Research Article

Interactive Application of Virtual Reality and Intelligent Big Data in Landscape Design

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In order to improve the accuracy and efficiency of performance evaluation, the interactive application of virtual reality and intelligent big data in landscape design is proposed. Clara algorithm is used to mine the performance evaluation index data of landscape simulation design. The performance evaluation index system of landscape simulation system is established based on the data mined. BP network is used to build a comprehensive evaluation model. The expert scoring method is the evaluation index system scoring, which is used as the input of BP network, and the expected output is a neuron. The value of the neuron represents the comprehensive performance evaluation value of the landscape simulation system. The experimental results show that the evaluation results of the research method are consistent with the expert evaluation results, with high accuracy; with the increasing number of systems, the evaluation efficiency of the research method is faster.

1. Introduction

Landscape environment is a complex system, which has become one of the key factors affecting urban construction, urban appearance environment construction, and urban management level [1]. In order to meet the needs of high quality and high efficiency of modern landscape construction, we should seek a new design thinking and path to solve the existing problems. VR is short for “virtual reality.” In order to complete the generation of interactive three-dimensional virtual landscape environment, virtual reality technology needs to combine computer graphics system and various display and control interface equipment to realize the generation of landscape environment. Presenting the design process in a modular form can enhance the innovation ability and expand the design resources [2, 3]. However, modularization contains a large amount of data, so how to effectively integrate the required information is an important problem that designers need to explore at this stage.

Interior landscape design needs to use interior design theory, based on interior planning, and comprehensive use of a variety of technical means to make the works not only have visual beauty, but also coordinate with the interior environment. It is extremely important for interior landscape design to show all-round, real and even dynamic design works, so as to accurately show the design ideas of interior designers [4, 5]. Most of the existing interior landscape designs use two-dimensional drawing, and most of the software is developed on a third-party platform [6, 7]. The degree of automation in the three-dimensional modeling and data statistics is low, which fails to give full play to the role of auxiliary design. With the development of virtual simulation technology, Virtual Reality Technology (VRT) brings a new revolution to the field of interior design [8]. Through the simulation sample, it can put forward improvement suggestions for the design proposal, and even the production procedure and the modified results can also be simulated, so as to reduce the construction period and cost and improve the efficiency of interior design. Therefore, the research of interior landscape design based on VRT has important practical significance. Li and Xie have found that the virtual reality (VR) experiment simulation system can effectively improve the experiment teaching approach and result in the education of the architectural discipline, and they, therefore, have discussed the detailed design of the
virtual reality (VR) experiment platform from the perspective of software and hardware [9]. The virtual reality technology is a simulation and modeling software system applied to landscape design, which is following such three main software applications as AutoCAD, Photoshop, and 3S (RS, GIS, and GPS). It is widely used because of its 3I (Interactivity, Immersion, and Imagination). It not only greatly reduces the working time and pressure of the designer, but also helps stimulate the imagination of the designer [10].

In reference [11], a microscanning laser landscape 3D virtual imaging technology method based on Geiger APD array was proposed. The laser dot matrix emission was used to correspond with the APD array pixels one by one, and the splicing technology was used to improve the landscape imaging resolution. Through infrared image processing and histogram area calculation, the edge contour of landscape was extracted and fused with the model to obtain a 3D landscape model with target detection information and realize 3D virtual imaging of landscape. This method does not use the point cloud stitching method to fuse the landscape laser points but directly stitches the image, which leads to the bigger stitching error and reduces the accuracy of landscape imaging. Reference [12] proposed the method of three-dimensional virtual imaging technology of landscape based on the fusion of 3D laser scanning and infrared detection. Through infrared image processing and histogram area calculation, the edge contour of landscape was extracted and fused with the model to obtain a 3D landscape model with target detection information and realize 3D virtual imaging of landscape. This method does not use the point cloud stitching method to fuse the landscape laser points but directly stitches the image, which leads to the bigger stitching error and reduces the accuracy of landscape imaging. Reference [13] proposed the method of three-dimensional virtual imaging technology of landscape. Firstly, the method quantifies the characteristics of landscape, uses digital close range photogrammetry, lidar scanning, and point cloud visualization technology to collect the spatial information of landscape, constructs the digital three-dimensional model of landscape, corrects the error of its spatial scale, and realizes the three-dimensional virtual imaging of landscape. When the laser point cloud is stitched, the laser point cloud features are not generated and stitched according to the feature points, which affects the stitching speed and reduces the imaging efficiency of landscape.

Based on the above problems, the interactive application of virtual reality and intelligent big data in landscape design is proposed. Landscape design is an important part of modern urban construction. Building a high-quality natural environment can relieve people’s mental pressure. It is particularly important to study the performance evaluation method of landscape simulation system. A good performance landscape simulation system can save manpower and material resources in the process of landscape design. Virtual reality and intelligent big data analysis technology have the functions of huge data collection, storage, analysis, and visualization. Therefore, the performance evaluation method of landscape simulation system based on virtual reality and intelligent big data analysis is studied to improve the accuracy and efficiency of performance evaluation.

The contributions of this paper are summarized as follows:

1. We consider a Clara algorithm, which is used to mine the performance evaluation index data of landscape simulation design. After that, a performance evaluation index system of landscape simulation system is established based on the data mined.
2. We build a comprehensive evaluation model by the BP network.
3. We propose an interactive application of virtual reality and intelligent big data in landscape design.

This paper is organized as follows. Section II presents performance evaluation method of landscape simulation system based on virtual reality and intelligent big data. Section III constructs a landscape information fusion model with the virtual reality and intelligent big data. In Section IV, experimental results are presented and analyzed. Finally, Section V sums up some conclusions and gives some suggestions as the future research topics.

2. Performance Evaluation Method of Landscape Simulation System Based on Virtual Reality and Intelligent Big Data

2.1. Data Mining Method. Clara (clustering large applications) algorithm is used to mine the data about the performance evaluation index of landscape simulation system. Clara algorithm is a sample based clustering algorithm, which is based on k-medoids algorithm, and partitioning around medoids (PAM) is the most typical algorithm in k-medoids algorithm. The Clara algorithm is suitable for massive data mining and improves the accuracy of data mining [14, 15]. The idea of PAM algorithm is to take the data set with n landscape simulation system evaluation index samples and the number of clusters K as the input, and the output result is K clusters. The specific steps of PAM algorithm are as follows:

Step 1: In the N landscape simulation system evaluation index samples, randomly select k to represent the landscape simulation system evaluation index samples, and regard them as the center of the initial cluster;
Step 2: According to the principle of proximity, the remaining landscape simulation system evaluation index samples are assigned to the cluster represented by the nearest center point;
Step 3: Traverse the cluster and select each noncentral point object 0r in the cluster;
Step 4: Calculate the total cost s after replacing the original center point 0j by 0r object;
Step 5: When the total cost is less than 0, the new center point is to replace 0j with 0r, and when the total cost is greater than 0, keep the original state;
Step 6: Repeat step 2 to step 5;
Step 7: All the k center points need not be replaced.

PAM algorithm uses Euclidean distance to obtain the similarity between the evaluation index samples of landscape simulation system:
$$D(i, j) = \sqrt{[x_{i1} - y_{j1}]^2 + [x_{i2} - y_{j2}]^2 + \cdots + [x_{ik} - y_{jk}]^2}.$$  

(1)

In the formula, the sample objects of the two $k$-dimensional landscape simulation system evaluation indexes in the data set are $x = (x_1, x_2, \ldots, x_k)$ and $y = (y_1, y_2, \ldots, y_k)$.

The convergence of Euclidean distance formula is judged by the evaluation formula:

$$E = \sum_{j=1}^{k} \sum_{x \in C_j} D^2(i, j).$$  

(2)

In the formula, $C_j$ is the cluster.

The flow chart of PAM algorithm is shown in Figure 1.

1. **Initialization**: Select samples for $N$ times and repeat steps 2 to 4.
2. **Clustering**: Select a sample of landscape simulation system evaluation index, which is composed of $M$ objects in the overall database, and use PAM algorithm to obtain $K$ optimal center points of the group of landscape simulation system evaluation index samples.
3. **Assignment**: Apply the obtained $K$ optimal centers in all data sets, and finally all data points are divided into $K$ clusters.
4. **Update**: Solve the total cost of the cluster obtained in step 3. If the total cost belongs to the current minimum value, then it needs to be replaced. At this time, $K$ clusters belong to the current optimal partition. If the total cost is not the current minimum value, then keep the original value.
5. **Convergence**: Go to step 1 to get the best clustering effect.

2.2. Evaluation Index System. This paper uses Clara algorithm to mine the data about the performance evaluation index of landscape simulation system and constructs the performance evaluation index system of landscape simulation system based on these data. The performance evaluation index system of landscape simulation system is shown in Figure 2.

The performance evaluation index system of landscape simulation system is mainly divided into four aspects, system construction and operation and maintenance, system users, external impact of the system, and simulation effect, including 21 evaluation indexes, which are described by $x_1 \sim x_{21}$, respectively. Patch density, maximum patch index, Shannon diversity index, landscape shape index, and average fractal dimension are used to evaluate the landscape, the authenticity, and stability of the simulation system, namely, the simulation effect.

2.3. Evaluation Method. Backpropagation (BP) network has the advantages of self-adaptation and self-organization and can make decisions in approximate and uncertain data [16], eliminating the process of artificially calculating weights and biases.
relevant coefficients. BP network is used as the evaluation method of performance evaluation index system of landscape simulation system to improve the efficiency of performance evaluation [17]. In general, BP network is constructed by input layer, hidden layer, and output layer to connect all layers in a fully interconnected way, and the cells in the same layer are not connected to each other [18].

The learning process of BP network is formed by forward propagation and backward propagation. In forward propagation, after inputting the samples in the input layer, the hidden layer is used to process the samples and then output them to the output layer. The state of neurons in each layer only affects the state of neurons in the next layer. If the desired output cannot be obtained in the output layer, it is transformed into backpropagation. Backpropagation is to transmit the error signal to the input layer through the output layer, and the connection weight between layers needs to be adjusted in turn. And the bias value of each layer neuron can reduce the signal error [19]. After repeated operation, when the error is lower than the allowable value, it means that the BP network adapts to the required mapping; that is, the training process of BP network is over.

The BP algorithm is completed in the basic form of the successive correction method. The successive correction method is to adjust the weight of each input learning sample. The specific steps of the learning process of the successive correction method are as follows:

Step 1: Initialize the BP network state, select any small number as the connection weights \{W_{mn}\} and \{V_{nm}\} and bias values \{\theta_m\} and \{\gamma_n\}, and set the initial value;

Step 2: Input the first learning sample;

Step 3: The input \{I_t\} of the input layer unit \(t\) is the learning sample value. The input \(U_m\) and the corresponding output \(H_m\) of the middle layer unit \(m\) are obtained by calculating the connection weight \{W_{mt}\} between the input layer and the middle layer and the offset value \{\theta_m\} of the middle layer unit. The calculation formula of the input \(U_m\) and the corresponding output \(H_m\) of the middle layer unit \(m\) is as follows:

\[
U_m = \sum_t W_{mt}I_t + \theta_m, \quad H_m = f(U_m).
\]  

In the formula, \(f\) is the sigmoid function, and the formula is as follows:

\[
f(u) = \frac{1}{1 + \exp(-u)}.
\]  

Step 4: The input \(Q_n\) and the corresponding output \(Q_n\) of the output layer unit \(n\) are obtained by calculating the output \(H_m\) of the middle layer, the connection weight \{\V_{nm}\} between the middle layer and the output layer, and the offset value \{\gamma_n\} of the output layer unit \(n\). The calculation formula of the input \(Q_n\) and the corresponding output \(O_n\) of the output layer unit \(n\) is as follows:

\[
Q_n = \sum_m V_{mn}H_m + \gamma_n, \\
O_n = f(Q_n).
\]  

Step 5: By learning the error between the expected signal \(T_n\) of the sample and the output \(O_n\) of the output layer, calculate and obtain the offset value of the output layer unit \(n\) and the connection weight error \(\delta_n\) of the output layer connecting to the upper layer. The calculation formula of the error \(\delta_n\) is as follows:

\[
\delta_n = (O_n - T_n)O_n(1 - O_n).
\]  

Step 6: Through the error \(\delta_n\), the connection weight between the middle layer and the output layer \{\V_{nm}\}, and the output of the middle layer \(H_m\), calculate and obtain the offset value of the middle layer unit \(m\) and the connection weight error \(\sigma_m\) of the upper layer connected to the middle layer. The calculation formula of the error \(\sigma_m\) is as follows:

\[
\sigma_m = \sum_n \delta_n V_{nm}H_m(1 - H_m).
\]  

Step 7: Adjust the weight \(V_{nm}\) of the middle layer unit \(m\) and the output layer unit \(n\) by using the error \(\delta_n\) and the constant \(\alpha\). The adjustment formula is as follows:

\[
V_{nm} = V_{nm} + \alpha \delta_n H_m.
\]  

The offset value \(\gamma_n\) of the output layer unit \(n\) is adjusted by using the error \(\delta_n\) and the constant \(\beta\), and the adjustment formula is as follows:

\[
\gamma_n = \gamma_n + \beta \delta_n.
\]  

Step 8: The connection weight \(W_{mt}\) of the input layer unit \(T\) and the middle layer unit \(m\) is adjusted by using the error \(\sigma_m\), the output \(I_t\) of the input layer unit \(T\) and the constant \(\alpha\). The adjustment formula is as follows:

\[
W_{mt} = W_{mt} + \alpha \sigma_m I_t.
\]  

The offset value \(\theta_m\) of the middle layer unit \(m\) is adjusted by using the error \(\sigma_m\) and the constant \(\beta\). The adjustment formula is as follows:

\[
\theta_m = \theta_m + \beta \sigma_m.
\]  

Step 9: Input the second learning sample;

Step 10: When there are learning samples, go to step 3;

Step 11: Change the learning times;

Step 12: When the learning times are lower than the specified times, go to step 2. When the learning times are higher than the specified times, continue to train.

The main function of virtual reality in landscape design is to set up training tasks and contents, and to choose the simulation operation mode and operation process of the whole landscape. It is presented to designers, who can realize
virtual landscape interaction and landscape roaming through virtual reality. There are 21 evaluation indexes in the performance evaluation of landscape simulation system. The performance evaluation indexes of landscape simulation system are scored by experts. The performance evaluation scores and corresponding grades are unqualified 0.1, qualified 0.3, average 0.5, good 0.7, and very good 1.0, respectively. Expert evaluation is used as the input of BP network for landscape simulation system performance evaluation \( I_i \) \((i = 1, 2, \cdots, 21)\). Corresponding to the input sample, the expected output of BP network is only one neuron, and the value range of this neuron is \([0, 1]\), which represents the comprehensive performance evaluation value of landscape simulation system. The score ranges are \(0.1-0.3, 0.3-0.5, 0.5-0.7, 0.7-1.0\), respectively. The corresponding score grades are unqualified, qualified, average, and very good [20].

3. Construction of Landscape Information Fusion Model Based on Virtual Reality and Intelligent Big Data

As the above modular organization structure of urban landscape design process contains more data, the landscape information fusion model based on genetic neural network is used to fuse the three-dimensional landscape generation data and modular data, so as to intuitively and clearly present the overall structure of urban landscape, completely evaluate the landscape construction process, and ensure the optimal landscape design results [21].

Genetic algorithm is a global optimization method, which integrates natural selection, competition, and population genetic theory. The independent variables for solving the problem are regarded as genes, coded to form chromosomes, and the best evaluation is taken according to the individual fitness in the chromosome set [20]. In the search process, three kinds of genetic operators, selection, crossover, and mutation, are constantly used to generate and reproduce new individuals, and finally the best individuals are obtained [21].

Chromosome coding generally uses binary bit string coding mode, and the weights of network nodes are real numbers. In the algorithm, the encoding is real number encoding to reduce the length of the string. Improve the network solution speed. The coding process is shown in Figure 3. In the formula, \( w \) is the weight matrix, and \( b \) is the critical value matrix [22].

The randomness of the initial population in the population initialization usually leads to the uneven distribution of the solution space. It is necessary to transform the initial solution of the optimization problem into individuals in advance and use the artificial method to generate the remaining individuals of the initial population in the solution space of the problem, so as to improve the individual morphological order of the initial population. The number of patterns is large and has diversity. By properly selecting the character length and population size, the initial population can be generated in the initial generations. Find out the range of each extreme point in the body to enhance the search speed [23].

![Figure 3: Chromosome coding process.](image)

Genetic algorithm regards fitness function as the evolution objective and can only evolve to the direction that the value of fitness function becomes larger. Reasonable transformation should be implemented between fitness function and objective function. The network deviation during evolution is a nonzero positive number, and then assume that the population size is \( N \), the individuals in the population are \( f_i \), \( F(f_i) \) represents the individual fitness value, and the individual \( f_i \) selection probability \( P_i \) is calculated analytically as follows:

\[
P_i = \frac{F(f_i)}{\sum_{i=1}^{N} F(f_i)}
\]

(12)

The design process of the selection operator is described in detail as follows:

First, calculate the cumulative probability \( P_i \):

\[
P_i = \sum_{i=1}^{N} P_i \quad (i = 1, 2, \ldots, N).
\]

(13)

A random value \((0, 1)\) is generated in the interval \(\theta\). If \(\theta \in (P_i, P_{i-1})\), the individual \(f_i\) enters the next generation population. By repeating the above steps, \(N\) chromosomes needed by the offspring population can be obtained.

On the basis of this kind of selection, individuals with higher fitness are more likely to be selected, and individuals with lower fitness are also likely to be selected. The optimal selection strategy is introduced to save the optimal individuals of each generation directly to the offspring [24].

There are two key parameters in crossover and mutation operators: exchange probability \( P_e \) and mutation probability \( P_d \). The selection of two parameters is extremely important to the global performance of the algorithm. In order to prevent premature convergence, adaptive \( P_e \) and \( P_d \) methods are used to change \( P_e, P_d \) according to the adaptive function of the solution:

\[
P_c = \begin{cases} 
(f_{\text{max}} - f') (f_{\text{max}} - f_{\text{avg}}), & f' > f_{\text{avg}}, \\
1, & f \leq f_{\text{avg}}.
\end{cases}
\]

\[
P_d = \begin{cases} 
(f_{\text{max}} - f') (f_{\text{max}} - f_{\text{avg}}), & f > f_{\text{avg}}, \\
1, & f \leq f_{\text{avg}}.
\end{cases}
\]

(14)

In the formula, \( f_{\text{max}} \) is the highest fitness, \( f_{\text{avg}} \) is the mean fitness, \( f' \) is the fitness function within crossover individuals, higher individual fitness, and \( f \) is the fitness of mutation individuals.

Crossover calculation is the most critical genetic operation. According to the crossover probability \( P_e \), select the parent chromosome, and use the crossover to generate a new chromosome, constantly expand the search scope, and finally achieve the global goal search. In this process, the use of arithmetic crossover can ensure that the offspring are generated between the two parent chromosomes. Arithmetic
crossover is a linear combination of two random points \( x_1, x_2 \) in the solution space. According to the key characteristics of convex search space:

\[
\alpha x_1 + (1 - \alpha)x_2 \quad \alpha \in [0, 1].
\]  

(15)

According to this feature, assuming that \( x_1, x_2 \) represent the parent chromosome of cross calculation, the offspring generated are

\[
\begin{cases}
    x'_1 = \alpha x_1 + (1 - \alpha)x_2, \\
    x'_2 = \alpha x_2 + (1 - \alpha)x_1,
\end{cases}
\]

(16)

where \( \alpha \) is a random constant, and the value range is \([0, 1]\).

Chromosome is a real number code, and its variation process is as follows.

The process of chromosome \( X_i \) locus \( x_i \) mutation is to choose a number \([x_1, x_2]\) substitution \( x \) in the interval \( x_i \). The calculation expression of interval \([x_1, x_2]\) is as follows:

\[
x_1 = x^{\min} = \frac{x^{\min} \times P_d \times \sum f}{f^{\max}},
\]

\[
x_2 = x^{\max} = \frac{x^{\max} \times P_d \times \sum f}{f^{\max}}.
\]

(17)

In the formula, \( x^{\max} \) and \( x^{\min} \) are the upper and lower limits of the value selection of \( x \), and \( P_d \) is the variation probability. It can be seen that the variation range of individuals with high fitness is smaller, and that of individuals with low fitness is larger, which can not only reduce the damage of mutation operation to excellent individuals, but also ensure the search performance of genetic algorithm. On this basis, backpropagation (BP) neural network is trained to realize the fusion of landscape information under virtual reality and intelligent big data. BP neural network uses a three-tier architecture, as shown in Figure 4.

The basic calculation process of BP neural network is as follows:

Build BP neural network architecture and input sample network architecture, including the number of node layers, the number of nodes in each layer. The weights and critical values are initialized in the \([-1, 1]\) interval, and the learning rate is determined in the interval. The network output of forward computing input to output layer and the second node input of hidden layer is as follows:

\[
\text{net}_j = \sum_i W_{ji} o_i + \theta_j.
\]

(18)

In the formula, \( o_i \) is the node input of input layer \( i \), and \( W_{ji} \) is the connection weight of hidden layer node \( j \) and input layer node \( i \).

The output analytic expression of hidden layer node \( j \) is described as follows:

\[
a_j = \frac{1}{1 + \exp(\text{net}_j)}.
\]

(19)

The input of output layer node \( k \) is

\[
y_k = \sum_i V_{kj} a_j.
\]

(20)

In the formula, \( V_{kj} \) is the connection weight of the output layer node \( k \) and the hidden layer node \( j \).

On this basis, the network deviation function is defined as

\[
E = \frac{1}{2} \sum_k (t_k - y_k)^2.
\]

(21)

In the formula, \( t_k \) is the expected output, \( y_k \) is the actual output, and \( k \) is the number of output layer nodes.

If the activation function is not used, the output of each layer is a linear function of the input of the upper layer. If the activation function is used, the neuron can approach any nonlinear function by introducing nonlinear factors into the activation function. So the model can be applied to any nonlinear model. Compared with other activation functions, when the difference of input data is not obvious, sigmoid function has better performance. Tanh or other activation functions are used when the difference of input data is large.

Since the excitation function affects the convergence speed of BP algorithm, it is necessary to modify the excitation function. The excitation function is as follows:

\[
f(x) = (1 + e^{-kx})^{-1}.
\]

(22)

In addition, the magnitude of the equivalent error sum and the change of positive and negative will also affect the convergence speed. The corrected error function is

\[
E = \sum_p \sum_k (T_p \cdot \log y + (1 - y)s_{pk} \cdot \log(1 - y)).
\]

(23)

In essence, the standard BP algorithm is a gradient descent optimization algorithm, which usually makes the learning process oscillate and converge slowly [25]. The selection of learning factors is also extremely important, and being too large or too small will have a profound impact on the convergence rate. In this paper, momentum method and learning factor are used to adjust the weights adaptively, and the above steps are repeated until the accuracy meets the expected requirements.

After training the BP network, the collected remote sensing sensor data and modularization can be fused with landscape information under virtual reality and intelligent...
big data. The information fusion model based on genetic neural network is shown in Figure 5.

For this network, the training data (signal 1, signal 2, . . ., signal n) may come from other communication systems. Therefore, it is extremely important to realize the effective communication of multiple terminals, and it is the prerequisite to ensure the performance of this system. In fact, we need to ensure that the data can be transmitted to the processing center in timely and safely manner. This network may face the following security problems: (1) malicious attacks by hackers, such as DOS; (2) network management defects; (3) software design vulnerabilities or “backdoor” problems.

4. Experimental Results and Analysis

In order to verify the effect and feasibility of interactive application based on virtual reality and intelligent big data in landscape design, Matlab and 3DMax are used to design simulation experiment. Matlab can provide the BP neural network toolbox, and 3DMax can help reconstruct the landscape. Taking the landscape simulation system of some garden construction engineering companies as the experimental object, 10 companies’ landscape simulation systems are randomly selected and evaluated by experts. The performance indexes of these 10 companies' landscape simulation systems are evaluated by this method. The 10 groups of data obtained by experts’ evaluation are taken as samples. These data are shown in Table 1.

The first five groups of data evaluated by experts are used as training data of this method, and the remaining five groups of data are used as test samples to simulate the objects waiting for evaluation. All these training data must be input to the BP networks, which can help adjust the parameter, and the test data can be used to verify the performance. In this experiment, the learning accuracy is 0.0001, the training times are 1500, the hidden layer of BP network is 6, the weight adjustment parameter is 0.4, and the bias adjustment parameter is 0.7. The learning results of this method are shown in Table 2. It can be seen from Table 2 that the gap between the learning results of this method and the expected output of expert evaluation is extremely small, which is always lower than 0.1%.

The simulation evaluation results of the five groups of untrained test samples are the same as the evaluation results of the experts on the landscape simulation system. The simulation performance evaluation results of the test samples obtained by this method and the evaluation results of the experts on the landscape simulation system are shown in Table 3. In this table, the error between the expert evaluation and training results is lower than 0.16%. According to Table 3, the test results of this method are highly similar to the expert evaluation results, indicating that this method has high accuracy in the performance evaluation of landscape simulation system.

In order to verify the evaluation efficiency of this method, the performance evaluation of landscape simulation system of 100 landscape architecture engineering companies is carried out by using methods and reference [5] and reference [6]. Among them, reference [5] proposed a scheme to reconstruct the landscape by the virtual reality technology, and reference [6] is a novel collaborative virtual reality system, which can offer multiple immersive 3D views at large 3D scenes. The evaluation results of these three methods are as follows. The results are shown in Figure 6.

According to Figure 6, the performance of the proposed method is always much better than that of the other two methods in the case of different number of systems. The

![Figure 5: Schematic diagram of landscape information fusion model under virtual reality and intelligent big data.](image-url)
worst performance is the method proposed in reference [5]. The performance of the method proposed in reference [6] is better than that in reference [5], but worse than that in this paper. With the gradual increase of the number of systems, the evaluation time of the three methods is increased, and the improved range of the evaluation time of the proposed method is the smallest. When the number of systems is 80, the evaluation time of this method is gradually stable, but the evaluation time of the other two methods is also increased. Moreover, the stability of the other two methods is poor. The reason of this experiment result might be that the proposed new scheme can exploit the advantage of neural network and big data, which can help extract the features of data effectively and can reconstruct original data by the data features. One obvious conclusion is that, with the gradual increase of the number of systems, the evaluation speed of this method is the fastest.

5. Conclusion

The performance evaluation of landscape simulation system is a relatively difficult work, which directly affects the planning effect of landscape. The performance of landscape simulation system is good, which can save the human and material resources in the process of landscape design. Therefore, this paper studies the interactive application of virtual reality and intelligent big data in landscape design, using virtual reality and intelligent big data. In order to improve the accuracy of performance evaluation, a more accurate comprehensive evaluation model is constructed, and the expert evaluation idea is introduced into the trained BP network. In the future research, we need to further study the digital landscape planning system, evaluate the digital landscape after planning, and test the practical application effect, so as to further improve the practicability of the digital landscape planning system.

If the activation function is not used, the output of each layer is a linear function of the input of the upper layer. If the activation function is used, the neuron can approach any nonlinear function by introducing nonlinear factors into the activation function. So the model can be applied to any nonlinear model. Compared with other activation functions, when the difference of input data is not obvious, s function has better performance. Tanh or other activation functions are used when the difference of input data is large.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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**Figure 6:** Comparison results of different evaluation methods.
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