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Water Pollution Evaluation and Prevention Measures Based on Intelligent Recognition

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Abstract: Water is one of the most important resources in nature, which can conserve water. It can also irrigate farmland and purify air. However, with the over-exploitation and utilization of water resources by human beings, water environmental problems are becoming increasingly serious and the scope of pollution is gradually expanding. At present, all over the world are strengthening the prevention and control of Water Pollution (WP), especially focusing on the quality of surface water environment. However, limited by geographical conditions and technical factors, the current situation of WP is still not optimistic. The water quality deteriorates rapidly and the degree of pollution is high, which affects people's normal living water demand. Therefore, it is urgent to find new ways to improve water quality. Intelligent recognition is a new research method based on machine learning theory, which can effectively reduce or avoid environmental pollution and protect biodiversity. In WP management, it can not only detect whether the water contains pollutants, but also transform them into information and store them in the computer for analysis and processing, so as to better predict and evaluate the water environment quality. This paper first introduced the source and characteristics of WP, and then analyzed the common intelligent identification technology. Finally, the design scheme of water quality automatic monitoring system based on neural network model was proposed, and the online monitoring and early warning functions of water quality were realized. The traditional manual detection method was compared with the intelligent identification monitoring model. The results showed that the intelligent identification technology had obvious advantages for the rapid diagnosis of WP, and could reduce the harm caused by human misjudgment to a certain extent. The classification accuracy was improved by about 6.54%, and good results could be achieved without manual intervention, which could well adapt to the current complex water situation.

1. Introduction

In nature, WP is a common phenomenon, which mainly exists in the natural and social

environment. It has the characteristics of strong concealment, great harm and wide distribution. With the passage of time, this hazard would be more prominent. In the context of current global warming, the shortage of water resources and serious WP have become a worldwide problem, which seriously restricts the sustainable development of economy and society. This makes people pay more and more attention to the management and protection of water resources and take reasonable measures to alleviate this situation.

WP has always been a hot topic in social research, and many scholars have explored it based on it. Sheng Jichuan described the existing forms of government in the South-to-North Water Transfer Project, and pointed out its existing problems and possible solutions, so as to provide a special perspective on the hydrological politics and WP control methods [1]. Shafeeque Muhammad studied the temporary reduction of air pollution during the blockade of COVID-19 and its impact on coastal aquatic systems, thus proving that wise restrictions on the use of fossil fuels could control air and WP [2]. Pichura Vitalii studied the causal law of the impact of the urban system on the river ecosystem, and allowed the spatial differentiation of protection measures to reduce the negative impact of sewage surface runoff on the surface water conditions and improve the crop yield of irrigated land [3]. In order to maintain a good environmental condition of surface water, Rizk Roquia regularly conducted water quality assessment to monitor the change of water quality over time, so as to understand the impact of water on human health in different periods [4]. Scavia Donald analyzed the phosphorus mass balance and its impact on the lake water load reduction, monitoring and climate change, and believed that the increase of phosphorus concentration would lead to the increase of phosphate content in the lake shore sediment, the decrease of lake hydrodynamics, and then the eutrophication of water body [5]. He Mingjing discussed the application of biochar in urban sewage treatment, industrial wastewater purification and rainwater management under the background of sustainable development. Through adsorption, precipitation, surface oxidation-reduction reaction and catalytic degradation process, priority pollutants in industrial wastewater treatment could be more effectively targeted [6]. There were many sources of WP. Different kinds of pollutants had their own unique characteristics, and the impact of human activities accounted for the main part.

Intelligent identification technology has been widely used in hydrological forecasting and water resources management, and many scholars have carried out relevant research. Ismail Muhammad achieved green environmental protection and sustainable development of the water environment by using nanotechnology to reduce the pollution, toxicity, carcinogenicity and catalytic bioremediation of organic dyes [7]. Based on the Internet of Things, big data and convolution depth neural network, Anbarasan M carried out flood disaster detection. He transformed the traditional “artificial+sensor” monitoring mode into “intelligent+sensor” monitoring mode, and used image fusion technology to realize the analysis of the relationship between various hydrochemical indicators and water quality in the water environment [8]. Guo Zhiwei proposed an intelligent industrial decision for complex wastewater treatment based on graph embedding, and used neural computing structure to simulate its internal uncertain biochemical transformation, which improved the precision of feature space and the ability to represent complex industrial processes [9].

Through systematic search of databases, specific websites and pollution regulatory agencies, Dwivedi Sanjay discussed the main sources of various pollutants, and assessed the bioaccumulation of toxic substances in fish in the waters and the potential harm to human health from eating contaminated fish [10]. Janga Reddy M reviewed the applications of genetic algorithms, differential evolution and evolutionary strategies in hydrological and water resources system planning and management, and discussed the problems of these methods and what types of water environment they were applicable to [11]. Lee Chang-Gu analyzed the role of titanium dioxide in the adsorption and photocatalytic degradation of water pollutants, and proved that titanium dioxide could be

effectively fixed into polymers with affinity for specific priority pollutants, which could improve the efficiency of photocatalytic water treatment and reduce energy demand [12]. Intelligent recognition technology played an increasingly important role in the research of environmental pollution. It could not only achieve the automatic acquisition of target object information under complex conditions, but also achieve the purpose of predicting its change trend through artificial judgment.

In order to solve a series of problems caused by WP and improve the ecological environment, it is necessary to strengthen the prevention and control of WP [13]. Intelligent recognition technology is such an effective means. It can automatically monitor and monitor the water body, and timely understand the water quality, timely find the presence of odor or toxic substances in the water, so as to then analyze the characteristics of various pollutants to know their source and distribution range for easy treatment. Compared with traditional manual detection, intelligent identification has a greater degree of automation, which greatly improves work efficiency and achieves the goal of reducing pollutant emissions and environmental hazards. At the same time, it can also improve the utilization efficiency of water resources, thus promoting sustainable economic development.

2. WP Source Investigation and Water Quality Monitoring

2.1. Source Evaluation of WP

There are a variety of pollutants in the water environment. These pollutants are widely distributed in the water body and in a large number, which are extremely harmful to human health, especially some toxic and harmful substances. Once flowing into the water, they would be decomposed by microorganisms and release harmful gases and toxic substances, which seriously affect people's health and life safety [14]. Therefore, scientific and effective monitoring and evaluation of water quality is a very important work. The most important thing is to correctly recognize the types and sources of pollutants, so as to take appropriate measures to prevent and control them, as shown in Figure 1.

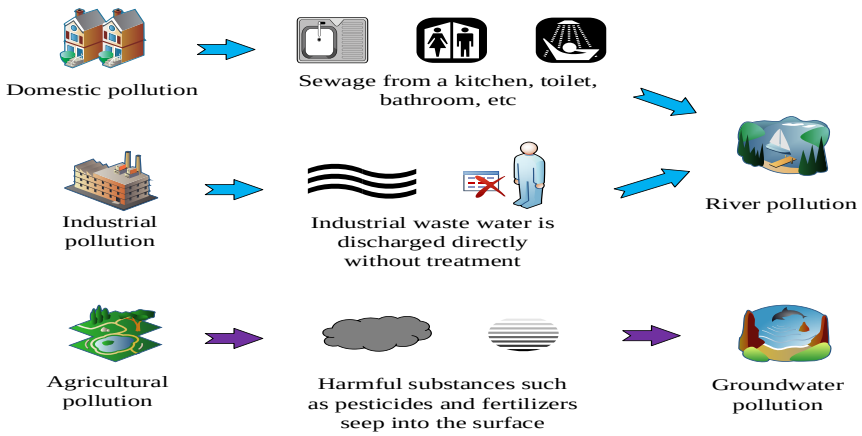


Figure 1. Source analysis of WP

As shown in Figure 1, the most common pollution is caused by human activities. For example, living sewage such as kitchen, toilet and bathroom directly enters the river through pipes and mixes with the river to form organic wastewater or suspension, sludge, etc. All of these would bring about eutrophication of water body to a certain extent, and affect water quality and biodiversity.

Secondly, the industrial wastewater discharged from industrial production contains more organic substances, such as organophosphorus pesticides, heavy metals and toxic and harmful gases. The

sewage discharged into rivers is easy to produce a large number of floating objects, foam and suspended particles, which would cause damage to the water environment. At the same time, most of these industrial wastewater are acidic or weakly alkaline substances, so it is difficult to degrade under strong acid and weak alkali conditions, which aggravates the acidity and alkalinity of water and leads to the deterioration of water quality. In addition, it may cause the water level of the river to rise and cause harm to aquatic organisms.

Finally, part of the sewage comes from agricultural production processes, such as livestock manure, crop straw and various plant residues. Pesticides, fertilizers and other harmful substances would seep into the surface after rainfall, thus forming groundwater pollution and directly affecting the stability of the river ecosystem.

To sum up, in order to truly achieve the goal of ecological environmental protection, it is necessary to control the pollution source from the source, and strengthen the research and application of WP prevention technology, so as to attach importance to the construction of water quality standard system [15].

2.2. Classification of Intelligent Identification Technology

People can directly perceive objects through vision and hearing in various situations. Intelligent recognition is a technology to recognize things from this perspective. It obtains the required knowledge and conclusions through information collection, processing, analysis and other processes. According to different work objects or tasks, intelligent recognition can be divided into four types, as shown in Table 1.

Table 1. Classification of intelligent identification technology

Classification	Identification method	Advantage
Fingerprint recognition	Compare the cellular characteristic points of different fingerprints to distinguish fingerprints	Fast identification speed, convenient application, high safety and sustainable development
Speech recognition	The word content is converted into computer readable data for input recognition	High recognition rate, high accuracy, rapid response, personalized training
Face recognition	According to the information of human facial features for identification	Intuitive, low cost, easy to promote the use
Image recognition	Target and object of different modes are recognized	Intelligent, convenient, practical

Speech recognition is a mainstream method at present. Its basic feature is to use human language to classify characters and generate corresponding text representation. It has the advantages of strong interactivity and high recognition rate. It can not only accurately recognize text content, but also convert voice into electrical signals and output them to the computer for storage and processing, so as to achieve rapid retrieval, query and other purposes.

Fingerprint is one of the most accurate methods of identification. It can be used to identify and determine identity. It is mainly used to distinguish by comparing the cell characteristics of different fingerprints. It has the advantages of fast identification, convenient application and high security. It has been widely used in personal security protection, identity verification, vehicle inspection and electronic wallet authentication.

Face is the most widely used category in intelligent recognition. Face recognition is a technology

that uses the human eye to observe the surface features of an object and extract the image signals matching the features. It is also one of the most advanced research fields of artificial intelligence, and is widely used in financial payment, identity authentication, personal goods management and other aspects.

Image recognition is the most basic category of intelligent recognition. Its main feature is that it can realize fast and accurate image segmentation and extraction, and can be used for automatic search, retrieval and positioning. At present, image recognition has become one of the fastest growing branches of intelligent recognition technology. Especially in the era of mobile Internet, intelligent algorithms based on images have been constantly emerging and widely used, so as to make people have a more profound and comprehensive understanding of images, thus speeding up the construction of video surveillance systems and promoting the further prosperity of social economy.

2.3. WP Prevention and Treatment Measures

With the acceleration of industrialization and urbanization, WP has become increasingly serious. Major social events or casualties caused by WP have occurred frequently, which has brought great threat and panic to people. In view of the current deteriorating situation of water environment quality, and combined with the current economic development and the continuous improvement of people's living standards and other actual conditions, some WP prevention and treatment measures are proposed, as shown in Figure 2.

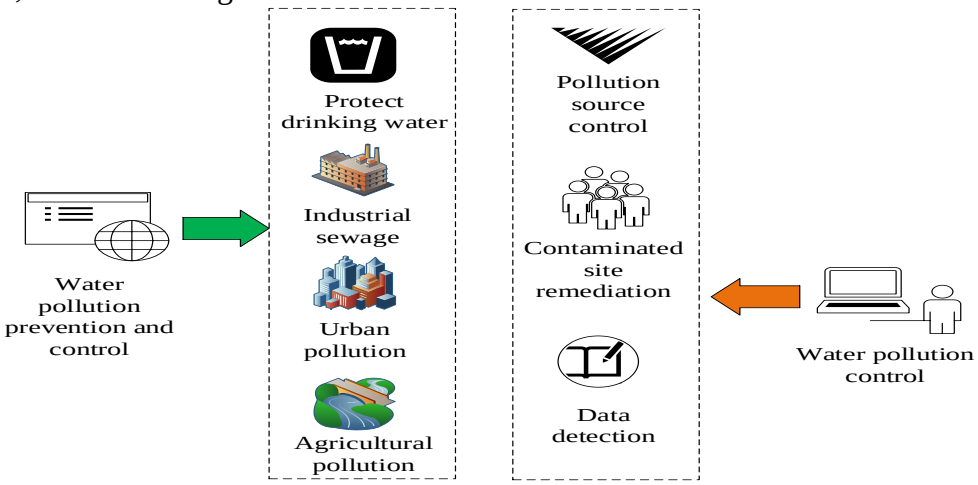


Figure 2. WP prevention and treatment measures

The prevention of WP needs to start from three main sources of pollution. First of all, it is necessary to cultivate good hygiene habits in life, and try to keep the natural environment clean, so as to reduce the harm of various harmful gases to human health. Secondly, for industrial enterprises, they should increase investment in environmental protection, and adopt advanced sewage treatment technology. They should also strengthen the supervision of sewage discharge, and maximize the role of sewage treatment plants, so as to treat sewage in strict accordance with relevant standards and ensure the discharge of industrial wastewater up to standard. Finally, in the process of agricultural production, a variety of measures should be taken to reduce the adverse effects of pesticides and other substances. At the same time, the quality and yield of agricultural products can be improved by planting pollution-free vegetables. Only in this way can the harmonious development of human and nature be truly realized. In addition, the awareness of environmental protection should be strengthened, and the establishment of a correct concept of ecological

civilization is also a problem that must be paid attention to. Especially for urban residents, they should pay more attention to their physical health and life safety, and avoid diseases or deaths caused by environmental pollution.

The treatment of WP is a complex and systematic project, and scientific decision-making must be made after comprehensive consideration of various factors. Pollution source control is one of the most critical links, because it is necessary to strengthen pollution source control to reduce the impact of pollutants on the environment, and control the total emission of pollutants, so as to protect the ecological environment. The specific work content is to reduce or eliminate the concentration of pollutants through purification treatment of various pollutants, so as to reach a certain level of control standards and make them meet the standard. However, when pollution has occurred, in order to minimize the harm, it is necessary to repair the contaminated area, which is a long-term and arduous process. It is necessary to establish a complete and effective WP prevention and control system to ensure the improvement of water quality and provide a strong guarantee for environmental protection, and it cannot simply solve the problem by a single means. Therefore, it is necessary to study new technologies, and adopt advanced technologies for prevention and control, so as to apply them to environmental protection. Data detection technology lays a solid foundation for achieving this goal.

2.4. WP Prevention Model Based on Intelligent Image Recognition

By aiming at the shortcomings of traditional sewage treatment, a new water quality automatic monitoring system based on intelligent recognition technology is designed. The system detects the depth and breadth of the water body, and processes the data through the computer to obtain the effluent concentration and water volume of each section. The system can well realize intelligent management in the actual operation process, as shown in Figure 3.

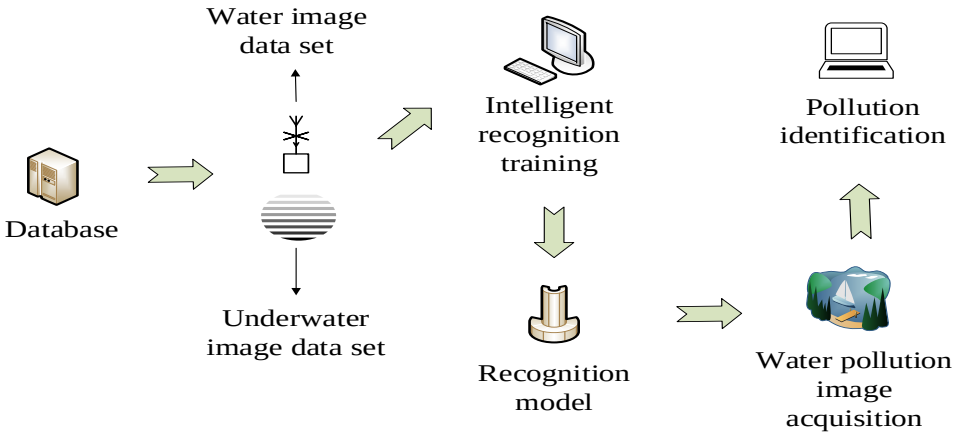


Figure 3. WP control model based on intelligent recognition

First of all, it is necessary to build a water area image database, which includes two parts: the data set of floating objects on the water and the data set of underwater organisms and sediment. The water data set includes the characteristic points of the water surface, the characteristics of floating objects, and the underwater data set includes the interference characteristics such as the distribution of underwater organisms and other microorganisms and sediment. The above feature sets are input into the neural network for training, and then the pollutant identification model is obtained. Finally, the sewage is monitored online in real time. Through the collection of water image, it can accurately determine whether the water contains organic substances, and it can also predict the degree of WP according to the sewage discharge. The system can effectively improve the accuracy of monitoring

data, and reduce monitoring costs, so as to realize information sharing, providing scientific decision-making support services for environmental management departments, which has good practicability.

3. Intelligent Identification Method of WP Factors

The mathematical model between influence factors and variables is constructed, and its formula is as follows:

$$\begin{cases} a_1 = r_{11}q_1 + r_{12}q_2 + ... + r_{1i}q_i + \lambda_1 \\ ... \\ a_n = r_{n1}q_1 + r_{n2}q_2 + ... + r_{ni}q_i + \lambda_n \end{cases} \tag{1}$$

In the formula, r_{xy} represents the linear relationship between the x th variable and the y th influence factor; λ_x represents the special factor; $x = 1,2...n$; $y = 1,2...i$.

The pollution indicators are standardized, and the formula is as follows:

$$A_x = \frac{e_i - e_j}{\mu} \tag{2}$$

In the formula, e_i represents the ith water quality detection index; e_j is the mean of e_i; μ is the standard formula value.

The correlation of variables is tested, and its expression is as follows:

$$KMO = \frac{\sum\sum_{u \neq v} w_{uv}^2}{\sum\sum_{u \neq v} w_{uv}^2 + \sum\sum_{u \neq v} m_{uv}^2} \tag{3}$$

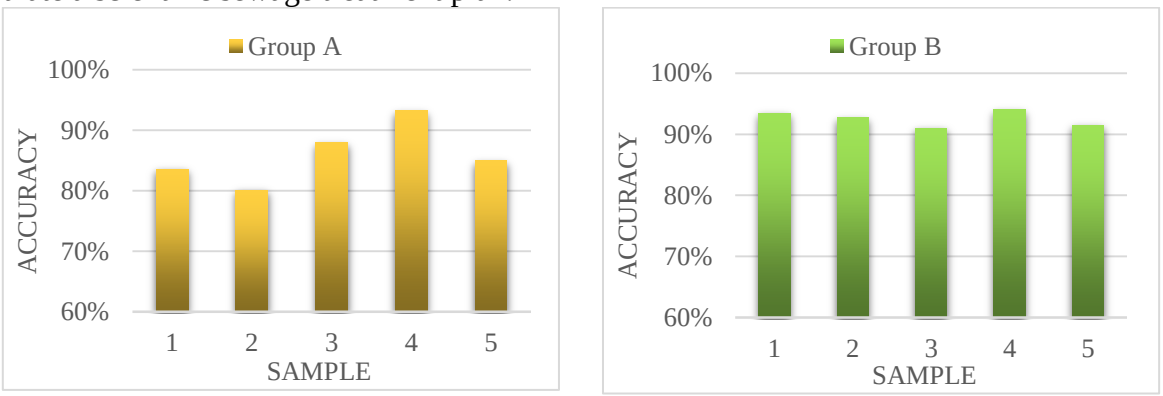
In the formula, w_{uv} is the correlation coefficient between e_i and e_j, and m_{uv} is the partial correlation coefficient.

4. Evaluation of WP Control Effect

Five regions were randomly selected for WP survey. According to the results of the offline field survey, the conclusion that there were WP phenomena in these five regions was obtained. The traditional manual detection and intelligent identification methods were used to classify the types of pollution, and the control effects of the two methods were analyzed. Two water samples were taken from each region, and 10 water samples were taken from five regions. They were divided into two groups: A and B. Group A was treated by traditional mode, while Group B was treated by intelligent recognition mode. The classification accuracy of the two groups was evaluated. The results were shown in Figure 4.

As shown in Figure 4, Figure a showed the classification accuracy of Group A and Figure b showed the classification accuracy of Group B. It could be seen that there were certain differences between Group A and Group B. Among them, the data distribution span of Group A was large, which reached about 93.2%. This was almost the same as Group B, but the lowest was about 80.1%. The detection level of this group was not stable and was greatly affected by human factors. The data of Group B was relatively concentrated, which was almost all distributed around 90%. This showed

that the WP classification and prevention system based on intelligent recognition technology was feasible, effective and economic, which had a good development prospect. After calculation, the average accuracy of Group A was about 85.98%, and that of Group B was about 92.52%. Group B was about 6.54% higher than Group A. Therefore, intelligent identification technology could control the total amount of water pollutant discharge and accurately analyze the WP status, so as to formulate a scientific sewage treatment plan.



a. Group A classification accuracy *b. Group B classification accuracy*

Figure 4. Comparison of classification accuracy of two models

5. Conclusion

Water quality is the key indicator that determines the quality and safety of agricultural products and people's health, and plays a very important role in ensuring the supply of drinking water and improving the living environment of human beings. The application of intelligent recognition algorithm in the automatic monitoring system of water quality can effectively reduce the error caused by manual operation, and at the same time reduce the human cost and material resource consumption to a certain extent, which is of great significance to the sustainable development of regional economy. By analyzing the current situation, existing problems and causes of water quality of pollution sources, this paper put forward measures to prevent and control WP, and improve the environmental supervision system of water sources, so as to strengthen monitoring and early warning, thus ensuring that the quality of drinking water sources reached the standard. This could improve the living standards of the people, and realize the unity of water resources development and utilization and environmental protection.

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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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