Computer System Integration Technology of Hydraulic Engineering Design Based on Machine Learning Algorithm

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Abstract. With the development of water conservancy informatization, the research on water information system integration is born, which is the need of water conservancy informatization construction at present and also an urgent problem to be solved. Based on the machine learning algorithm, combined with the actual needs of water conservancy business field, the overall framework of computer system integration for water conservancy engineering design is put forward. The overall framework includes: resource layer, comprehensive integration layer and user layer, which exchange data with configuration monitoring software by means of communication. The analytic hierarchy process in machine learning algorithm is used to construct the risk prediction index system, and the risk prediction index and initial prediction results are taken as the input and output of extreme learning machine algorithm in machine learning algorithm. The simulation results show that the prediction accuracy of this method is 94.88%, which can accurately predict the risks existing in hydraulic engineering design computer system and improve the system security.

Keywords: Machine learning; Water conservancy project; Computer system integration.

1. Introduction
With the continuous development of science and technology, productivity has made rapid progress. At present, informationization, represented by computer technology, has become the mainstream trend of all walks of life and world economic development. In the aspects of geological survey, engineering design, information collection, etc. involved in the design and construction of water conservancy projects, computer technology has occupied an important position with its unique advantages, which has laid a solid foundation for the information processing speed and engineering design accuracy in the design and construction of water conservancy projects.

Water conservancy informatization refers to the process of making full use of modern information technology, deeply developing and utilizing water conservancy information resources, realizing the modernization of water conservancy information collection, transmission, storage, processing and service, and comprehensively improving the efficiency and effectiveness of water conservancy activities [1]. Because of the different investment channels and construction units, independent application systems with low level, repeated development and no unified standard appear, which to a great extent restricts the collaborative work, resource sharing and software reuse among water information systems,
and slows down the pace of water conservancy informatization construction. Therefore, with the development of water conservancy informatization, the research on water information system comprehensive integration is born, which is the need of water conservancy informatization construction at present and an urgent problem to be solved.

Machine learning integrates neurophysiology, computer science, applied psychology and other knowledge [2], which has incomparable advantages for big data analysis [3], and can be applied to risk prediction of computer system in hydraulic engineering design [4]. In order to improve the risk prediction accuracy of hydraulic engineering design computer system, a risk prediction method of hydraulic engineering design computer system based on machine learning algorithm is proposed, which combines AHP and neural network in machine learning to accurately predict the risk of hydraulic engineering design computer system and ensure the stability and reliability of hydraulic engineering design computer system.

2. System function analysis

Water conservancy project planning involves many aspects of information and data. If manual survey technology is used to complete the project, it will not only be difficult to complete the task within a certain time, but also affect the completion efficiency. In order to improve the efficiency of design and survey, ensure the improvement of design quality and speed, we should give full play to the role of computer technology.

The development of computer system integration for water conservancy engineering design should meet the needs of users, realize the construction of water conservancy integrated information network by using modern public telecommunication network, and effectively exert the potential of local telecommunication channels. In the automation of information management, the operation efficiency of information network management should also be ensured [5]. The integrated construction of computer system for water conservancy project design should not only realize the automatic monitoring of comprehensive information of water conservancy project, but also realize the management of operation information of water conservancy project, so that it can meet the actual use requirements. In the construction of comprehensive information network, it can include hydrological forecasting, flood control and drought relief information detection, project operation monitoring, office government affairs system detection, etc., while ensuring the sharing and operability of data information in the system, and providing effective and friendly man-machine interface for customers.

3. Overall framework and comprehensive integration platform

3.1. Overall framework

The overall framework of water information system integration is divided into three parts: resource layer, water information system integration layer and application layer. This paper studies the application integration under the integration of computer system in water conservancy engineering design. The key research contents include two specific parts, which are the research of integrated platform and service components supported by integrated application mode. See fig. 1 for the content design, hierarchical relationship and overall framework of water information system integration.
Figure 1. General framework of computer system integration in hydraulic engineering design

3.2. Comprehensive integration platform

According to the overall framework, starting from realizing the system technical functions of the framework and combining the characteristics of water information system, a comprehensive integration platform is designed. Its basic functions are as follows:

1) Man-machine interaction interface;
2) Knowledge processing and management;
3) Communication and transmission management;
4) Application integration support;
5) Generation and management of decision report;
6) System maintenance and other functions.

Generally speaking, the realization of different functions of the system has its own characteristics, such as man-machine interface diversity (information browsing, SMS mobile information); The knowability of knowledge management, the reliability of communication network transmission management, the extensibility of application integration, and the security of decision report and system management. As shown in fig. 2:

Figure 2. Functional composition of integrated platform
(1) Man-machine interaction interface

The functions of man-machine interface of integrated platform are divided into visual query tools, which can provide different query functions, such as mobile information query, GIS query, RS remote sensing query and chart analysis. Business process modeling tools: provide information, data and service composition functions of business services. Such as the establishment of forecasting scheme, model calibration, real-time forecasting, model state variables, parameter correction and so on. Knowledge development editor: The system supports the perception and exchange of knowledge and information between experts and computers through the knowledge editor. And data analysis tools: provide various forms of data analysis functions.

(2) Knowledge processing and management

Formal representation of qualitative knowledge, domain knowledge and structured knowledge is the core content of the design and implementation of integrated platform. The advantages and disadvantages of knowledge processing and management are directly related to the exchange between experts to discuss and solve problems.

Knowledge processing and management provide basic data, information and knowledge resources for the system, including: template library: the template library stores knowledge diagram templates and discussion process templates. Expert database: the expert database mainly records the data analysis results, decision-making schemes and other professional data resources related to decision-making. Opinion library: the opinion library is an auxiliary library of expert database, which comprehensively expresses the opinion information related to experts in the expert database, and ensures that the information content of specific professional opinions is completely preserved for future review and evaluation. Method library: the method library is also the auxiliary library of expert database. To provide the information description of the method to solve the problem and the description of the method to solve the process. Knowledge sharing library: The knowledge sharing library is a shared resource library established on the basis of template library, expert library, opinion library, method library and seminar site library [6].

(3) Communication and transmission management

Communication and transmission management provides an open platform structure for the integrated platform, which completes the interaction between users and nodes (that is, the application server of Web services) and the problems of interactive communication, transmission and management among users. Communication and transmission management provides communication and transmission support for other functions of the integrated platform in order to solve the underlying communication problems of the integrated platform.

(4) Application integration support

According to the achievement goal of achievement integration and the demand for water conservancy decision-making service, the key point is how to package, accommodate and call the achievements in other systems. The heterogeneity of each subsystem is fused by container, and the bottom details of components and subsystems are encapsulated in the container, which realizes component assembly, indirect dialogue between subsystems and operators, and establishes a shared instance pool among users. The last "call" can be realized simply by solidifying the interface.

(5) Generation and management of decision report

The ultimate goal of discussion and decision-making is to form a unified and synthesized decision support report for the corresponding decision-makers through expert discussion on the integrated platform. Therefore, the comprehensive integration platform should establish a decision report generation system, an expression system (especially the visual expression of results), an output system and a file sharing system.

(6) System maintenance

Interview control management realizes the integrated control of the whole resources, information and services of the system through the role interview control model, and establishes a control scheme from authority to role to ensure the safety of the interview process.
4. Key technologies and implementation

4.1. Construction of risk prediction model
As a data machine learning algorithm integrating qualitative and quantitative theories, analytic hierarchy process can effectively analyze the initial data and make scientific decisions according to the analysis results, and the implementation process is relatively simple. The main purpose of predicting the risk of computer system in hydraulic engineering design is to ensure the safety of information assets in the system, which can be described by confidentiality, integrity, reliability, truthfulness and availability [7-8].

Neural network is a nonlinear distributed parallel information processing algorithm, which has the characteristics of self-learning, self-adaptation, associative storage and so on, among which feedforward neural network has the advantages of simplicity and effectiveness. Compared with other feedforward neural networks, the single hidden layer feedforward neural network-extreme learning machine can complete the neural network learning under the condition of partial parameter correction, which improves the learning efficiency.

Let $x_p$ and $y_p$ represent the risk prediction index and initial risk prediction value of computer system for hydraulic engineering design, respectively, and the sample data is described as follows:

$$J_s = \{(x_p, y_p)\}_{p=1}^L$$

Equation (1) describes the regression constraint form of extreme learning machine:

$$\min \left( \frac{1}{2} \eta_L^\top \eta_L + \frac{\gamma}{2} \phi^\top \phi \right)$$

s.t.

$$y_p = \sum_{i=1}^L \eta_i \phi \left( \delta_i x_p + z_i \right) - \phi_p$$

In which $L, z$ is the number of hidden layer nodes and regression error respectively; $f(\cdot), \phi$ is the mapping function and the node regression error of the output layer; $\delta_i$ is the weight vector of $x_p$, $\eta_i$ is the weight vector representing $y_p$, and $Y$ is the expected output.

Set the Lagrange function:

$$L(v, \phi, \eta_L) = \frac{1}{2} \eta_L^\top \eta_L + \frac{\gamma}{2} \phi^\top \phi - v(G_L \eta_L - Y - \phi)$$

In which $G_L$ and $v$ are output matrix vectors and weight coefficients, respectively.

Constructing risk prediction model of computer system for hydraulic engineering design:

$$y = \sum_{i=1}^L \eta_i f \left( \delta_i x + z_i \right)$$

The work flow of risk prediction of hydraulic engineering design computer system based on machine learning algorithm is shown in Figure 3.
The final risk prediction value is obtained through the flow chart in Figure 1, which can accurately describe the risk of water conservancy engineering design computer system.

4.2. Data access technology
DDE (Dynamic Data Exchange) is a dynamic data exchange mechanism. Using DDE to communicate requires two Windows applications, one of which serves as a server to process information, and the other as a client to obtain information from the server. The client application sends a message to the currently activated server application requesting information, and the server application responds according to the information, thus realizing the data exchange between the two programs [9].

DDE is a complete communication protocol on Windows platform, and the mode of DDE conversation is agreed by the following three identification names:

1) Application Name: the name agreed by both parties for DDE dialogue. The application name of "Kingview" running system is "view"

2) Subject: the data domain being discussed, for Kingview, the subject is specified as "tagname"

3) Item: the specific data object under discussion, I/O variables defined in Kingview's data dictionary.

The DDE data access method is shown in Figure 4.
Taking Kingview as an example, configuration software uses Kingview as DDE server, develops DDE client program by using DDE interface provided by Kingview, and DDE client is used as intranet data acquisition program, which forwards data taken from Kingview, and external network data receiving program receives data forwarded by intranet data acquisition program, and stores the received data in SQL Server database for the upper information system to call.

Set the variables in Kingview data dictionary to allow DDE access. Kingview, as the DDE server, uses the DDE interface provided by Kingview to realize the DDE client. The application name for establishing DDE communication is VIEW, the subject name is Tagname, and the project name is Connection Device Name and Register Name. A DDE client can read its value through these three identifiers.

4.3. System database design
The database of the integrated information management system is used to store the real-time, results and basic data of the system, which can satisfy the query and utilization of data and the information release of the automation system, including the databases of engineering foundation, water regime and quality, hydrology and water resources, safety monitoring, gate operation and dispatching, reservoir dispatching, calculation methods and models, etc. In the system database design, a unified data and command exchange protocol is adopted, and a real-time data exchange platform is developed. According to the special data interface program, the real-time data in water conservancy projects can be exchanged, stored and queried, which can not only ensure the sharing of reservoir information, but also effectively improve the management efficiency of water conservancy projects.

Code realization: in the integrated information management software, the modular design method is adopted, and the software design scheme with common core codes and independent module codes is adopted to ensure that the faults among the modules do not affect each other and effectively reduce the occurrence rate of system faults. In the design of integrated information management software, VB language is adopted, and C/S structure and B/S structure are adopted to realize the system information management control.

5. Experimental analysis of risk prediction
In order to verify the effect of this study on the risk prediction of water conservancy engineering design computer system, this study is realized by VC++6.00, and the water conservancy engineering design computer system in a different region is selected as the research object for example verification.

Choose any one of all the research objects, adopt the risk prediction index system constructed in the process of predicting the risk of the research objects in this paper, collect relevant data, and calculate the comprehensive weight. Comprehensive calculation results and actual risk value verify the prediction effect of this study, and the results are shown in Figure 5.

![Figure 5. Verification of risk prediction effect](image-url)
It can be seen from Figure 5 that the risk prediction results studied in this paper have high accuracy, and the predicted values are basically consistent with the actual risk values.

The high precision of predicting the value at risk of the research object in this paper is due to the combination of the two prediction models, which not only has the function of linear theoretical prediction model (analytic hierarchy process) to predict through linear mapping, but also has the function of nonlinear theoretical prediction model (neural network extreme learning machine) to fit the changing relationship between evaluation index and risk prediction result by using nonlinear approximation ability, so as to improve the prediction accuracy. The comparison of the average prediction accuracy of the three methods shown in Figure 6 can fully illustrate this point.

![Figure 6. Comparison of risk prediction accuracy](image)

It can be seen from Figure 6 that the accuracy of single linear theory prediction method and nonlinear theory prediction method for risk prediction of research objects is significantly lower than that of this study. The linear theory prediction method has the lowest prediction accuracy, and the average accuracy of risk prediction of research objects has not reached 90%, while the risk prediction accuracy of this study has reached 94.88%.

6. Conclusion
Information system integration is a frontier research involving water conservancy engineering, computer science and system science, which involves a wide range of business fields, various information organization methods and various system structures. The application of computer technology in water conservancy project planning and construction can provide high-precision construction information, effectively design construction drawings and schemes, scientifically analyze various design and construction data and information, and effectively prevent various potential safety accidents. The application of computer system integration in hydraulic engineering design can not only integrate various professional systems encountered in hydraulic engineering into a system information platform for management, so as to realize information sharing and solve the problem of difficult coordination of system hardware interface and communication protocol. But also provides a functional, efficient and advanced management platform for the operation and management units, and finally improves the practical benefits of the system.

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