that the proposed model is superior to all other models in terms of the best prediction accuracy and the lowest error rate [11]. Experts put forward a diversified combination of water quality prediction method, which provides technical support for water pollution prevention and sustainable development [12]. Scholars have created a remote sensing and remote control platform, which is conducive to the analysis of sample data and mass spectrometry data, and finally to the analysis and timely monitoring of water pollution [13]. These prediction models proposed by the above scholars can well explain the current situation of water pollution.

The social and economic benefits of water conservancy infrastructure are the best, but due to its insufficient supply or restrictions on its increase, it would bring difficulties to sewage treatment. The reasons include its historical and practical roots, macro and micro factors; And there are both institutional and non-institutional reasons. Relevant scholars have used several methods to reduce the pollution level of these water sources, and analyzed the pollution index to produce a value to indicate the relative pollution level of the water quality standard. To use the pollution index method to evaluate its pollution level, efforts need to be made to control the pollution level of the river [14]. Environmental governance in various countries mainly explores measures and mechanisms for environmental governance and management from the perspective of environmental pollution of air, sea, forest, water and solid waste [15].

In order to ensure the balance of nature, people put forward the air quality control plan. Wireless sensor network is a revolutionary system, and pollution sensors and monitoring systems have a significant contribution to improving the environment [16]. Therefore, in order to achieve long-term financing and sustainable supply, in addition to creating a good environment and conditions, it must also carry out institutional reform and technological innovation. The influencing factors of river water pollution are shown in Figure 2.

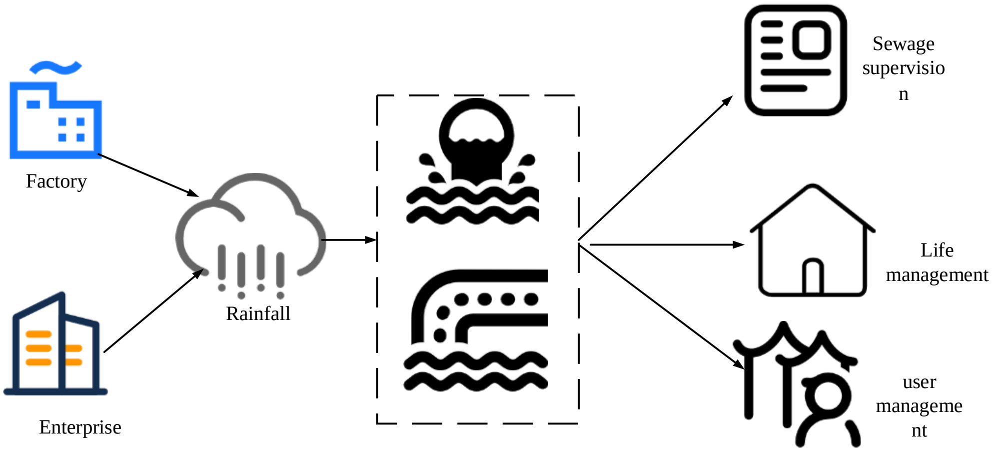


Figure 2. Analysis of influencing factors of river water pollution

2.3. River Water Pollution Prevention and Monitoring System

The system uses cloud computing technology based on the Internet of Things to realize an intelligent monitoring system based on mobile terminals. The monitoring system uses an intelligent monitoring chip based on mobile terminals, which can monitor the operation of monitoring devices in real time, and record the operation of various monitoring devices into the background database.

Governments at all levels stressed the impact of the water quality of the Jamatawi River in the United Territory. According to the network link of the Pollution Control Committee, the water quality data of real-time water quality monitoring at four locations were obtained. The important parameters used in the study include alkalinity, hardness and conductivity. A statistical analysis called cluster analysis was also carried out to evaluate the homogeneity of various monitoring points based on physical and chemical variables. The current need is to address the gap in the rehabilitation strategy and work for effective river resilience and sustainable river basin management [17].

Professionals reviewed the economic research on its effectiveness. Over time, China's environmental regulatory system has evolved into a complex multi-level maze, revealing several challenges for empirical analysis: the regulatory status of enterprises is often endogenous, the quality of data is variable, and further research is needed. It is necessary to comprehensively evaluate the cost-effectiveness of China's environmental regulations, determine the interaction of various policies, and expand the analysis to include soil and other types of pollution in addition to water and air [18].

"Chemical oxygen demand" refers to the amount of oxidation required for the treatment of water samples using a powerful oxygen reagent under a specific environment. It is an indicator reflecting the reduction amount in water. Various organic compounds, nitrites, sulfides, ferrous salts, etc. are the most common in water. If the COD is high, it would increase the treatment capacity of sewage, thus improving the treatment capacity of sewage. However, if the sewage cannot be controlled in time, it is easy to cause the quality of natural water body to decline.

Some scholars have proposed a system based on wireless sensor networks. The system monitors and controls various electrical and environmental variables, including power consumption, weather temperature, humidity, flame, lighting and detection and cutting of cables in poles. Each sensor is a node and connected to the microcontroller board. The data collected by these sensors are displayed and monitored on the web page and stored in the database of the local server, which is created using a variety of network programming languages. The system was developed using a free global domain. The website has a database for storing real-time sensor information [19].

Relevant professionals adapt to consumers' demand for energy through various methods. In the future, the smart grid would use the most advanced technologies such as the Internet of Things and cloud computing to introduce the architecture, design and implementation of the Internet of Things and cloud computing, and generate the load profile of consumers for remote access by utility companies or consumers. It shows the generated load distribution of user load in terms of current, voltage, energy and power accessible through the portal [20].

The policies being implemented now include the adjustment of industries and the closure of industries with high energy consumption, high pollution and high cost. The most important policy is to close those industries without governance capacity. The production process of the sewage treatment plant should be improved to reduce the amount of wastewater treatment and resources. Pollution control of agricultural non-point sources: including agricultural sources, agricultural non-point sources, livestock and poultry breeding and aquaculture. In order to overcome non-point source pollution, compared with domestic sewage in large and medium-sized cities, it must be treated through comprehensive control and biological agriculture demonstration projects. The analysis of the river water pollution prevention and monitoring system of the Internet of Things cloud platform is shown in Figure 3.

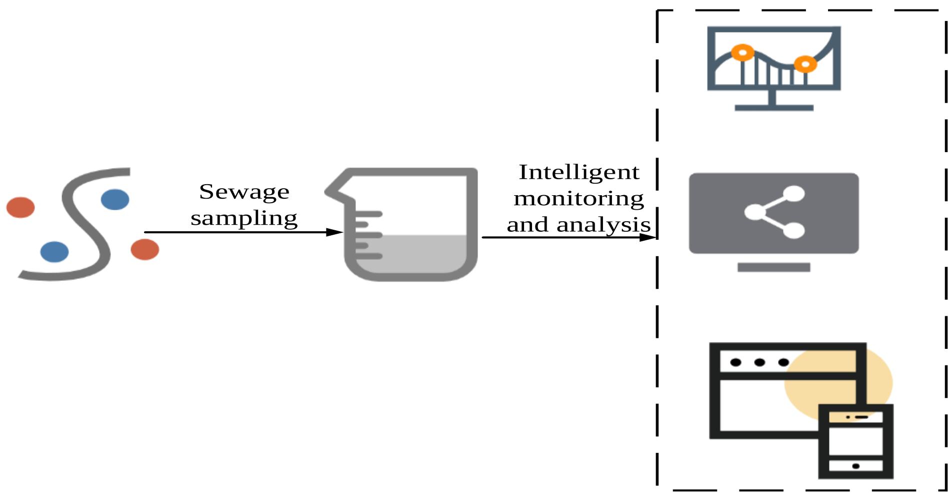


Figure 3. Analysis of river water pollution prevention and monitoring system based on Internet of Things cloud platform

3. COD Online Detection Model

This model can monitor the structural state of the slope, and predict the remaining use of the slope from the monitoring results. In terms of full coverage and all-weather monitoring, it can realize real-time monitoring and protection of the slopes on both sides of the river, which is used to monitor and alarm the slope on both sides of the river, and calculate the average displacement first and then carry out safety assessment.

The calculation formula of average displacement is

$$\Delta s = \frac{1}{N-1}\left(\sum_{i=1}^{N-1} w(i+2t) - \min(i+t)\right) \quad (1)$$

Δs is the average displacement, N is the number of displacement, w is the speed weight, t is the time, and i is the number of monitoring.

The safety assessment judgment formula is

$$A = \frac{1}{\sum_{i}^{N}\left[\frac{p_i}{10^7} \bullet \left(\frac{wi}{\sigma}\right)\right]} \quad (2)$$

A is the safety assessment value, p is the risk factor, and σ is the structural limit.

Due to the influence of slope structure, the nonlinear process is

$$T = \left(\frac{d_z - d_g}{d_z}\right)^i \quad (3)$$

T is the history of structural design, d_z and d_g are slope structures.

4. Comparative Experiment before and after the River Water Pollution Prevention and Monitoring System

4.1. Experimental Method

By analyzing the river pollution data of a region, five groups of data are selected, and five groups of data are processed according to the two identification methods of COD online detection and manual detection, and the effect of five groups of data is evaluated using the 100-point system. From the experimental image and data analysis, it can be seen that the COD online detection in this paper can realize the monitoring of river water pollution prevention and control, record the data and compare the experimental results.

4.2. Data

4.2.1. COD Online Detection of Sewage Indicators

This paper selects five sewage samples and compares the monitoring efficiency of COD online detection by analyzing the content of organic matter, nitrite, ferrous salt and sulfide in the sewage. The indicators of COD online detection of sewage are shown in Table 1.

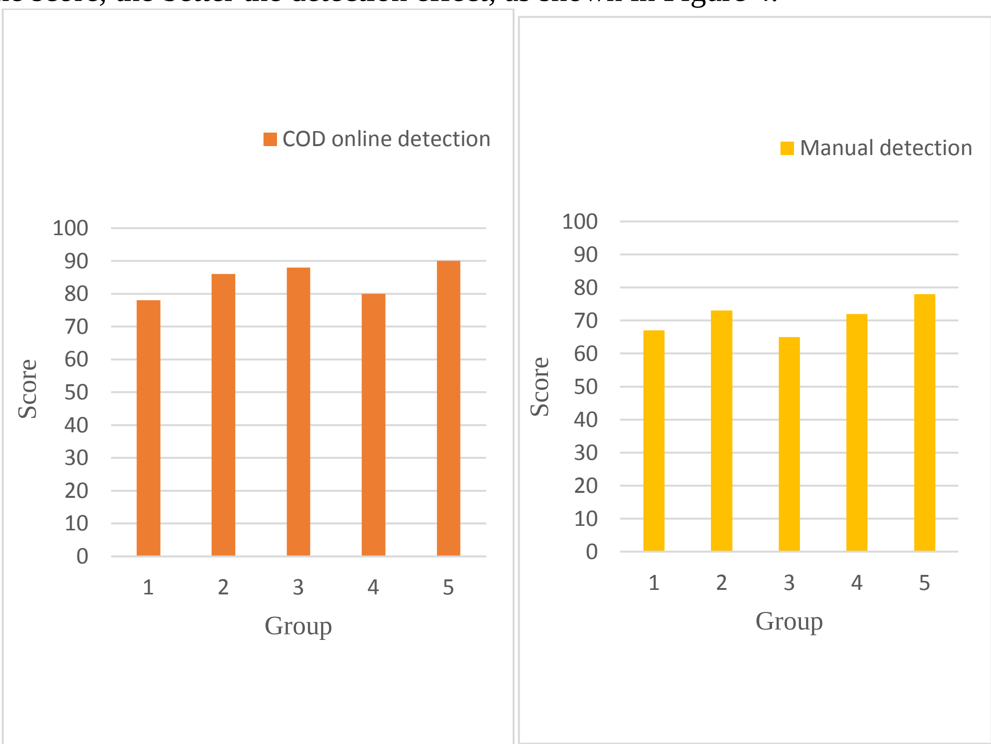
Table 1. Analysis of various indicators of COD online detection of sewage

Category	Data				
	1	2	3	4	5
Organic matter	0.01g/ml	0.03g/ml	0.05g/ml	0.25g/ml	0.34g/ml
Nitrite	0.42g/ml	0.56g/ml	0.74g/ml	0.32g/ml	0.12g/ml
Ferrous salt	0.45g/ml	0.56g/ml	0.32g/ml	0.33g/ml	0.25g/ml
Sulfide	0.25g/ml	0.27g/ml	0.34g/ml	0.54g/ml	0.45g/ml

According to the analysis of the data in the table, the content of organic matter is in the range of 0.01g/ml~0.05g/ml, the content of nitrite is in the range of 0.12g/ml~0.74g/ml, the content of ferrous salt is in the range of 0.25g/ml~0.56g/ml, and the content of sulfide is in the range of 0.25g/ml~0.54g/ml. Among the indicators of sewage treatment, the content of nitrite and ferrous salt is the highest, which is of great significance in sewage treatment.

4.2.2. Satisfaction of Cod Online Detection and Manual Detection

Analyze and compare the satisfaction of using COD online detection and using manual detection. The higher the score, the better the detection effect, as shown in Figure 4.



(a)COD online detection *(b)Manual detection*

Figure 4. Comparison of satisfaction between COD online detection and manual detection

It can be seen from Figure 4 that Figure a shows the score of COD online detection effect. The average score of COD online detection is 84.4, the highest value is 90, and the lowest value is 78. The fluctuation range is small, and the effect is good. Figure b shows the score of manual detection effect. It can be clearly seen that the score of COD online detection is higher than that of manual detection. The average value of manual detection is 71, and the score is basically distributed in the range of 65~78, with large fluctuation and poor effect. COD online detection is 18.87% more efficient than manual detection.

5. Conclusion

COD online monitoring system can give full play to this role, monitor water quality quickly and efficiently, so as to achieve the goal of water quality control. Water is the greatest threat to mankind. Water pollution, noise pollution and air pollution are regarded as three important environmental problems. When COD exceeds the standard, it would bring different harm to human health and work. However, its impact on human body is often lagging, and it is easy to be ignored. The COD online monitoring system has complete facilities, good equipment status, high accuracy, and network transmission data meet the requirements. The environmental protection facilities meet the current requirements. After the COD online monitoring system is put into use, the indicators meet the national emission standards after monitoring by the environmental protection supervision department. This has improved the living environment quality of the surrounding residents, lifted the pollution disputes between residents and enterprises, greatly improved the relationship between residents and enterprises, and restored the order of production and life. Social stability and ecological benefits are significant.

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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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