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Progress of Artificial Intelligence Applied in Water Pollution Prevention and Control Process

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Abstract: With the high-quality development of the current social economy, people's demand for various resources in nature is also increasing. This increasing demand has led to the abuse of various natural resources in some regions, which not only caused the waste of ecological resources, but also caused more damage to the ecological environment. Therefore, with the further development of various technologies and economies, government agencies in most regions began to attach importance to the rational use of natural resources, prevention and control of ecological pollution and other work. Most of the current pollution treatment and control models are based on the previous technical fields, and do not cite some information technologies that have emerged recently. Therefore, in the current pollution control, the work process is often more complex, and the work efficiency can not meet people's expectations. In addition, with the further aggravation of social ecological environment pollution, conventional pollution control measures can no longer meet the rapid growth of social development. At this time, the emergence of artificial intelligence (AI) also brings new ideas to the means of pollution control of the ecological environment. Reconstruction of the existing water resources management and control system through AI technology can not only further improve its performance, but also greatly improve the efficiency of water pollution prevention. This paper first analyzed the existing water pollution prevention and control (WPPC for short here) mode, and identified some shortcomings in the existing prevention and control mode. Then, the existing prevention and control mode were reconstructed by AI technology and support vector machines (SVM) algorithm. Finally, through simulation experiments, the performance difference between the existing WPPC model and the new model proposed in this paper in multiple evaluation indicators was determined, and the new model proposed in this paper has increased by about 25.1% compared with the existing prevention and control model on average.

1. Introduction

The rapid development of modern industry has first had a positive impact on the progress of social economy, and this impact has also improved people's material living standards. However, the rapid development of industry also has a certain negative impact on the local ecological environment. Therefore, it is necessary to minimize the negative impact on the ecological environment in the process of industrial development under the premise of ensuring the high-quality development of industry.

Some researchers in the current society first studied the damage caused by water pollution to the natural environment, and determined the negative impact of these damages on life and economic development. He Xiaodong explored the situation of surface water pollution in the central part of a plateau, and identified some hazards of water pollution to local residents [1]. Haghnazar Hamed explored the impact of the COVID-19 epidemic on the water pollution in the urban basin during the closure and control period, and determined that there was still a certain amount of water pollution discharge during the closure and control period [2]. Yan Yan explored the relationship between surface water pollution and its ecological risk in a certain area, and confirmed that there is a deep correlation between them through relevant experiments [3]. He Mingjing explored the role of biochar in water pollution control and determined the effectiveness of this biochar [4]. Liu Yi explored the relationship between water pollution and regional economic development in a region, and determined that the deepening of water pollution would have a negative impact on economic development [5]. Singh Upma explored the pollution of local water resources caused by the unrestricted discharge of industrial wastewater, and determined that the discharge of industrial wastewater is one of the main causes of local water pollution [6]. Mekonnen Mesfin M explored the impact of phosphorus content in global freshwater resources on water pollution, and determined that phosphorus content level is directly related to water pollution [7]. Through the analysis of a series of adverse effects caused by water pollution, it is clear that the current society needs to pay more attention to water pollution.

The other part of researchers have explored the treatment of water pollution, and hope to propose a better treatment plan through the study of various treatment methods. Singh Nirala explored the role of electrocatalysis in the treatment of water pollution, and determined the role of electrocatalysis in the treatment of water pollution by studying the categories of major pollutants of drinking water and industrial water pollution species and effective treatment methods [8]. Xu Zuxin explored the pollution situation and control plan of urban water area and determined a more effective water pollution control plan [9]. Tang Yankui studied some emerging pollutants in the water area and determined the sources of these pollutants through monitoring of different water areas [10]. Dai Yingjie explored the situation of groundwater pollution and put forward an effective treatment plan [11]. Shukla Bishnu Kant explored the proportion of physical and chemical elements in groundwater pollution in a certain area and determined a reasonable treatment plan [12]. However, the research of these researchers on the governance model is still fragmented, so they cannot combine to get a better governance plan.

This paper mainly analyzes the current situation of WPPC, and identifies some parts that can be optimized through relevant technologies in the process of WPPC. Then the main processes of WPPC are optimized through AI technology and related algorithm models such as SVM, so as to further improve the ability of WPPC and meet the needs of high-quality development of social industry.

2. AI Technology

With the rapid progress of information technology in recent years, researchers have proposed a

variety of information technologies to improve the quality of people's daily life. This paper analyzes the application of AI technology in the treatment of water pollution. AI technology in the current society generally refers to the imitation of human intelligence and learning ability, so that all kinds of machines in life have certain intelligence, and people can easily complete all kinds of work through these intelligent machines [13]. At the same time, AI technology can also be applied in the relevant facilities of water pollution analysis and treatment, which not only further improves the computing performance of these facilities, but also greatly simplifies the workflow of these facilities. Among them, AI technology also includes a variety of branch technologies and algorithms, such as SVM algorithm, neural network, particle swarm optimization, genetic algorithm, and so on. These algorithms have been widely used in many fields of life, and can also simplify the water pollution assessment model on the basis of ensuring high processing accuracy, so that this water pollution assessment model can process uncertain data and dynamic problems [14].

In addition, the rapid development of AI technology in recent years has also made it possible to reconstruct the management and control system of urban water resources, and has also provided key technologies for breaking the bottleneck of water system management performance. In AI technology, in the control of water resources and the prevention and control of water pollution, it is mainly to carry out more detailed regulation and control of water resources through its relevant algorithms, and quickly analyze and judge the various pollutants that cause water pollution, and select appropriate treatment schemes for them. This automatic water resource management and control and water pollution treatment mode not only further improves the efficiency of water resource management and control, but also makes the treatment of water pollution more timely. The application of AI technology in the analysis, detection and treatment of water pollution is shown in Figure 1.

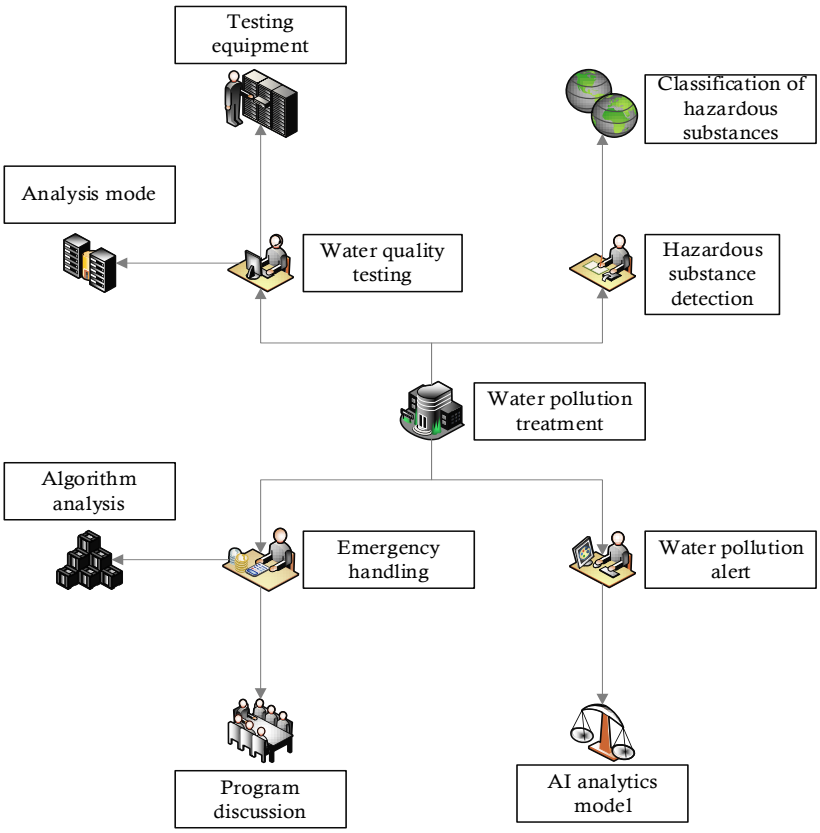


Figure 1. Schematic diagram of the application of AI technology in water pollution analysis and management

3. Water Pollution Prevention and Control Process

The rapid development of information technology and economy in the current era has further improved the average living standard of residents, but also brought more contradictions between environmental protection and economic development, which also led to the increasing frequency of water pollution. Therefore, at present, some researchers are carrying out comprehensive analysis of water pollution, so as to use corresponding means to control the further development of water pollution. The current water resource pollution is different from the previous environmental pollution, mainly because it is relatively difficult to trace the source of water resource pollution, and the process of its component analysis is also complicated. Therefore, in the process of prevention and treatment of water pollution, it is not only necessary to add various emerging technologies, but also needs the policy cooperation of relevant regional management institutions. First of all, the management of different river basins needs to be clearly divided, and then the existing water pollution prevention standards and supporting systems need to be improved, which requires the in-depth integration of some emerging technologies. The existing water pollution prevention and treatment process is shown in Figure 2.

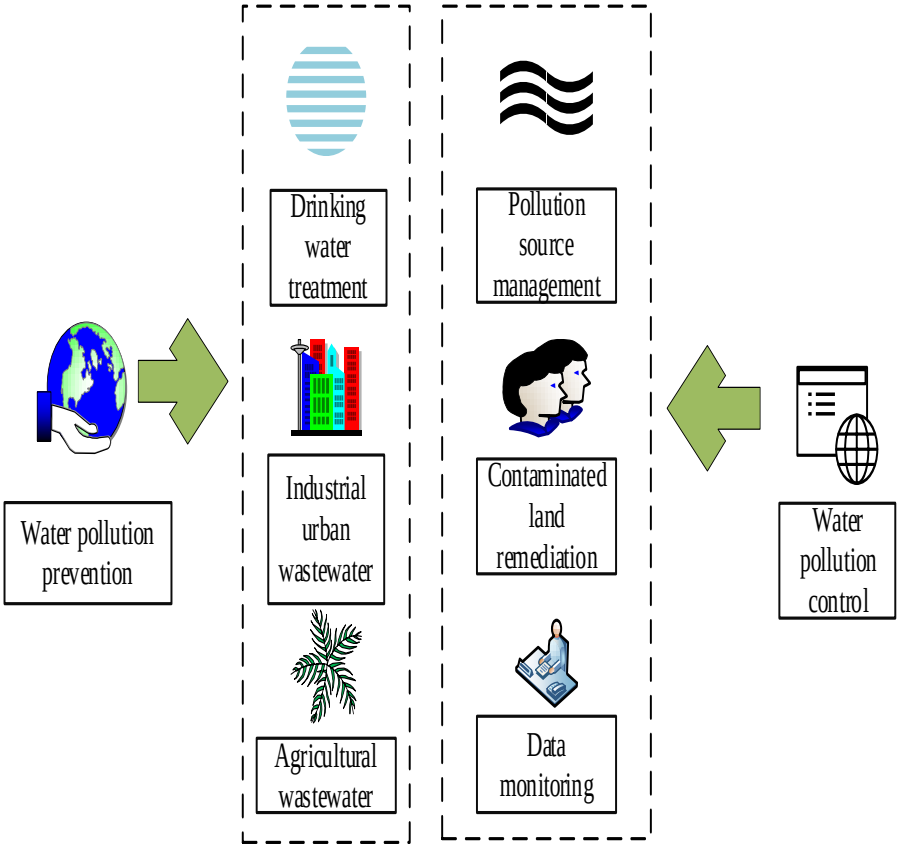


Figure 2. Schematic diagram of the existing water pollution prevention and treatment process

At present, AI technology and a series of derivative technologies and algorithm models are widely used in the prevention and treatment of water pollution. These technologies can not only realize the automatic monitoring and alarm of water quality status [15]. At the same time, on this basis, people can also analyze the proportion of pollution sources and various pollutants, so as to give a relatively reasonable water pollution control measure. The water pollution analysis process combining AI technology is shown in Figure 3.

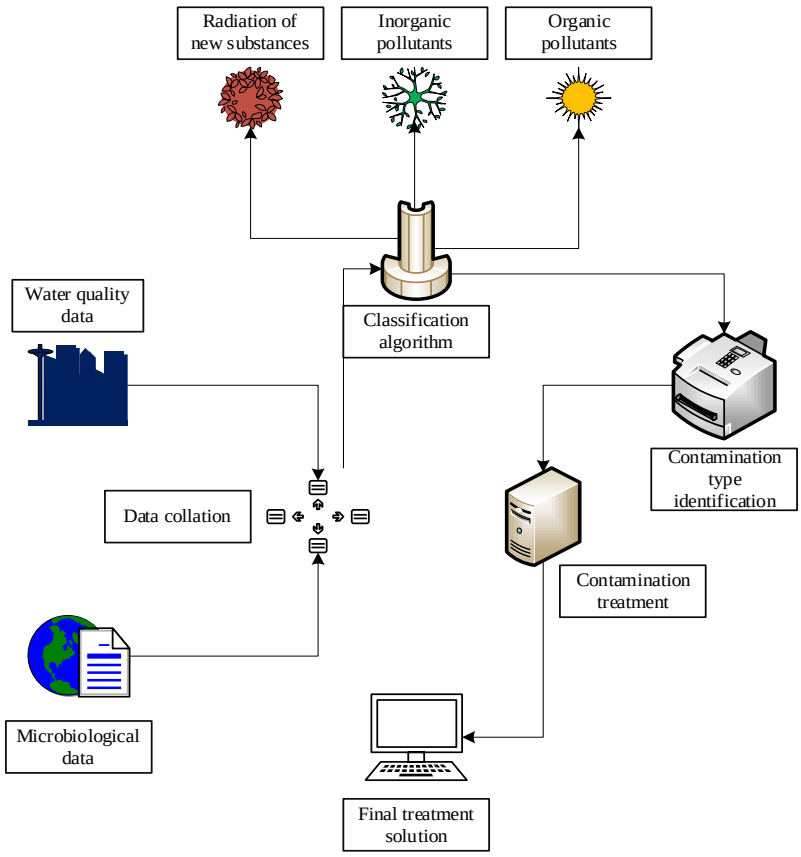


Figure 3. Schematic diagram of the water pollution analysis process combined with AI technology

4. AI Algorithm

The pollution of water resources has always been one of the focus issues in the current society, and the evaluation of river pollution degree and the detection of water quality are also one of the key work of water resources pollution prevention and control. The accurate detection of the pollution degree and water quality of rivers can not only further reflect the pollution status of rivers, but also play a positive role in the next step of water pollution control. At present, when evaluating the degree of river pollution and detecting the water quality, the main problem is that there is no perfect data processing model to process the relevant data of river pollution, and the work efficiency of the evaluation model for water quality is relatively low. Therefore, the prevention and control model of water pollution urgently needs the integration of various emerging algorithm models. Among them, the SVM algorithm in AI technology is an algorithm model that has just emerged in the recent period. This algorithm model is currently mainly used to solve various complex nonlinear problems. And because of its superior performance in data classification and regression, this algorithm has been widely used in many fields. This paper mainly analyzes and judges the types of pollution in the water area through SVM algorithm, so as to better improve the work efficiency.

The first step is to analyze and judge the types of pollution and water quality in the water area through SVM algorithm. The first step is to collect data and divide the location of the data in the plane. Generally, formula (1) is used to divide different types of data in the plane.

$$f(x) = a_w x + b \tag{1}$$

a_w represents the weighted normal vector of the plane where the data is located, x represents

the input sample data, and b represents a parameter of the plane. Then the interval of data in the plane is calculated, and the formula is shown in (2).

$$f(d) = y \cdot (a_w x + b) \cdot \frac{1}{w} \tag{2}$$

In the formula, y represents the characteristics of the data, and w represents the weight. Finally, the optimization problem is solved by Lagrange function, and its formula is shown in (3).

$$L(x) = \frac{1}{2} w^2 - \sum_{i=1}^{n} y_i (w \cdot x_i + b) \tag{3}$$

This paper realizes the assessment of water pollution and the classification of water quality pollutants through the algorithms in relevant AI technologies such as SVM, so as to carry out more accurate treatment of water pollution.

5. Experimental Study on Prevention and Control of AI Background Water Pollution

The current WPPC mode is mainly to limit the pollution discharge to a certain extent, arrange sewage treatment facilities in each basin for general pollution treatment, and improve the treatment technology of sewage or pollutants. However, there are still many problems in the existing WPPC mode, such as the low efficiency and carrying capacity of sewage treatment facilities, etc. Therefore, it is necessary to integrate various information technologies into sewage treatment, and greatly improve the working process and carrying capacity of sewage treatment facilities and treatment technology. On the other hand, the control of pollutant discharge in the current WPPC mode is relatively not scientific and effective, so it is necessary to further optimize the work flow in the aspect of pollution discharge and carry out more detailed control on the treatment of enterprises or various domestic sewage. In this paper, AI technology and related algorithms are mainly used to optimize multiple work processes such as pollution discharge and pollution treatment, so as to ensure better prevention and control of water pollution in the process of high-quality socio-economic development.

The first is to analyze the common types, main treatment modes and effects of pollutants in general waters, as shown in Table 1.

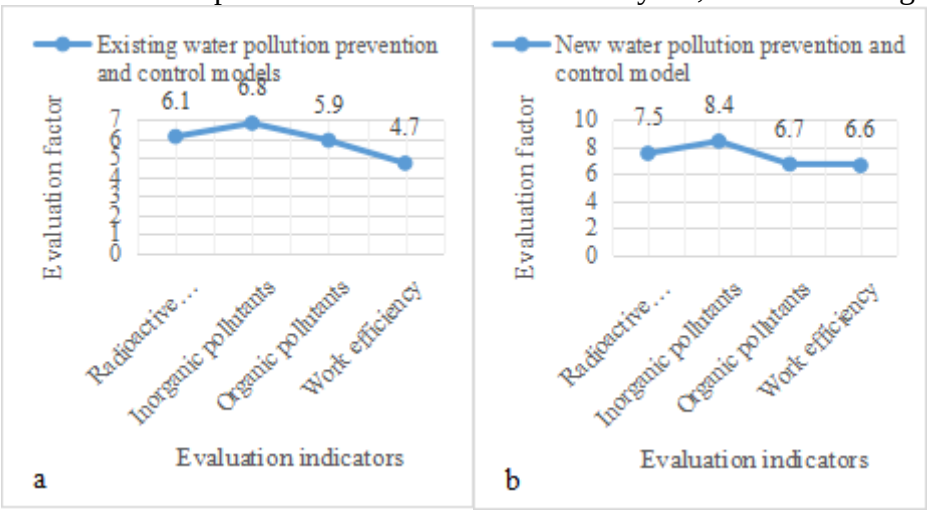
Table 1. Common pollutants in general waters and the main treatment modes and effects

Water pollutants	Physical treatment method	Chemical treatment method
Radioactive substances	7.6	5.9
Inorganic pollutants	4.3	8.5
Organic pollutants	6.8	5.1

After analyzing the common pollutants of current water pollution in Table 1, it can be determined that there are various types of pollutants in the current general water area, so it is generally necessary to take more steps for a section of the river basin to completely remove all kinds of pollutants in the water area. In the process of pollutant removal, physical and chemical methods are generally used for treatment. First, physical treatment methods include membrane engineering method and adsorption method. Among the physical treatment methods, the membrane engineering method started relatively late, so its use cost is relatively high, so at present, the

membrane engineering method is also less widely used for pollution treatment. On the other hand, the adsorption method mainly uses the activated carbon adsorption method to adsorb a variety of substances in the water. Because this activated carbon adsorption method does not occur chemical reaction, it generally does not cause additional pollution to the treated water area, and its cost performance is also high. In addition, there are chemical treatment schemes. The general chemical treatment scheme is to change the nature of pollutants in the water through a series of chemical reactions to reduce their harmfulness. This chemical treatment scheme includes flocculation sedimentation and electrolysis. However, due to the chemical reaction during the treatment process, the water quality needs to be analyzed at a deep level during the use of this method to ensure that it would not cause additional pollution.

Then, the performance differences between the WPPC model proposed in this paper and the existing WPPC model in multiple evaluation indicators are analyzed, as shown in Figure 4.



a. Performance of existing WPPC models

b. Performance of the new WPPC model

Figure 4. Performances of the existing water pollution management model and the AI technology-based water pollution management model on several evaluation indicators

Generally, relevant staff need to conduct in-depth comprehensive analysis of the pollutants in a water area during the pollution treatment of a water area, and then select appropriate treatment scheme to purify the water area according to the types and contents of various pollutants in the water area. In the existing WPPC mode, the water area to be treated is generally sampled in sections, and the appropriate treatment scheme is selected in different river sections by manpower. After analyzing the capacity and overall work efficiency of the existing WPPC mode in the treatment of various pollutants in Figure 4a, it can be seen that the existing WPPC mode has a good performance in the treatment of inorganic pollutants, but its overall work efficiency is poor. On the other hand, after analyzing the performance of the WPPC model combined with AI technology proposed in this paper in the same aspects in Figure 4b, it can be seen that this WPPC model combined with AI technology has improved its governance ability in many aspects, and its overall work efficiency has also been greatly improved. This is mainly due to the addition of SVM algorithm model in AI technology, which greatly improves the efficiency of pollution type and governance mode selection. Finally, the performance difference between the proposed WPPC mode combined with AI technology and the existing WPPC mode in many aspects is analyzed, and the performance of the

new WPPC mode proposed in this paper is determined to be improved by about 25.1% on average.

6. Conclusion

As a natural resource on which people live and economic development depends, the pollution level of water resources has also increased rapidly in recent years. This growth not only has a direct impact on people's health, but also has a certain impact on the high-quality development of society and enterprise economy. At present, the regional water environment is facing the pressure of water pollution and extreme shortage of water resources. On the other hand, the domestic sewage in cities is also increasing rapidly, but the domestic sewage treatment measures and institutions cannot deal with these domestic sewage in time. The main reasons for this situation are the lack of effective water environment protection infrastructure in cities, and the low working capacity of urban water system. The emergence of AI technology has brought new ideas to the work flow of WPPC. On the one hand, AI technology has optimized the regional water quality assessment model and environmental assessment model, further improving the regional water pollution treatment and prevention and control capabilities. On the other hand, the early warning and emergency treatment model of regional water pollution is completed through AI technology, SVM and other related algorithms. This model completes automatic water pollution treatment through the adaptive data processing ability of AI technology. Through in-depth research on the WPPC mode under AI technology, it is determined that the WPPC mode combined with AI technology provides a more scientific and effective means in the analysis and removal of pollutants in rivers.

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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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