

# ***Construction of Comprehensive Prevention and Control Project of Water Works Based on Artificial Neural Network Algorithm and Artificial Intelligence***

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**Abstract:** The further development of information technology has brought more convenience to people's lives. However, this process of social and economic development has also brought more burdens to the local ecological environment, making people face water pollution and water resource depletion and other problems. In order to improve or even solve these problems, it is necessary to control water pollution, and at the same time make people develop the concept of saving water. The safety of drinking water is not only an important guarantee for the maintenance of human health, but also can help the current ecological environment to carry out sustainable development and provide a certain auxiliary role for social and economic development. First of all, to solve the problem of water pollution, it is necessary to pay enough attention to the waterworks in the city, so as to further improve the performance of the water purification technology of the waterworks. At the same time, it is also necessary to optimize the water quality treatment mode of the waterworks to meet the needs of social development. However, the current artificial intelligence (AI) and artificial neural networks (ANN) algorithms have experienced a long period of development and have deep applications in many fields of real life. Among them, the ANN algorithm model can automatically analyze and process data. At the same time, it can transform problems that cannot be solved by existing solutions into mathematical problems for efficient solution. On the other hand, the ANN algorithm model can also be combined with the branch technology in AI to analyze all kinds of feature data of things. Based on these data analysis, fault detection and precise control in industry can be well completed. Through AI technology and ANN algorithm model, this paper proposed a comprehensive prevention and control project for water works, and compared the performance of this comprehensive prevention and control project with the existing comprehensive prevention and control of water works in many aspects. It is determined that the performance of this new comprehensive prevention and control project in many aspects has been improved by about 22% on average.

## 1. Introduction

At present, there are many technologies that can treat water resources in the comprehensive prevention and control project of the water plant. However, these technologies can not be well applied in the actual workflow. On the one hand, the efficiency of the existing manual work mode is relatively slow. On the other hand, the analysis mode in the existing prevention and control project is still not perfect. This paper is to study the water treatment process, water treatment technology and the development direction of these technologies in the comprehensive prevention and control project of the waterworks, which is of great help to propose a new type of prevention and control project of the waterworks.

At present, some researchers have analyzed the current pollution in tap water, hoping to determine the category of pollutants through this analysis. Solangi Ghulam Shabir explored the performance of the index for evaluating the quality of water resources in a region and the pollution index in the evaluation of water resources pollutants, and determined that the integration of the two indexes could further improve the evaluation efficiency of pollutants [1]. Son Cao Truong explored the role of water quality and water pollution index in the comprehensive assessment of water resources in a region, and determined the superior performance of this model [2]. Hamid Aadil explored some factors affecting the quality of water resources in a region, and determined the harmfulness of pollutants through the analysis of these pollutants [3].

Tang Yankui explored some emerging pollutants in the water source of a region, and determined the characteristics of these emerging pollutants through various analysis models [4]. Mekonnen Mesfin M explored the impact of the content of pollutants in freshwater resources on the quality of the whole water area, and determined the dangerous degree of such pollutants [5]. Singh Upma analyzed the impact of waste generated in the process of industrial development on the quality of water sources and determined the degree of water pollution [6]. Yan Yan explored the pollution of domestic water in a city and determined the pollution of surface water resources [7]. However, these analyses do not play a significant role in improving the deficiencies in the integrated prevention and control model of the existing waterworks. Therefore, other studies are needed.

Another part of researchers have analyzed the analysis and treatment technology of water pollution, hoping to optimize the treatment process in the waterworks through this analysis. Muharemi Fitore explored the role of machine learning algorithm in AI technology in the analysis of water pollution, and determined the reliability of this algorithm [8]. Bisht Anil Kumar explored the role of ANN algorithm model in the quality analysis of water resources in a region, and determined the reliability of ANN algorithm [9]. Haghiabi Amir Hamzeh explored the effect of an algorithm model in AI technology in the analysis of water pollution, and determined the feasibility of AI technology in water pollution analysis [10]. Sahu Subhankar explored the role of an identification device in the analysis of water pollution and determined the reliability of this device [11]. Li Xiang explored the role of a metal frame in the treatment of water pollution, and determined the feasibility of this metal frame. Although these studies have obtained many results, they are not enough to support the overall optimization and update of the existing integrated prevention and control project, which needs further research.

First of all, this paper analyzed some shortcomings of the existing comprehensive prevention and control project of the waterworks, and identified some parts that can be improved. Then, AI technology and ANN algorithm model were analyzed in depth, and the feasibility of the application of the branch technology of AI technology and ANN algorithm in the existing integrated prevention and control project was determined. A comprehensive prevention and control project of waterworks based on AI and ANN was proposed, which further improved the overall work efficiency.

## 2. AI and ANN

With the continuous progress of information technology in the current society, researchers in relevant fields have put forward the breakthrough technology of AI technology through the study of human characteristics [12-13]. AI technology does live up to expectations. After a period of development, it has been applied in many fields in real life at a deep level. The current AI is mainly a technology that helps some machines to solve problems in different situations adaptively through the research of human intelligence [14]. AI technology can also play a greater role in the prevention and control of water resources. In the existing comprehensive prevention and control project of the water plant, the machine vision technology under AI technology can be used to analyze the working conditions of multiple work processes, so as to better complete the allocation of multiple types of machines in the comprehensive prevention and control project of the water plant, which also saves a lot of costs for the water plant. Among them, AI technology includes branch technologies and their applications as shown in Figure 1.

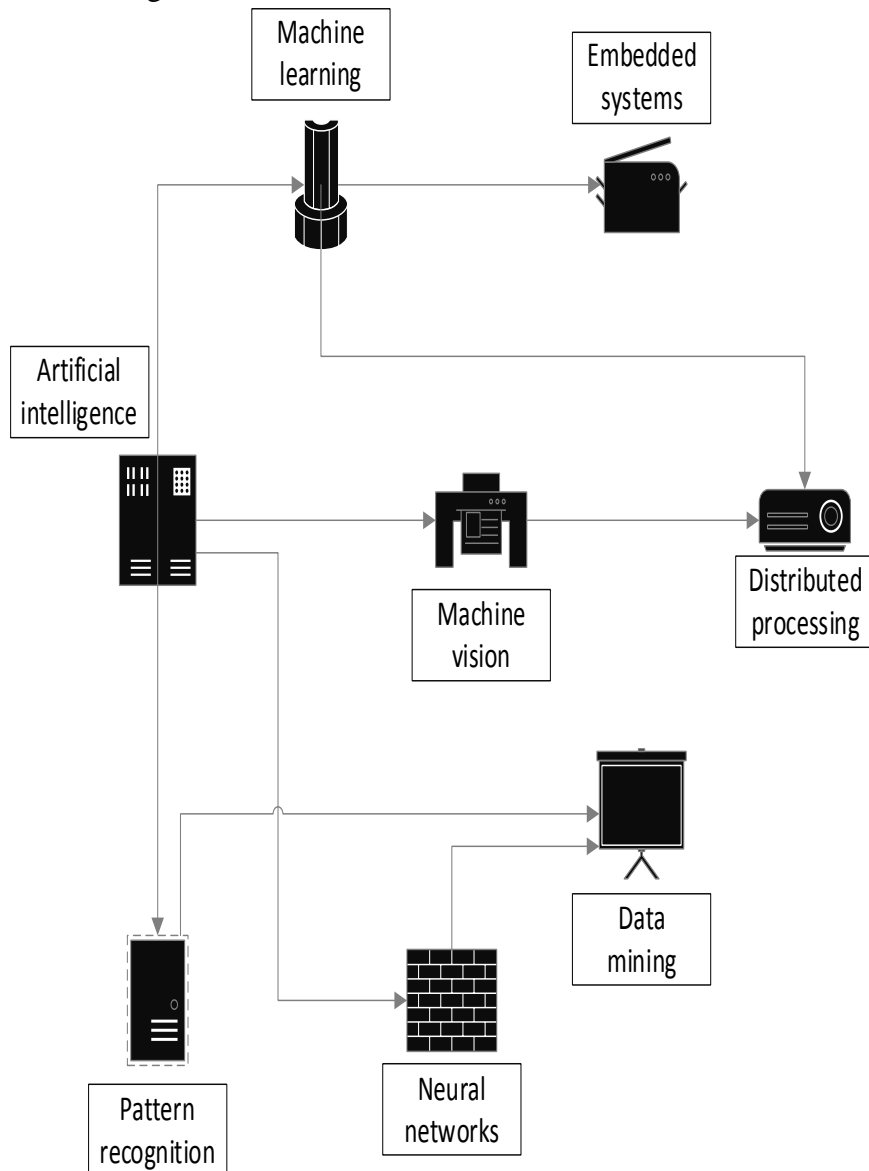


Figure 1. Schematic diagram of branch technologies and their applications of AI technology

As the most representative algorithm model under AI technology, ANN algorithm has made great contributions to the process of promoting AI technology to achieve its final goal. ANN can help the machine acquire stronger data processing ability by imitating the biological brain structure, and it is also a high-quality statistical method [15]. This paper mainly uses ANN algorithm model to optimize the water source treatment process in the waterworks. First of all, through the adaptive processing mode of data in ANN, the water plant can automatically complete the water source analysis and processing process through the allocation of relevant machines. At the same time, in this process, it is generally necessary to simplify the algorithms in various operation modes of the comprehensive prevention and control project of the water plant, so as to further improve the work efficiency. The general workflow of ANN algorithm model is shown in Figure 2.

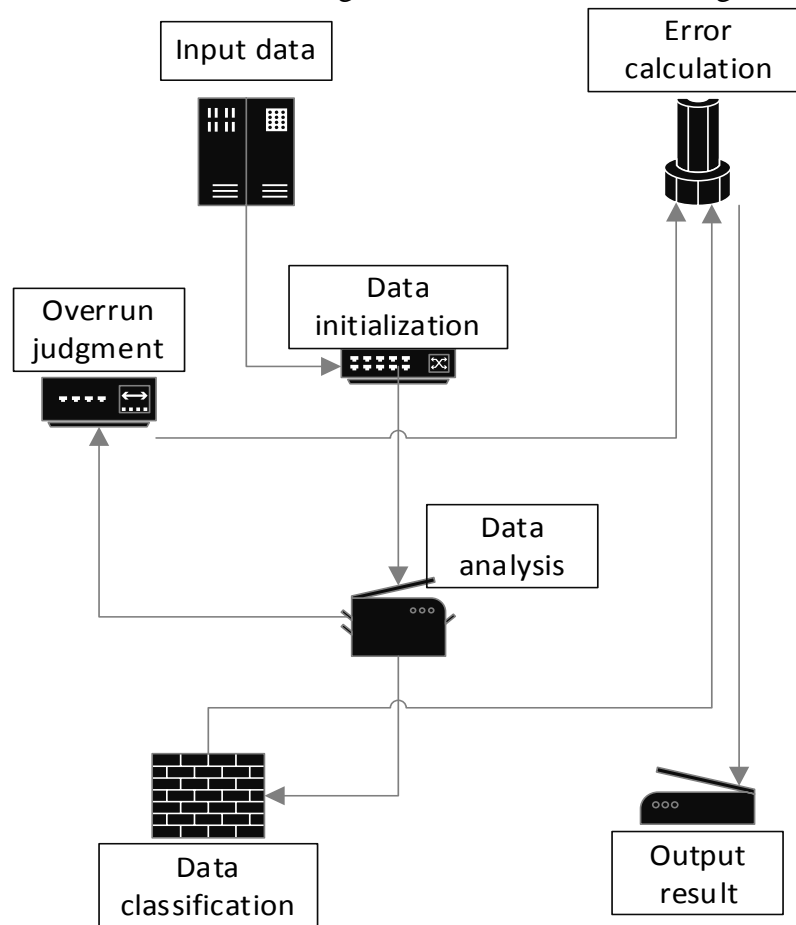


Figure 2. Schematic diagram of the general workflow of the ANN algorithm model

### 3. Comprehensive Control Project of Water Plant

The current water plant generally has many processes in the water source treatment process, including water intake process, sedimentation tank, filter tank, outlet pump and distribution center. Among them, the water intake pump mainly includes a number of centrifugal pumps capable of high-speed rotation. This centrifugal pump can drive the incoming water and throw the water into the system to achieve the purpose of water transmission. In the comprehensive prevention and control project of the whole water plant, the water pump is mainly used to pressurize the water source and deliver it to the next process for treatment. Then there is the sedimentation tank. The sedimentation tank can generally settle the inflow water in a static state. During the whole process, the larger pollutants in the water can be settled to the bottom of the tank, thus achieving the effect of

removing some pollutants. The bottom of the whole sedimentation tank is generally equipped with sludge discharge pipes to discharge pollutants regularly. Then, the chemical disinfection process is carried out for the water source, which is generally carried out in the filter tank. Most of the pollutants in the water can be removed by reaction through a variety of disinfectants. Finally, the water is pressurized by the water outlet pump. In this process, the allocation center generally transfers various equipment to complete the water source treatment. This paper optimizes the operation model and technology of the distribution center through ANN algorithm and AI technology, thus improving the overall work efficiency. The integrated prevention and control engineering process of the water plant is shown in Figure 3.

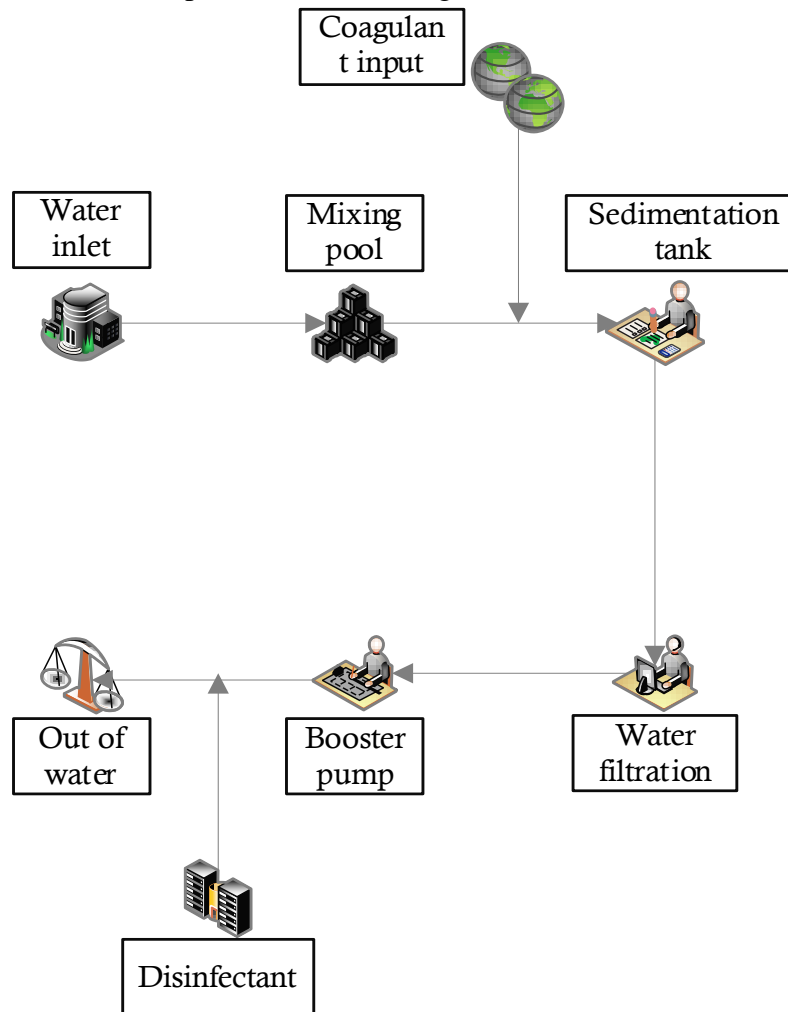


Figure 3. Schematic diagram of the comprehensive prevention and control engineering process of the waterworks

#### 4. ANN Algorithm

For a long time, because the water plant is in a monopoly position in the field of water resources purification, it still uses the traditional purification and allocation mode in the purification and allocation mode of water resources, so its various performance can not meet the needs of social development. At present, researchers in relevant fields begin to analyze and optimize the comprehensive prevention and control engineering mode of the water plant. In this process, based on the main water purification business process of the waterworks, the waterworks are optimized

and reformed in all aspects. The water purification business of the waterworks mainly consists of four parts. In this paper, through the analysis of the existing four parts of the work flow, the shortcomings of the existing water purification business of the waterworks are identified. Through AI technology and its ANN algorithm model, some of the calculation modes in the four parts have been simplified and optimized, making the core business of the water plant have stronger performance, and also making its work efficiency further improved.

First, the activation function is used to calculate the input vectors in each neural network level in the ANN algorithm. In this calculation process, it is generally necessary to consider the weight and bias of neurons in each layer. The main calculation formula is shown in Formula (1).

$$f(x) = \sum_{i=1}^m w_i x_i + b_i \quad (1)$$

Among them,  $w_i$  represents the weight value of neurons.  $b_i$  represents the offset of neurons in each layer, and  $m$  represents the number of network layers. Then, the loss value in the whole calculation process is calculated. Generally, the mean square error of the output value is calculated, as shown in Formula (2).

$$L = \frac{1}{2} \sum_{i=1}^m (x_i - T_i)^2 \quad (2)$$

Among them,  $T_i$  represents the difference between the  $i$ th value of the output vector and the value at the same position of the label vector. Finally, the loss value of linear regression is calculated, as shown in Formula (3).

$$J = \frac{1}{2} \sum_{i=1}^m (h_{\theta}(x) - y)^2 \quad (3)$$

The addition of the above ANN algorithm model not only further improves the working efficiency of the comprehensive prevention and control project of the existing waterworks, but also improves the analytical ability of water pollution in the analysis of water pollution, and improves the performance of the comprehensive prevention and control project of the waterworks in many aspects.

## 5. Comprehensive Prevention and Control Project Experiment of New Water Plant

With the deepening of the industrial level of society, people's pollution of water resources in the ecological environment is also increasing rapidly. However, people's daily life and social economic development cannot leave the support of water resources. Therefore, this situation has brought great pressure to the waterworks responsible for water environment purification and water resources management in the city. At present, the categories of water resources pollutants in the natural ecological environment are also increasing rapidly. This situation also makes the waterworks need to carry out more processes in the process of water purification to make the tap water exported by the waterworks meet the daily needs of the society and residents. Therefore, this paper mainly uses AI technology and ANN algorithm model to optimize the existing tap water treatment process and tap water distribution system, and supplement some of the deficiencies. It adds some functions to improve the user experience to the existing comprehensive prevention and control project of the waterworks, and provides better technical support for the further development of the waterworks. On the other hand, the ANN algorithm model can also analyze and judge the pollutants in the current water resources pollution, which not only greatly reduces the pollution degree of the treated tap water, but also improves the overall work efficiency.

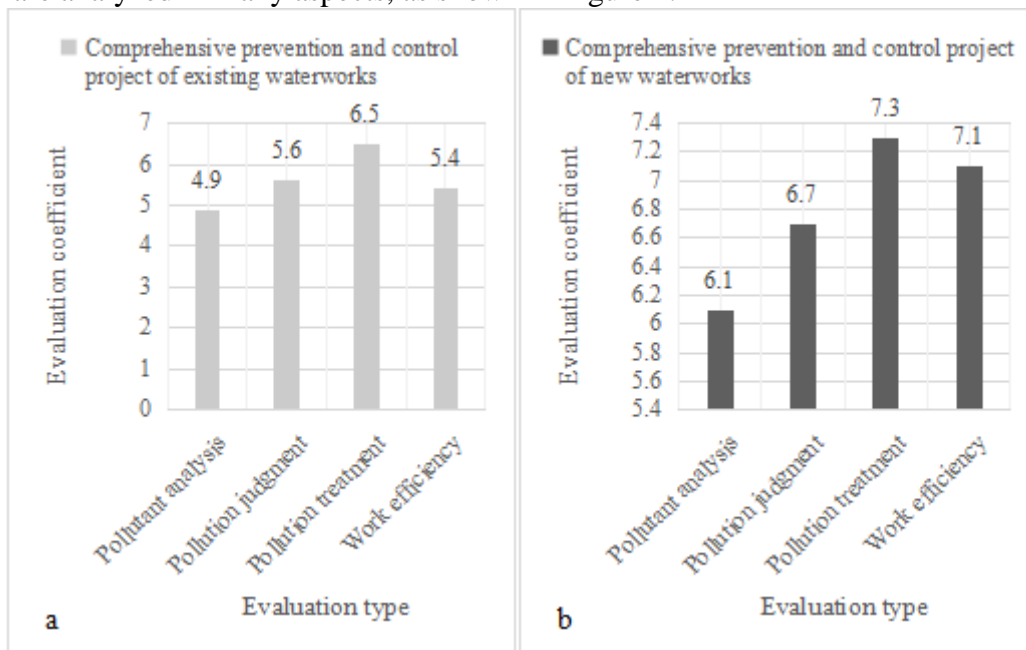
The first is to analyze the purification effect of different water source treatment substances in a water plant in a certain area when treating water pollution, as shown in Table 1.

Table 1. Purification effect of different water treatment agents in waterworks

	Jelly	Suspended matter
Polymerization aluminum chloride	6.3	7.3
Aluminum sulfate	5.7	6
Ferric chloride	6.9	5.2

The first water treatment agent, polyaluminum chloride, generally adsorbs various impurities in the waterworks, and precipitates the adsorbed substances. In addition, this water treatment agent has a long history of development. Therefore, the cost of its use is also relatively low. The other two are to remove toxic substances that may exist in water. Through the analysis of the performance of the three water treatment agents in Table 1 during the removal of colloidal and suspended solids, it is determined that the first water treatment agent has relatively good ability to treat suspended solids. With this advantage, this water treatment agent has also been well applied in the waterworks in the region.

Finally, the performance of the existing integrated prevention and control project of a water plant in a certain area and the new integrated prevention and control project combining AI and ANN algorithm are analyzed in many aspects, as shown in Figure 4.



a. Schematic diagram of the performance of the comprehensive prevention and control project of the existing waterworks

b. Schematic diagram of the performance of the new waterworks comprehensive prevention and control project

Figure 4. Schematic diagram of the performance of the comprehensive prevention and control project and the new prevention and control project in the existing waterworks



At present, with the continuous development of society, various environmental pollution problems are increasingly prominent. Under this social background, the comprehensive prevention and control project of water works is becoming more and more important. More researchers in relevant fields began to study the new model of integrated prevention and control project in water works. In this paper, AI technology and ANN algorithm model are used to optimize the integrated prevention and control engineering model in the existing waterworks. The first is to analyze the performance of the existing comprehensive prevention and control project of the water plant in Figure 4a, and determine that the existing comprehensive prevention and control project has a good performance in the treatment of pollution. On the other hand, it is to analyze the performance of the new water plant integrated prevention and control project in Figure 4b, which combines AI technology and ANN algorithm model. It can be clearly seen that this new engineering model has better performance in many aspects. The performance of this new comprehensive prevention and control project has increased by about 22% on average compared with the existing prevention and control projects.

### 6. Conclusion

Water resources have always been the basis of high-quality socio-economic development and daily life in a region, which also makes the water plant supplying domestic water for residents become one of the most important infrastructure in a city. In recent years, with the rapid development of social economy and industrial level, urbanization and industrialization are developing faster and faster. The negative impact of this rapid development has further deepened the pollution of the ecological environment. In the current society, the purity of domestic water has attracted more and more attention of residents. Therefore, the requirements of relevant researchers on the quality, safety and reliability of the water supply of the waterworks are also being further improved. At present, the optimization of the comprehensive prevention and control project of the waterworks still needs the in-depth integration of some emerging information technologies to update the existing comprehensive prevention and control project of the waterworks and make its various performance meet the requirements of social development. Currently, the water works are mainly responsible for the purification and allocation of water sources. Therefore, the main place for upgrading is the water source treatment and management. At present, the treatment and management of water sources in waterworks are mostly carried out by manpower, and its efficiency is also relatively low. In the process of rapid social and economic development, the water demand of enterprises or residents cannot be met. In this paper, the AI technology and ANN algorithm model are used to update and iterate the comprehensive prevention and control project of the waterworks, mainly simplifying or updating multiple steps in the workflow of the water source control system and water source purification system of the waterworks. This update also makes the work efficiency of the comprehensive prevention and control project of the waterworks further improved, and plays a good role in the high-quality development of the social economy.

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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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