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Construction of Water Pollution Prevention and Control Project of Urban Sewage System Based on Feature Selection Algorithm and Machine Learning

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Abstract: With the rapid development of economy, people have higher requirements for living standards. However, the problem of domestic sewage has not been fundamentally solved, which has also led to serious environmental and health hazards in more and more cities. Water pollution is one of the reasons. Therefore, in order to effectively control the discharge of pollutants and the deterioration of water quality in urban water bodies, it has become an important work urgently needed to deal with. In order to solve the problems in the construction of traditional urban sewage system water pollution prevention and control engineering, such as relying too much on the professional knowledge and subjective judgment of experts and scholars, not being able to effectively monitor and predict water pollution problems, and the single means of preventing and controlling water pollution problems, this paper proposed a new construction model of urban sewage system water pollution prevention and control engineering. This model not only has better collection effect and evaluation efficiency, but also has more efficient response measures for sudden water pollution problems. Finally, according to the experimental data, the construction model of governance of water resources issues project of urban sewage system proposed in this paper has increased by 11.4% on average in four evaluation indicators compared with the traditional model of governance of water resources issues project of urban sewage system.

1. Introduction

In the process of urban sewage treatment, first of all, in order to ensure that the water quality reaches the standard, the organic matter in the sewage should be decomposed, and then the

ammonia gas should be converted into nitrite, nitrogen or iron ions by microorganisms to reduce the oxygen content in the water, improve the activity of harmful organisms in the water, remove nutrients and purify the water body to meet the requirements of the best fertilizer environment. Finally, the chemical fertilizer is recovered from the waste water by physical methods to prevent and control various raw materials and energy consumption required by the project construction. At the same time, the urban domestic sewage should be disinfected to reduce the generation of urban pollution sources. The system built in this paper has solved the problems of traditional systems that rely too much on the subjective judgment and professional knowledge of experts and scholars, not finding the hidden danger of water pollution in time, slightly weak response measures, and not predicting the water pollution problem in time in urban prevention and control.

Some scholars have explored the problem of water pollution in urban water system. Through investigating the pollution sources of water pollution in some waters around the local area, He Xiaodong collected samples focusing on the content of special elements. The harm of high content of special elements in water pollution to human body was found, and the severity of water pollution was emphasized [1]. Dwivedi Sanjay combined information technology and system search to analyze and investigate the composition of pollution sources in local waters. The health level of the local population can reflect the severity of the water pollution problem in the local waters, and the potential impact of different pollution sources on human health has been found [2]. Lee Chang-Gu put forward different water pollution prevention and control schemes by purifying different water pollution problems and combining various adsorbed cleaning substances. By analyzing the experimental results, the effectiveness of different adsorbed cleaning substances on water pollution problems was obtained, which contributed valuable experience to the prevention and control of urban water pollution [3].

In order to study the effective prevention and control measures of water pollution, Akpomie Kovo G combined with local water samples and biosorption technology, and explored the prevention and control effects of water pollution problems, thus determining the reliability of such technology in water pollution problems [4]. By studying the per capita distribution of local water resources and people's awareness of water pollution prevention, KiliC Zeyneb stressed the importance of water resources for human survival and the need for timely prevention and control of water pollution [5]. Rizk Roquia conducted sampling survey on the water quality status of local waters, and assessed the monitoring quality of samples from different waters through different assessment methods. After analyzing the assessment data, it was found that the monitoring quality assessment of different water samples by different assessment methods is different. In order to maintain the timely monitoring of water quality, the water quality assessment method needs to be improved [6].

Misganaw Awoke studied the sustainable development of local water resources. Based on the dynamic model and computer system, a sustainable evaluation framework for water resources was proposed. Through comparative analysis of the assessed data, more accurate assessment results were obtained, thus determining the reliability of the model in water pollution prevention and control [7]. Elkhatib Dounia explored the extraction method of pollution components in water pollution wastewater. Combined with different collection, quantification and adsorption substances, a variety of purification schemes and methods were proposed, and the effects of different methods were compared and analyzed, thus determining the effectiveness of this method in water pollution control [8]. In order to study the secondary pollution problem in the process of water pollution purification, Wang Faming combined the new nano-adsorption technology and improved it based on the traditional model, and proposed a new water pollution prevention method, which opened up a new direction for the field of water pollution prevention [9].

In addition, some scholars and experts have explored the monitoring and prediction methods of

water pollution problems, hoping to have a more complete plan for the construction of water pollution prevention and control projects. Azad Armin combined with adaptive neuro-fuzzy inference system to tentatively improve the water resources and water quality monitoring system, and the reliability of this technology in water resources and water quality monitoring can be obtained through experimental analysis [10]. Janga Reddy M studied the application of water resources engineering in cities. Combined with big data algorithm and computer technology, a new water resources engineering construction model was proposed, and its application in the construction of governance of water resources issues engineering was seen in the process of engineering construction, which opened up a new direction for the construction of governance of water resources issues engineering [11]. Abba S I studied the direction of predicted dissolved oxygen in water system. He tentatively introduced the artificial neural network algorithm, and proposed a water resources management framework based on information technology, which opened up a new field for the construction of water pollution prevention projects [12]. However, none of the above studies has put forward a relatively complete plan for the construction of urban water pollution prevention and control projects.

The main purpose of this paper is to solve the problems in the construction of water pollution prevention projects in traditional urban sewage systems, such as over-reliance on the professional knowledge and subjective judgment of experts and scholars, inability to effectively monitor and predict water pollution problems, and difficulty in highly implementing countermeasures after the impact of water pollution problems. This paper summarized and analyzed the construction of governance of water resources issues projects of traditional urban sewage system, and showed its advantages and disadvantages. Finally, combined with feature selection algorithm and machine learning, a new construction model of urban sewage system water pollution prevention project was proposed. This model not only has better collection effect and evaluation efficiency, but also has more efficient response measures for sudden water pollution problems.

2. Construction Technology of Water Pollution Prevention Project of Urban Sewage System

In the context of the gradual advancement of urbanization in various regions, the problem of urban water pollution is becoming increasingly serious, affecting the sustainable development of cities. With the development of the Internet and the progress of big data technology, machine learning has been widely used in various fields of human survival and life, the most representative of which is artificial intelligence technology. Artificial neural network was originally proposed and developed based on modern neuroscience, and is an abstract mathematical model reflecting the structure of human brain [13].

Artificial neural network is a complex system composed of a large number of simple processing units, which are widely interconnected and capable of thinking and learning [14]. Their operation has two main stages: learning stage and reasoning stage. In the learning stage, the weight of the connection path is modified based on the learned mode through continuous learning, so that the learning results can converge to the value obtained by running in the learning mode. In the reasoning stage, the information is preprocessed, and the reasoning path is made according to the modified weight of the connection path obtained in the learning stage.

In this paper, neural network technology is introduced to carry out machine learning in the proposed construction model of urban sewage system water pollution prevention and control project. A large number of sample parameters collected by the neural network technology are continuously coupled and analyzed in the computer to obtain the most uniform characteristic sample in the sample, so that the system can analyze the sample data collected in the monitoring process in a deeply learned coupling way in the subsequent monitoring behavior, and predict whether there is a

trend of the occurrence of samples with strong deviation from the uniform characteristic sample. Compared with the traditional system model, such system model has better ability of feature analysis and learning and reasoning, and the experimental results from the system model analysis can more scientifically and normatively reflect the essential structure of data, reflecting the high quality monitoring and prediction level [15]. The machine learning flow chart is shown in Figure 1.

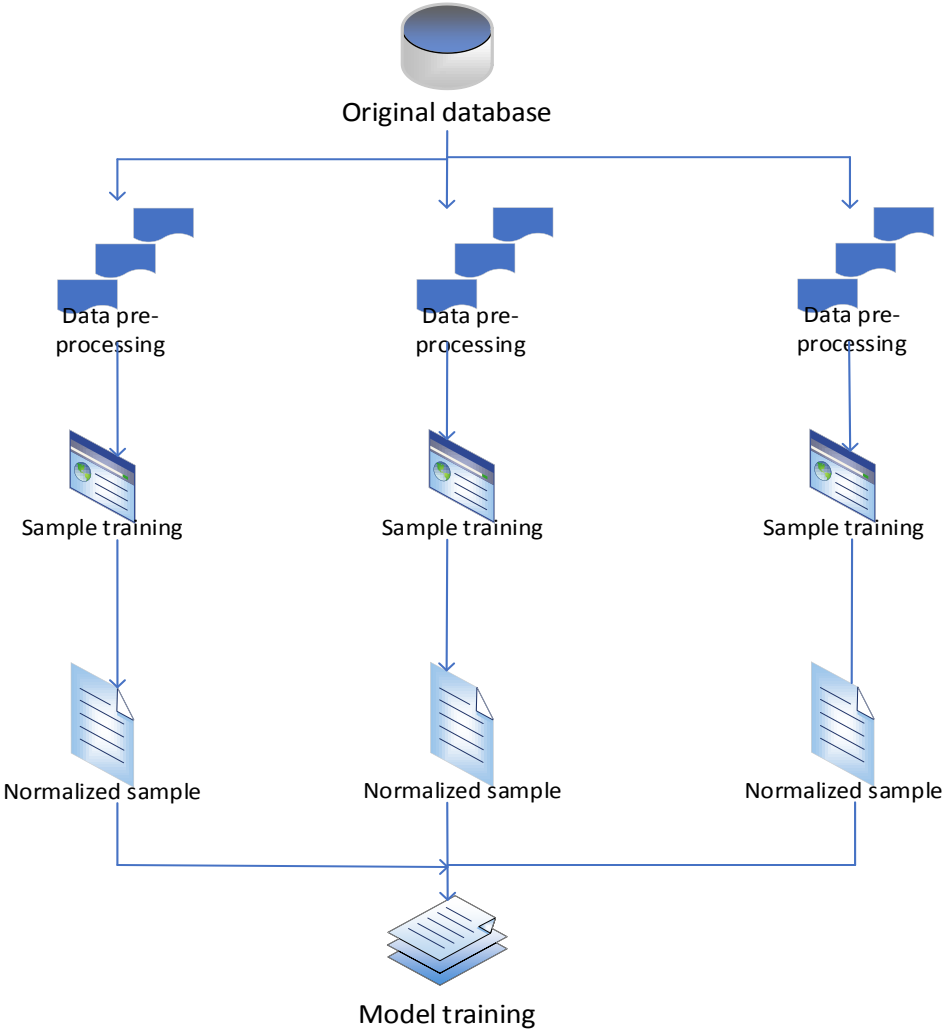


Figure 1. Machine learning processes

3. Construction and Development of Urban Governance of Water Resources Issues Projects

With the construction of cities and the development of society, the vast majority of cities belong to cities with low per capita water resources allocation, and urban water pollution is not only the main reason for low per capita water resources allocation, but also the direct reason for urban water shortage. However, in the urban water pollution problem, the composition of pollution sources is too complex, and urban water pollution is caused by the living behaviors of companies, units, residents and other subjects. Therefore, the prevention and control of urban water pollution should also be started from multiple aspects, so as to effectively curb the urban water pollution problem, effectively construct the urban sewage system governance of water resources issues project, and promote the effect of urban water pollution treatment.

Urban water pollution refers to the land water pollution in cities, that is, people discharge complex substances and energy into the sewage system in their daily life, resulting in chemical,

biological and even radioactive characteristic reactions in the sewage system. This will lead to the deterioration of water quality or eutrophication, and the enrichment and growth of microbial communities. This kind of seriously polluted sewage exceeds the purification capacity of the sewage system, and will affect the effective use of water resources due to the residual pollution in the process of recycling, which greatly reduces the sustainable development of water resources recycling, and even endangers human health and the ecological environment.

Rivers and lakes in the city will eventually be connected with the urban sewage system, and these places are also natural places where people dump domestic garbage and discharge industrial wastewater. With the development of modern industry and the advancement of urbanization, people's pollution is increasing day by day, and the pollution level of these pollution sources is far higher than the average level in the past. When the degree of pollution exceeds the carrying capacity of the water environment, it will lead to serious water pollution disasters, which are reflected in the shortage of urban water and the low allocation of water resources per capita. It poses a direct threat to urban production and people's normal life.

The pollution source composition of urban water pollution is complex, and the fundamental reason is that many actors in the urban area interfere improperly with the sewage system, so the construction of urban governance of water resources issues project should be carried out from two aspects at the same time. On the one hand, all actors causing urban water pollution should be subject to legal and moral management and restraint, and relatively complete laws and regulations affecting the behavior of urban water resources system should be formulated. On the other hand, mature emerging technologies should be introduced with the development of the times to improve the digital construction of urban sewage system water pollution prevention and control projects. It is necessary to improve the monitoring level and prediction quality of the governance of water resources issues project of the urban sewage system in a two-pronged way, so as to optimize the prevention and control effect of the system. The composition classification of urban water pollution sources is shown in Figure 2.

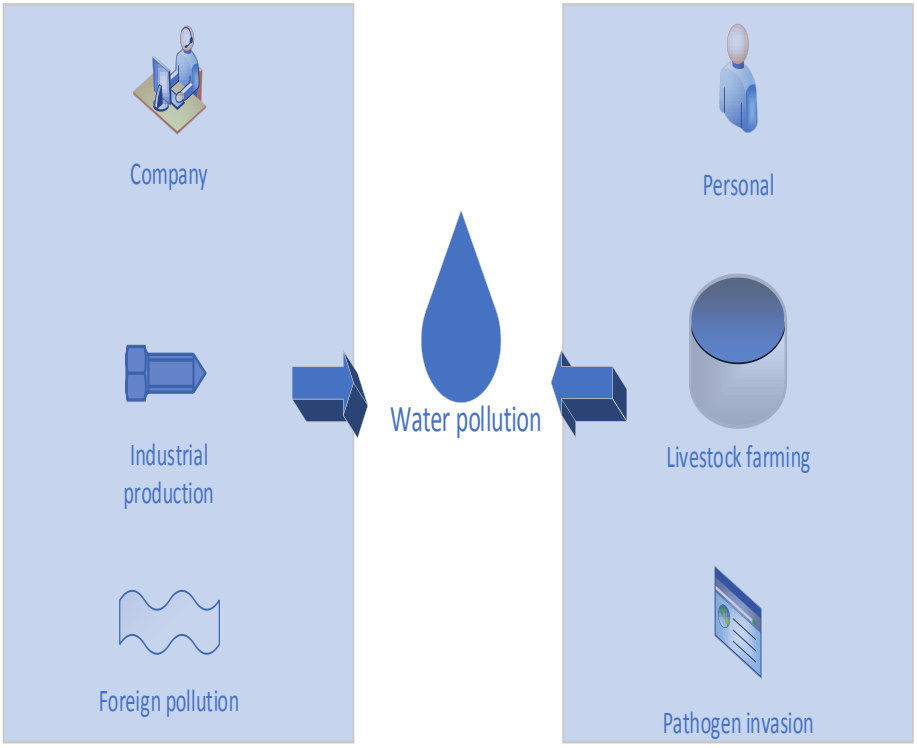


Figure 2. Classification of urban water pollution sources

4. Feature Selection Algorithm

In the feature selection algorithm, it is mainly to select, transform and re-classify the data according to the actual needs, and determine the model parameters. The original database contains a large number of information resources and there are differences among different types of attributes, which lead to various kinds of phenomena in the process of computer system processing. For a problem, it is often necessary to consider the interrelation and influence of these factors from multiple aspects, so there are also great differences between data characteristics. The feature selection algorithm is based on neural networks, which mainly includes two processes: learning and recognition. In data collection, the sample information needs to be pre-processed first, and the samples are pooled into a trained learning model, which is required to accurately distinguish between different categories, attributes and types of widely varying sample sets. The structure of the algorithm is shown in Figure 3.

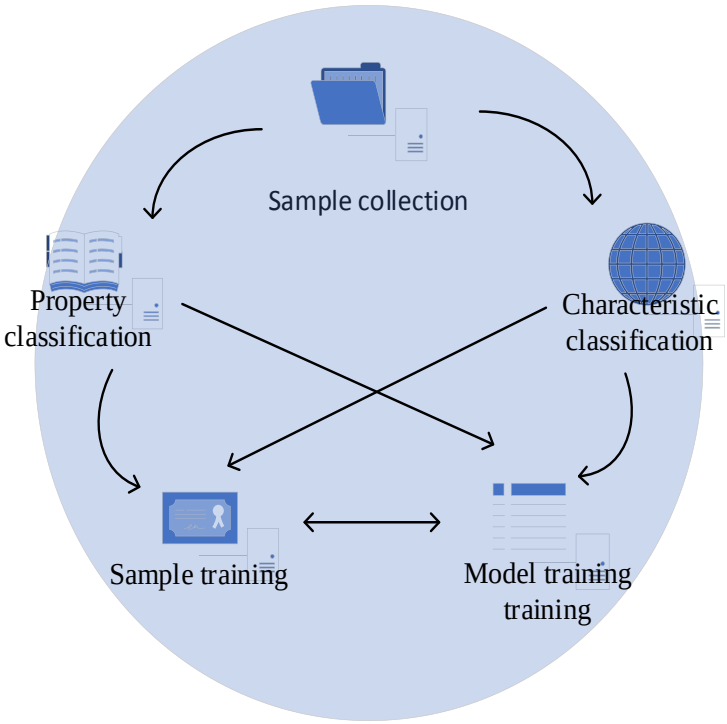


Figure 3. Feature selection algorithm structure

The process of feature selection for the collected samples is the process of machine learning. In this process, the normalization of data can not only eliminate the impact of large changes in the number of different feature sets on the prediction model, but also maintain the original distribution of data, which is helpful to improve the prediction effect of the model. Therefore, the original data is standardized or normalized before feature selection, which is calculated and processed by Formula (1):

$$y_a^* = \frac{y_a - \min(y)}{\max(y) - \min(y)} \tag{1}$$

In this formula, $y = (y_1, y_2, \mathrm{K}, y_n)$ means that each feature is composed of a set of y samples. $y_a \in y$, $\max(y)$ and $\min(y)$ are the maximum and minimum values of each element in the

feature set, respectively, and y_a^* is the value of the y_a eigenvalue in any value range converted to the value in the [0,1] interval, that is, the normalized eigenvalue.

After obtaining the feature value of the collected sample for attribute feature selection calculation, each feature would affect the prediction result as a factor. In the process of machine learning, it is to select the relevant features that have a greater impact on the target sample and remove the irrelevant features. The prediction model in machine learning predicts the water quality status of the target water area through sample characteristics, so as to prevent the trend of pollution. Then the filtered feature selection method is used to select attributes by calculating the correlation between each attribute and the target value. The correlation index between each attribute and the target value is calculated according to Formula (2), and a certain number or percentage of the most relevant attributes are selected for attribute selection.

$$W(I,J)=\iint p(I,J)\log(\frac{p(i,j)}{p(i)p(j)})didj \tag{2}$$

Among them, $W(I,J)$ is the correlation index of random samples I and J, and $p(i,j)$ is the joint probability density function of random samples I and J; $p(i)$ and $p(j)$ are marginal probability density functions of random samples I and J, respectively. By iterating all possible subsets, the subset with the best correlation is selected under the given number of features. To sum up, some algorithms used to build the model in this paper make the operation of the model more efficient.

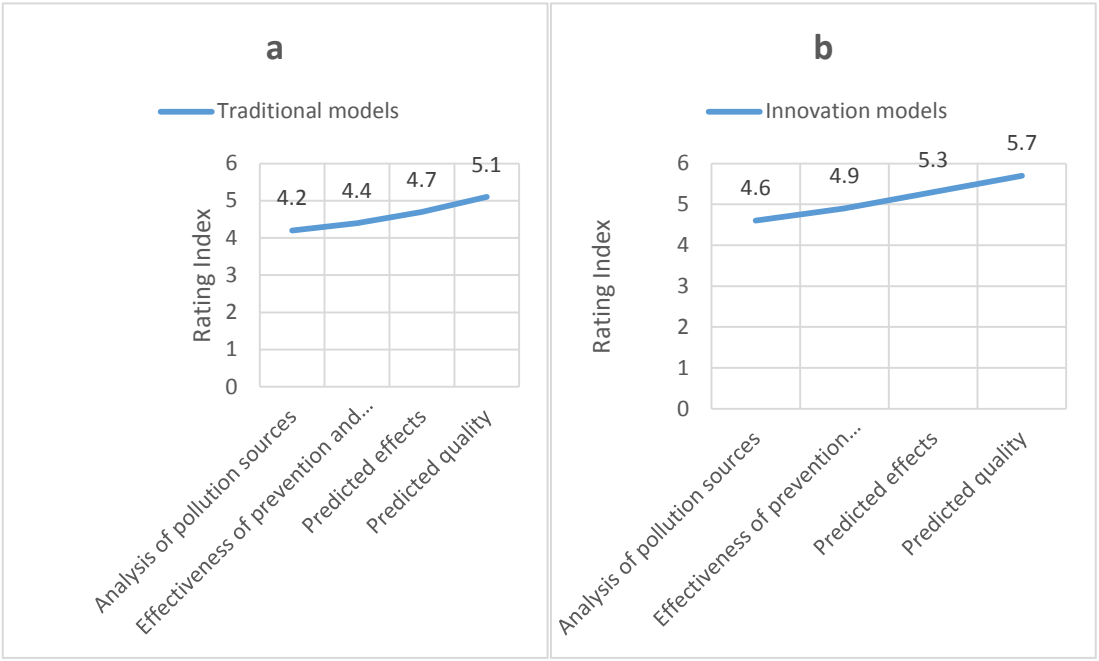
5. Experiment of Urban Water Pollution Prevention and Control Engineering Construction Model Based on Feature Selection Algorithm and Machine Learning

With the development of information technology and the advancement of urbanization, the problem of urban governance of water resources issues has attracted more and more attention from many objects. Serious urban water pollution will cause great harm to the process of urbanization and people's daily life. In order to solve various problems in the construction of governance of water resources issues projects of traditional urban sewage system, this paper tentatively introduced feature selection algorithm and machine learning technology to optimize the construction of governance of water resources issues projects of urban sewage system, so as to make an intuitive evaluation of the effect of water pollution prevention and control of urban sewage system. The establishment of evaluation criteria is particularly important. Table 1 shows the classification of some evaluation criteria. In order to monitor and predict the water pollution problems of the existing urban sewage system, and thus promote the urbanization process and the development of digital construction, it is first necessary to divide the urban water area into sample areas. By collecting samples from each sample interval, the collected samples were selected and classified by feature selection algorithm. The samples with strong correlation were clustered and stacked to eliminate the interference of unrelated samples. In the process of sample classification by machine learning, the prediction of target samples was carried out while monitoring the target samples. It predicted whether there would be samples with strong deviation from the existing samples, so as to prevent and control the water pollution of the urban sewage system. Such urban sewage system governance of water resources issues engineering construction can effectively solve the problems of traditional models that rely too much on the subjective judgment and professional knowledge of experts and scholars, as well as backward prevention and control methods and single prevention and control methods, but it still needs some experiments to verify the effectiveness of the model.

Table 1. Evaluation indicators for assessing the effectiveness of water pollution prevention and control

Evaluation indicators	Rules of Conduct
Predicted effects	Predicted speed Source of sample collection
Predicted quality	Effectiveness of prevention and treatment Speed of prevention and treatment

Firstly, the water quality in the sewage system of a city was monitored and predicted by dividing the sample interval. After a period of test, the system managers and some residents were surveyed with questionnaires. Based on the feedback and evaluation indicators of system managers and some residents, the performance of the proposed urban sewage system governance of water resources issues engineering construction model and the traditional urban sewage system water pollution prevention and control engineering construction model was compared. The results are shown in Figure 4.



a. Performance analysis of traditional models

b. Performance analysis of innovative models

Figure 4. Comparative analysis of the performance of innovative and traditional models

Figure 4a shows the performance analysis of the construction model of the governance of water resources issues project of the traditional urban sewage system. The performance indexes of pollution source analysis, prevention and control effect evaluation, prediction effect and prediction quality of the four performance indicators were 4.2, 4.4, 4.7 and 5.1 respectively. Figure 4b shows the performance analysis of the construction model of water pollution prevention and control project of innovative traditional urban sewage system. The performance indexes of pollution source analysis, prevention and control effect evaluation, prediction effect and prediction quality of the four performance indicators were 4.6, 4.9, 5.3 and 5.7 respectively. From the comparative analysis of the four performance index data, it can be seen that the innovative traditional urban sewage system governance of water resources issues engineering construction model was better than the

traditional urban sewage system governance of water resources issues engineering construction model. Through the comparison of the two, the innovative traditional urban sewage system governance of water resources issues engineering construction model proposed in this paper improved 11.4% in four aspects on average compared with the traditional urban sewage system water pollution prevention and control engineering construction model.

6. Conclusion

With the advancement of information technology and urbanization, people have higher and higher requirements for urban life. In the process of urbanization, urban water pollution is becoming increasingly serious. In order to solve the problems in the construction of water pollution prevention and control projects in the traditional urban sewage system, a new construction model of water pollution prevention and control projects in the urban sewage system was proposed based on the feature selection algorithm and machine learning, combined with the evaluation indicators of prevention and control effects. The reliability of the model was verified by experiments, which opened up a new development direction for the construction of governance of water resources issues project of urban sewage system.

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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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