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Computer-Aided Design AND APPLICATIONS

Simulation and Evaluation Method of Landscape Design Scheme Based on OPENGL Virtual Reality Platform

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Abstract. This article introduces the main steps of landscape design using CAD (Computer aided design) and VR (Virtual reality) technology, including modeling, drawing and post-processing, and expounds the use of CAD and VR in landscape design. Based on this, this article puts forward a modeling method based on 3D model of CAD data, which provides support for simulation evaluation of landscape design scheme. This method adopts VC platform and combines OPENGL and Open Flight API to analyze and process CAD data. The concept level describes the concepts and entities in the real world, while the attribute level describes the attributes possessed by these concepts and entities. By combining these two levels, HDM can effectively describe the relationships between data and information at different levels in the real world. And the leaf information is established by the Billboard model. Finally, the effectiveness of the simulation evaluation method of landscape design scheme is verified by an engineering example. The simulation shows that the accuracy and efficiency of the algorithm are high, and the expected idea is achieved. This method simplifies the 3D model mesh and can write the model data into the industry standard Open Flight format. The research results can be used to automatically model and evaluate the VR visual system according to the existing CAD data.

Keywords: Computer Aided Design; Virtual Reality; Landscape Design; Scheme Evaluation
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1 INTRODUCTION

Landscape design is a technology based on landscape planning to create landscape environment through scientific and artistic means. Landscape design works need to be coordinated with the surrounding overall environment, giving people a beautiful feeling. Chen and Stouffs [1] introduced the importance of architectural conceptual design and its connection with spatial

interpretation. Architectural conceptual design refers to the process of planning and designing the basic structure and functions of a building. Spatial interpretation refers to the process of explaining and understanding spatial forms and relationships. This process needs to take into account the laws of human perception and cognition of space. Next, the article introduces the basic principles and methods of understanding entanglement representation learning. Deentanglement representation learning is a deep learning-based algorithm that aims to learn meaningful representations from data, which can reflect the internal structure and laws of the data. The article explores the development trends and applications. Computer assisted civil and infrastructure engineering is a technology that utilizes computer technology to model, simulate, and optimize buildings and infrastructure. Thereby improving the quality and safety of buildings. The results of landscape design need to provide convenience for human life, and the artistry of design should be integrated with the cultural and regional characteristics of the geography, paying attention to the natural resources and promoting the sustainable growth of the ecological environment. Traditional teaching models are no longer able to meet the needs of modern teaching. In this context, flipped classroom has emerged as an emerging teaching mode. Through the application of Rainwater Classroom, the teaching effect of flipped classroom can be effectively improved. Da et al. [2] adopts a flipped classroom based on rainwater classrooms for 16 weeks of computer-aided landscape design teaching. Through practice, it has been proven that this new teaching model can effectively enhance students' learning interest and teaching effectiveness. Meanwhile, with the influence of future development trends and policy support, this teaching model will be more widely applied and promoted. However, attention needs to be paid to solving some practical problems and challenges in order to better promote and apply this new teaching model. The way of landscape design has gradually developed from traditional 2D to 3D. Denerel and Anil [3] analyzed the field of indoor architecture, computer-aided drawing programs have a wide range of application scenarios. For example, AutoCAD software can be used to draw building plans, elevations, sections, and 3D renderings. Revit software can integrate various stages of building design, construction, and operation through the Building Information Model (BIM), achieving full lifecycle management. In the actual operation process, students can use this software for drawing, modeling, and rendering operations. For example, using AutoCAD software, students can easily draw room plans and ceiling layouts. By using Revit software, students can construct a 3D model of the building and use a rendering engine for realistic rendering to generate more intuitive 3D renderings.

Parametric design can help designers better predict and simulate the performance of buildings, such as light environment, thermal efficiency, structural optimization, etc. By using parameterized design, designers can better optimize design solutions and improve design quality. In terms of landscape design, the application of parametric design is also becoming increasingly widespread. Designers can use parametric design to simulate and analyze dynamic changes in the landscape, such as vegetation growth, hydrological cycles, etc. In addition, parametric design can also help designers optimize spatial layout and improve landscape visual effects. Han et al. [4] aim to explore the application of parametric design in traditional landscape optimization, analyze its application cases and future development, in order to provide reference and inspiration for related work. Parametric design is a technology based on computer-aided design (CAD) that uses parameter equations or programs to describe the relationships between design objects, achieving numerical and programmatic design processes. In traditional garden optimization, parametric design can help designers better grasp the spatial structure, morphological characteristics, material properties, and other aspects of gardens, providing technical support for optimized design. In a local optimization case of a certain park, the designer used parametric design methods to optimize the design of the pavilion in the park. Compared with traditional garden design methods, parametric design not only improves design efficiency, but also provides designers with more accurate design basis. Then allocate appropriate hardware resources to the system, such as matching appropriate display devices and input devices, and selecting a VR engine with appropriate cost performance. To take landscape design as the core and be professional in landscape design. The planning technology, building information, and the landscape design

requirements are realized by establishing facilities parameters. Parametric assisted design, as a modern design method, is playing an increasingly important role in landscape education. Hsu and Ou [5] discussed the background and significance of sustainable landscape education, as well as the application of parametric assisted design in landscape education, and analyzed specific cases. Sustainable landscape education refers to the concept and practice of emphasizing environmental protection and sustainable development in landscape education, emphasizing respect and protection of the environment, and pursuing green, ecological, and sustainable design and planning. The goal of sustainable landscape education is to cultivate students' awareness of ecological civilization, improve their environmental literacy and sustainable design ability, Parametric assisted design is a computer-based method that establishes mathematical models and uses variables and parameters to describe and analyze design objects, thereby achieving design optimization and automation. In landscape design, parametric assisted design can be used to improve the efficiency and accuracy of planning, design, and evaluation, while also helping designers better understand the relationships between design elements. For landscape design, the features of VR, such as free intersection, immersion and 3D visualization, will become one of the best means to plan and display landscape design works. VR technology can break through the limitations of time and space in landscape design works. Designers can construct design works of various sizes and complexities in a virtual environment, without being constrained by actual physical limitations. For example, they can simulate how future climate change may affect design works, or predict how a particular design element will behave in the actual environment. Compared with CAD, VR also includes motion modeling, physical modeling and other modeling types in visual modeling, as well as auditory modeling that CAD cannot replace, so VR is more realistic and immersive than CAD modeling.

The application of computer big data in various fields is becoming increasingly widespread. The application of computer big data has also achieved significant results. Hu et al. [6] the spatial form in digital nonlinear landscape architecture design is a concrete manifestation of digital technology. In digital nonlinear landscape architecture design, designers use mathematical language and computer technology to create complex and dynamic architectural spatial forms. These spatial forms often go beyond traditional architectural design and have a strong sense of future and modernity. For example, the works of designers such as Zaha Hadid fully demonstrate the charm of digital nonlinear landscape architecture design. Digital nonlinear landscape architecture design is a modern architectural design method based on computer technology and big data analysis. It emphasizes respect and protection of the natural environment and ecosystem, and achieves spatial and morphological design of landscape architecture through digital technology and data analysis. Digital nonlinear diversity, dynamism, and sustainability, bringing modern landscape architecture design. In the scheme design stage, the application of computer big data is mainly reflected in the analysis and processing of design data. Designers can quantitatively analyze various design elements through computer big data technology. In the field of landscape design, it is very important to evaluate the design scheme accurately and effectively for the success of the project. Traditionally, this evaluation relies on tedious and time-consuming physical model making and various experiments on the model to test and optimize the design. However, this method is time-consuming and resource-consuming, and the accuracy of evaluation will also be affected by model making technology and experimental conditions. This method makes use of the accurate modeling ability of CAD software and the realism and interactivity of VR, and can effectively simulate and evaluate the landscape design scheme. In this way, the designer can model, test and optimize the design on the computer without making a physical model. Its main work and innovations are as follows:

(1) A modeling method based on three-dimensional model of CAD data is proposed, which can realize three-dimensional modeling of landscape design scheme on CAD platform, and realize high-precision simulation evaluation of landscape design scheme by analyzing and processing CAD data.

(2) Combining VC platform with OPENGL and Open Flight API effectively, a virtual landscape environment was established. By adding the information of branches and leaves of tree model with

hierarchical detail model, and loading and rendering with TreeEngine engine, a more intuitive and real virtual reality experience was provided for landscape design.

(3) According to the specific needs of landscape design, an extensible virtual landscape environment model is established, which can effectively support the three-dimensional simulation evaluation and visual representation of landscape design schemes, thus better meeting the needs of landscape design.

Firstly, this article introduces the background and research theme of the article; Then it discusses the main steps of landscape design using CAD technology, including modeling, drawing and post-processing, and expounds the use of CAD in landscape design. Then a simulation evaluation method of landscape design scheme is proposed. Finally, the effectiveness of the simulation evaluation method of landscape design scheme is verified by an engineering example.

2 RELATED WORK

In the field of landscape planning is becoming increasingly widespread. Among them, parameterized models are an efficient and accurate design method that can achieve a system assisted planning process starting from data. Jia [7] uses Python language and the node visualization programming language Grasshopper to construct a parameterized model. And explore how to apply ecological, structural, dynamic, and geographic information system (GIS) collaborative planning and design to model construction. This innovative design method will bring more possibilities for future landscape planning and design, which is worth further research and exploration. Jiang and Zhang [8] analyzed the students can use 3D software to conduct virtual simulations of the design site, analyzing the terrain, vegetation, hydrology, and other elements of the site from multiple perspectives, in order to better understand, including landscape design. 3D visualization, as a type of computer technology, has been widely used in landscape design teaching. It not only helps students better understand the basic concepts and techniques of landscape design, but also helps students cultivate spatial thinking and creativity to a certain extent. Sędzicki et al. [9] explored automated green design in sustainable development and how to achieve sustainable development through green BIM (Building Information Modeling) technology. Green design is a design method that fully considers environmental factors during the design process, reducing energy consumption and environmental pollution. In the fields of construction, industry, and transportation, the widespread application of green design helps to reduce carbon emissions, save energy, and improve resource utilization efficiency. Sustainable development is an indispensable consideration in green design. To achieve sustainable development at the global, regional, and individual levels, green design should combine strategies such as renewable energy, energy-saving technologies, and circular economy.

With the acceleration of urbanization, the relationship between urban ecosystems and human health is receiving increasing attention. As an innovative method, computer-aided green design urban environmental quality and human health. Sędzicki et al. [10] explored the application of computer-aided green design in urban ecosystems, with the aim of providing effective means for improving human health. Urban ecosystem is a complex system that includes multiple aspects such as nature, economy, society, and culture. Landscape planning and design is an important component of urban planning and architectural design, with the aim of creating a harmonious, comfortable, and beautiful outdoor environment. Software is becoming increasingly widespread, which has had a profound impact on landscape planning and design. Song and Jing [11] analyzed a digital design tool that integrates 3D modeling (SketchUp) and image processing (Photoshop). This integrated software technology has the advantages of simple operation, strong visualization, and high interactivity, providing a new design method and creative space for landscape planning designers. By utilizing CAD SketchUp PS integrated software technology, urban planners can establish a three-dimensional model of the city, visually analyze and optimize the spatial layout and architectural form of the city, and improve the rationality and scientificity of planning. Firstly, SketchUp was used for conceptual design, utilizing its rich plugins and template library to quickly establish a 3D model of the park. During this process, designers can adjust model details in real-

time, such as the position and size of landscape sketches, vegetation, water bodies, etc., After the conceptual design phase, the designer imports the SketchUp model into PS and utilizes its powerful image processing capabilities to further detail design and effect adjustments.

The Lin Family Courtyard and Garden were one of the famous private gardens from the Qing Dynasty to the Republic of China, with the Chinese Scholar Garden being an important component. However, due to historical reasons, this garden has lost its original form and urgently needs to be repaired and studied. Tai [12] used computer simulation projection technology to analyze the geometric distortion of the courtyard and garden, in order to provide technical support and theoretical basis for the restoration of the garden. In order to conduct geometric distortion analysis on Chinese scholar gardens, A geometric model of the garden. Tai uses a 3D laser scanner for data collection to obtain point cloud data from Chinese scholar gardens. Then, use professional software to process the point cloud data and establish a three-dimensional geometric model of the garden. With the continuous development of technology, digital landscape design mechanisms have become important tools in many fields such as urban planning, environmental protection, intelligent transportation, and so on. With the rise of edge computing, digital landscape design mechanism will play a more important role in the future. Wu and Yan [13] aims to explore the application scenarios and advantages of digital landscape design mechanism under edge computing, with a view to providing useful reference for research and practice in related fields. The digital landscape design mechanism refers to the method of using digital technology to design, simulate, and analyze landscapes. This mechanism smart cities, intelligent transportation, and intelligent environmental protection. In the field of intelligent transportation, digital landscape design mechanisms can provide effective solutions for traffic congestion management and optimization through real-time monitoring and prediction of traffic flow. In the field of intelligent environmental protection, digital landscape design mechanisms can provide scientific basis for environmental protection and governance by monitoring and analyzing environmental indicators.

CAD and collaborative design tools also have important applications in the later evaluation and maintenance stages of design. By utilizing the simulation function of CAD, various environmental and physical aspects of the design can be simulated and tested to evaluate the feasibility and effectiveness of the design. At the same time, using collaborative design tools can easily modify and maintain the design, ensuring its long-term effectiveness and sustainability. In low-cost plant landscape design, color effect, as an important design element, plays a crucial role in overall effect and cost control. Xu and Wang [14] chooses a main color tone as the overall tone of the landscape to achieve overall coordination. The main color tone can be a certain color, a certain color tendency, or a certain color combination. After determining the main tone, the use of other colors should be limited to adjacent color systems of the main tone to maintain color coordination. In landscape design, color effects have multiple dimensions. Firstly, color can have psychological effects, and different colors can have an impact on people's emotions and feelings. For example, warm colors can bring a warm and comfortable feeling, while cool colors can easily make people feel calm and at ease. Secondly, colors also have cultural connotations, and color preferences and symbolic meanings vary among different regions and cultural backgrounds. In addition, colors also have physical effects that can affect the sense of space and depth of scenery. In low-cost plant landscape design, the unity and coherence of the landscape can be enhanced by repeatedly using a certain color or color combination. For example, a brightly colored plant or a landscape element with special color characteristics can be used multiple times in the landscape to enhance the repetition effect of colors. This system provides landscape designers with more efficient and accurate design tools, and also provides a broader space for color application in landscape design. Zhang and Deng [15] explored the selection and application of colors are crucial. Firstly, the color design of natural landscapes should follow natural laws. At the same time, the choice of color can also have an impact on people's psychology and emotions. For example, warm colors can create a warm and harmonious atmosphere, while cool colors can make people feel calm and peaceful. Through 3D virtual technology, designers can build realistic indoor environments on computers, enabling better conceptual design and evaluation. Zhang et al. [16] explored the aim of further understanding their application methods and advantages in the field of interior design. 3D virtual

vision technology is a technology that utilizes computer graphics, artificial intelligence, and other technologies to create a virtual 3D environment. Since the 1990s, with the continuous improvement interior design, 3D virtual vision technology can help designers improve accuracy and efficiency in scheme design, effect display, construction, and other aspects. Landscape design is a creative process aimed at creating a beautiful environment that harmoniously coexists with nature for people. In this process, three-dimensional computer-aided design (CAD) technology plays an increasingly important role. Through the application of 3D CAD technology, designers can present design solutions more accurately, improve communication efficiency, reduce errors, and reduce costs. Zhao [17] utilizing the modeling function of 3D CAD, designers can finely depict landscape elements, such as the shape and texture of plants, the texture of sculptures, and the ripples of water features, making the landscape more vivid and realistic. Designers need to quickly create and modify design plans. 3D CAD software can create realistic design schemes and renderings. Designers can enhance the realism of the renderings by adjusting parameters such as materials, lighting, and shadows, making them more intuitive in showcasing the characteristics and effects of the design scheme. Using 3D CAD software, designers can accurately calculate the usage of various materials, including garden roads, paving, vegetation, etc. This calculation method not only improves the accuracy of calculations, but also helps designers optimize resource utilization and reduce costs.

Although some research achievements have been made in the field of simulation evaluation methods of landscape design schemes based on CAD and VR, there are still some shortcomings and challenges. For example, data acquisition and accuracy: For many landscape design projects, it is a difficult task to obtain high-precision and high-quality data, which limits the use of VR and CAD technology. Sometimes, the designer may not be able to get the required detailed information, which will lead to the decline of the quality of the model or the inability to accurately simulate and evaluate the design. Technical limitations: Although VR and CAD technologies have made remarkable progress, there are still limitations in some aspects. For example, for some complex landscape designs, more advanced algorithms and computing power may be needed to create accurate models. In addition, VR needs more advanced hardware equipment, which may increase the cost. Lack of evaluation criteria: Although VR and CAD technology are more and more widely used in landscape design, there is still a lack of unified and clear evaluation criteria. This may make the evaluation results subjective, and may also affect the authenticity and accuracy of the design. Based on the above, this article puts forward a simulation evaluation method of landscape design scheme based on CAD and VR. This method makes use of the accurate modeling ability of CAD software and the realism and interactivity of VR, and can effectively simulate and evaluate the landscape design scheme. In this way, designers can model, test and optimize the design on the computer.

3 METHODOLOGY

3.1 Application of CAD and VR in Simulation Evaluation of Landscape Design Scheme

CAD is a design technology using computer technology. With the help of CAD, designers can carry out various types of design work on the computer, including but not limited to architectural design, landscape design, industrial design and so on. In landscape design, the application of CAD software is of great significance. Designers can create 3D models in CAD software, carry out accurate size measurement, carry out complex graphic design, and debug virtual effects such as color, lighting and materials. Moreover, CAD software can also generate various engineering drawings, such as construction drawings, structural drawings, renderings, etc., which provides strong support for landscape design. In this study, CAD technology is mainly used in two aspects: one is to create a 3D model of landscape design, and the other is to generate construction drawings and renderings. Through CAD technology, we can simulate the landscape design more accurately, and provide the basis for the follow-up evaluation.

VR is a computer technology that can create and experience virtual worlds. By simulating people's audio-visual and tactile sense, it makes users seem to be immersed in a highly realistic, computer-generated 3D virtual environment. Through VR, designers can show their designs in a virtual environment, and users can also feel the charm of design through interactive devices such as headsets. This technology can not only improve the visualization of the design, but also enable users to better understand the designer's intentions and make better evaluation and improvement of the design. In this study, VR is mainly used in two aspects: one is to create and display the 3D virtual environment of landscape design, and the other is to simulate the audio-visual and tactile experience of people, so that users can feel the landscape design more intuitively and truly. Through VR, we can better simulate the actual situation of landscape design and provide more accurate data for subsequent evaluation.

3.2 Advantages of CAD and VR in Simulation Evaluation of Landscape Design Scheme

In the simulation evaluation of landscape design scheme, the application of CAD and VR has the following advantages: (1) High-precision modeling: CAD technology can create high-precision 3D models, thus accurately expressing designers' intentions and ideas. Moreover, VR can also render and display more accurately on the basis of CAD model, thus making the simulation evaluation more accurate. (2) Good visualization effect: VR can simulate people's audio-visual and tactile experience, so that users can feel landscape design more intuitively and truly. This technology can directly show the designer's design intention to users, so that users can better understand the design and better evaluate the feasibility and advantages of the design. (3) Real-time interaction: Through VR, users can interact with designers, so as to better understand the designer's intentions and ideas, and at the same time, they can put forward more specific opinions and suggestions on the design. This interactivity also provides better support for the evaluation work. (4) Strong expansibility: The application of CAD and VR in the design stage, but also play an important role in the whole life cycle such as construction stage and maintenance stage.

This section mainly introduces the basic concepts of CAD and VR and their applications in this study. Through CAD technology, we can simulate the landscape design more accurately, and provide the basis for the follow-up evaluation. Through VR, we can better simulate the actual situation of landscape design, so that users can feel landscape design more intuitively and truly. Moreover, this section also elaborates the advantages of CAD and VR in the simulation and evaluation of landscape design schemes.

4 LANDSCAPE MODELING BASED ON 3D MODEL OF VR AND CAD DATA

The standard specification generated by interpretation is VRML specification. In landscape animation, a very important technology is drawing technology. Because of the large amount of model data in the landscape design industry, the display speed and drawing effect of the system are required. The system uses contour technology to improve the rendering effect, and deeply studies the related content of OpenGL, and optimizes the specific rendering algorithm. When the edge shrinks, the normal direction of the object surface changes, which may affect the user's vision because it is often used in the calculation of illumination. In order to calculate the change of the normal direction of vertices, this article uses the normal direction with the largest angle between the normal direction of the original two vertices of the contracted edge and the normal direction of the new vertex to represent the error normal direction. The camera state formula is:

$$x_c = (e^T, l^T, v^T, w^T)^T \tag{1}$$

The 3D world coordinates of the camera map feature state vector composed of feature points are:

$$g_i = (x_i, y_i, z_i)^T \tag{2}$$

The state vector of 3D terrain scene reconstruction is from:

$$x = (x_c^T, g_1^T, g_2^T, g_3^T, \ldots . g_i^T, \ldots g_n^T)^T \tag{3}$$

$$x_{c,t+1}=\begin{bmatrix} e_{t+1} \\ l_{t+1} \\ v_{t+1} \\ w_{t+1} \end{bmatrix}=\begin{bmatrix} e_t+(v_t+m_v)\Delta t \\ l_{t\times l}(w_t+m_w)^{\Delta t} \\ v_t+m_v \\ w_t+m_w \end{bmatrix} \tag{4}$$

In reconstructing 3D terrain scenes, the projection position coordinate formula of random points in the image can vary depending on different algorithms. This algorithm can represent contour lines in two-dimensional images as a level set function, and then extend the level set function to three-dimensional space to calculate the position coordinates of each point. This algorithm can use deep neural networks to learn the mapping relationship between input images and 3D terrain, and output the position coordinates of each point.

$$\begin{cases} x=\frac{gX_c}{Z_C} \\ y=\frac{gY_c}{Z_c} \end{cases} \tag{5}$$

In the virtual scene, any solid model will be replaced by polygons or even triangles. This speeds up the elimination and rendering efficiency of the scene, improves the frame cycle speed, and makes people look immersive. In this article, by shrinking the edge composed of two vertices that are almost parallel to the normal direction, the plane characteristics of the model are preserved while the mesh is simplified. The normal direction of the vertex adopts the weighted average normal direction of the triangle plane where it is located. After the edge shrinks, the normal of the new triangle and the normal of the new vertex are recalculated. Let the area and unit normal of the triangle where the vertex V is located be $N_1, N_2, N_3, N_4, , , , N_m$ and $A_1, A_2, A_3, A_4, , , , A_m$ respectively, then the weighted average normal of the vertex V is:

$$N=n/|n| \tag{6}$$

$$n=\sum_{i=1}^{m}(N_i \bullet A_i)/\sum A_i \tag{7}$$

For a certain edge (V_1,V_2), if the normals of vertices V_1 and V_2 are N_1 and N_2 respectively, the edge (V_1,V_2) can be shrunk when the included angle θ between N_1 and N_2 is less than or equal to a certain threshold ε. Due to:

$$N_1 \cdot N_2=(N_1)\cdot(N_2)\cdot\cos\theta \tag{8}$$

Then:

$$\cos\theta=(N_1\cdot N_2)/(|N_1|\cdot|N_2|) \tag{9}$$

If N_1 and N_2 are normalized, there are:

$$\cos\theta=N_1\cdot N_2 \tag{10}$$

For the convenience of calculation, when ε is very small, the following formula can be used:

$$\cos\theta=N_1\cdot N_2>1-\varepsilon \tag{11}$$

Schematic diagram of terrain slope and slope calculation is shown in Figure 1.

In this article, firstly, the original topography is simulated by 3D graphic data, and the topographic grid map is generated. Then, according to the relevant rules, the rationality of the terrain, such as orientation, water flow and slope, is analyzed, and according to the analysis results, the terrain transformation and plant distribution scheme are designed, the excavated parts are simulated, and the earthwork quantity is calculated, filling and digging mountains and lakes in landscape design and the reasonable planting of various habit plants. Adding the information of branches and leaves of tree model with hierarchical detail model and establishing the information

of leaves with Billboard model can effectively reduce the consumption of tree model rendering in landscape design.

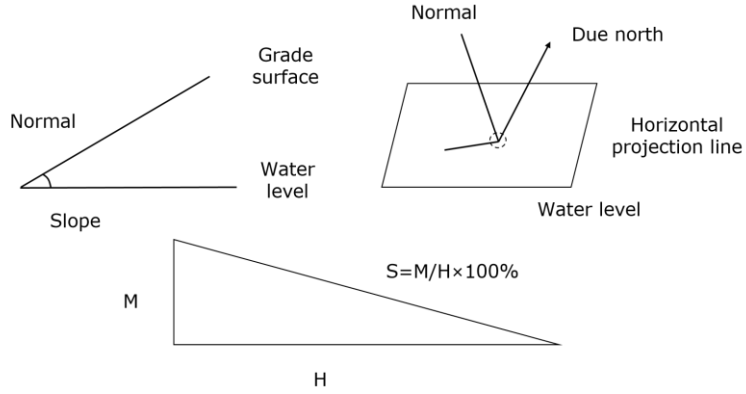

Figure 1: Schematic diagram of terrain slope.

Let the roughness be $DH_{\max}$ if it meets the following conditions:

$$\frac{1}{\max(DH_{\max}O)_2} \tag{12}$$

$$l/d < C_1 \tag{13}$$

By combining Equations (12) and (13), we can get:

$$\frac{1}{d \cdot C_1 \cdot \max(DH_{\max}O)_2} \tag{14}$$

Judging the conditions for eliminating triangular cracks:

$$\frac{1}{2}(1+\frac{d^2-d_2^2}{d^2-d_2^2}) < \frac{DH_{\max 2}^2}{DH_{\max 1}^2} < 1 \tag{15}$$

$$l_2^2 = d^2 + d_1^2 / l_1^2 = d^2 + d_2^2 \tag{16}$$

In the rough mesh drawing, the contour line needs special treatment most. In this article, a contour line smoothing technique is proposed to optimize the contour line drawing of rough mesh, which solves the problem of how to make the contour line drawing of rough mesh more natural and smoother without a more refined model. The mesh simplification algorithm is shown in Figure 2 below.

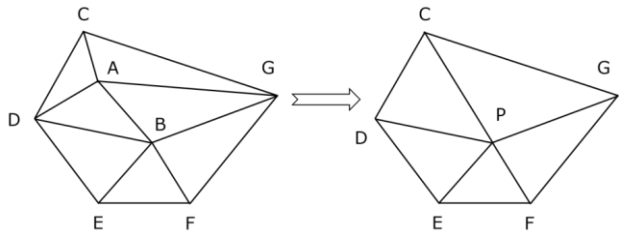

Figure 2: Mesh simplification algorithm.

There are a large number of triangles that are directly converted from CAD data, and a large number of triangles will lead to a lot of memory exchange when rendering, which will reduce the real-time interaction rate of the system. Therefore, it is needed to simplify the model without affecting the visual effect, and build a 3D model with as few sides as possible to improve the rendering speed. The mesh view visualizes the triangulation of the surface, and the finite element mesh automatically generated by CATIA has compact structure, coordinated shape and controllable quality. We can obtain grids with different accuracy by specifying different grid parameters, such as cell size, sag and angle. In this article, 3D realistic topographic map method of 3DSMax is adopted. 3D realistic topographic map can realistically reflect the external real world. Compared with traditional paper topographic map, computer-generated line topographic map and entity topographic map, it has the characteristics of high visualization, practicality and convenience for storage and query.

5 SIMULATION EVALUATION SIMULATION OF LANDSCAPE DESIGN SCHEME

This section takes the landscape planning and design of a city as an example to carry out concrete practice. In landscape design, 3D terrain scene modeling plays an important role, which covers a lot of building information, and the modeling workload is heavy and difficult. The software platforms selected in the experiment include AutoCAD3D drawing software, SketchUp3D modeling software and Adobe Photoshop CS6 2D mapping software. The stage of reading and writing Open Flight files is shown in Figure 3.

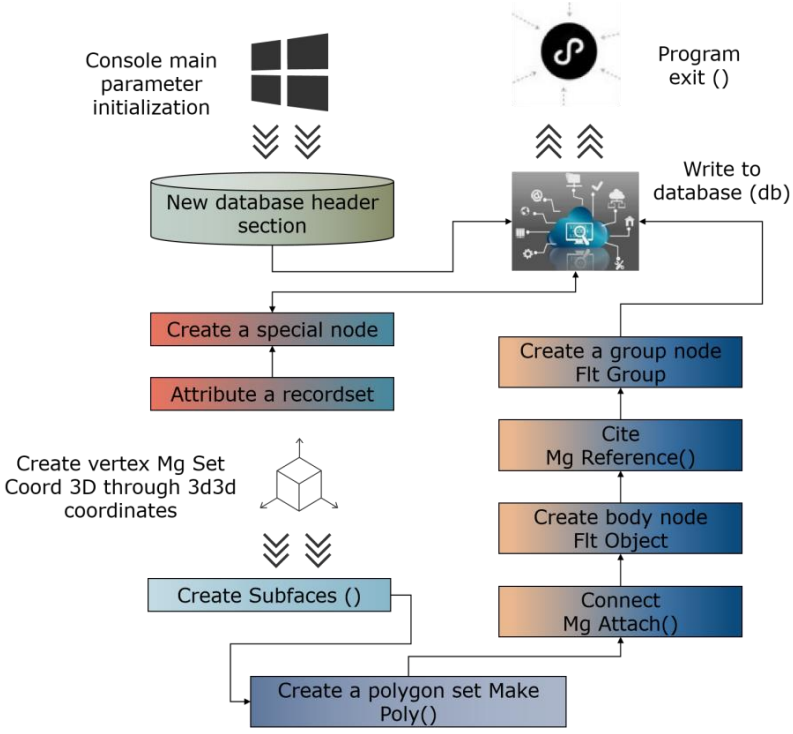

Figure 3: Open Flight file reading and writing process.

In reality, data often contain noise, which is inevitable. By training the algorithm many times in this article, we can observe the change of data error with the increase of noise in the training set. This change is vividly reflected in Figure 4.

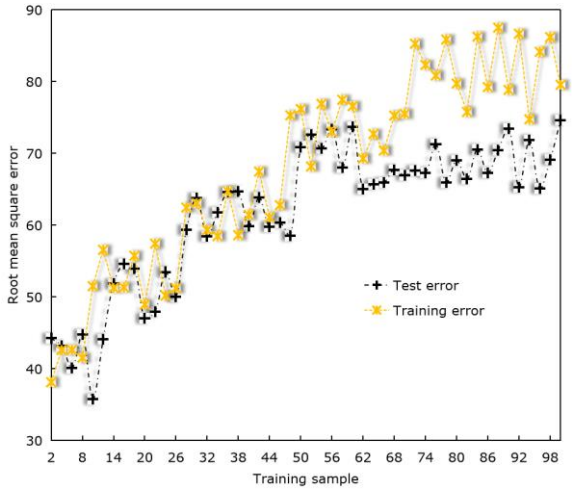

Figure 4: Data error change.

With the increase of noise in the training set, the error of the algorithm may increase. This is because noise data may interfere with the learning and prediction ability of the algorithm, resulting in an increase in error. Too much noise may make it difficult for the algorithm to extract useful information from it, so the performance will be degraded. This emphasizes the importance of noise reduction and data cleaning in the data preprocessing stage. When dealing with noisy data. In addition, too much noise may lead to the performance degradation or over-fitting of the algorithm, so it is needed to control the proportion and influence of noise when designing and implementing the algorithm.

In this article, data are preprocessed to remove repeated, invalid and abnormal data, fill in missing values and deal with abnormal values. And transform the original data into a format more suitable for analysis and modeling. In addition, the most important features are selected from the original data to improve the accuracy and efficiency of the model. Experiments are carried out on the processed data, and the accuracy results of the algorithm are shown in Figure 5.

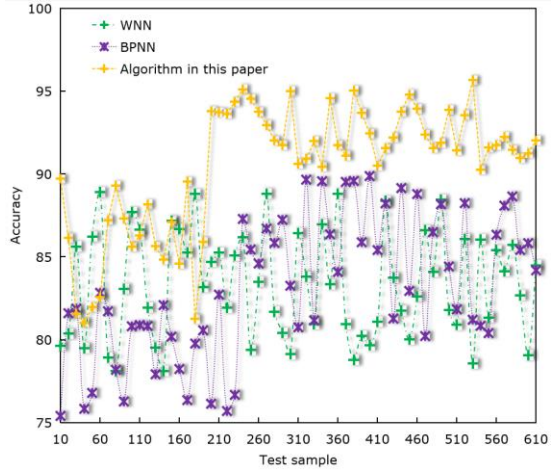

Figure 5: Accuracy results of the algorithm.

According to Figure 5, the processed data is evaluated by the algorithm in this article, and the accuracy of the algorithm exceeds 90%. This means that the algorithm in this article can

accurately reflect most of the information of the design scheme when predicting the result of the landscape design scheme. Compared with traditional neural network and PSO, this algorithm has certain advantages in accuracy. Specifically, the traditional neural network may be affected by data complexity and noise when dealing with such problems, resulting in lower accuracy. However, PSO algorithm may fall into local optimal solution in the optimization process, which limits its performance. In contrast, the algorithm in this article can better understand and use the internal structure of landscape design data by combining CAD and VR, thus achieving better performance in accuracy. Figure 6 shows the RMSE results of the algorithm.

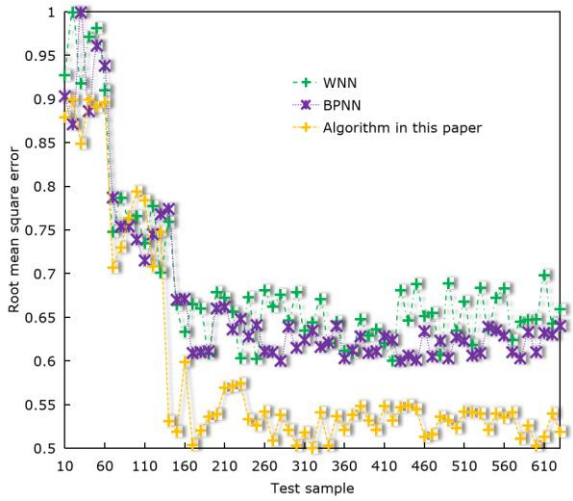

Figure 6: RMSE results of the algorithm.

According to Figure 6, the RMSE value of this algorithm is low, only 4.10. Compared with traditional neural network and PSO, this algorithm also has certain advantages in RMSE. In RMSE, the traditional neural network and PSO algorithm may have large errors due to the influence of data complexity and noise. The algorithm in this article can predict the result of landscape design scheme more accurately through accurate modeling and realistic simulation, so it has a lower RMSE value.

In this article, binocular stereo vision camera is used to collect landscape terrain scenes, and 3D terrain scene model is reconstructed by image feature points. The bounding volume hierarchy method is selected to render landscape scene elements with OSG3D graphics engine. The user's actual landscape design is shown in Figure 7.

Figure 7: User's actual landscape design exhibition map.

It can be seen that the landscape design makes full use of space and makes reasonable arrangements at different heights and positions. Moreover, the landscape shows a diversified, interactive, sustainable and humanistic design concept, which can bring more vitality and value to urban public space. Figure 8 shows the accuracy of different algorithms in the simulation and evaluation of landscape design schemes.

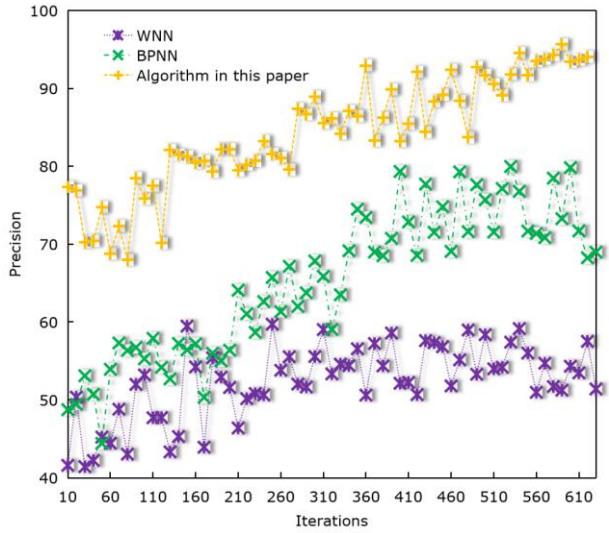

Figure 8: Accuracy comparison of simulation evaluation algorithms for landscape design schemes.

The accuracy of the algorithm in this article reaches 95.14%. From the experimental results, the algorithm in this article does have certain advantages in accuracy. To sum up, by comparing the traditional neural network and PSO, and analyzing the accuracy index, RMSE index and evaluation accuracy index of the results, it can be concluded that the algorithm in this article has advantages in the simulation evaluation of landscape design schemes. The experimental results basically meet the expected expectations. Generally speaking, the method in this article simplifies the 3D model mesh and can write the model data into the industry standard Open Flight format. It can be used to realize automatic modeling and evaluation of VR visual system model according to existing CAD data.

6 CONCLUSIONS

This article introduces the main steps of landscape design using CAD and VR, including modeling, drawing and post-processing, and expounds the application of CAD and VR in landscape design. Based on CAD and VR, this article puts forward a modeling method based on 3D model of CAD data, which provides support for simulation and evaluation of landscape design scheme. The simulation experiment is carried out. Moreover, the RMSE of the algorithm is low, reaching From the results, the algorithm proposed in this article performs well in the simulation and evaluation of landscape design schemes. CAD technology enables the landscape design scheme to be modeled and presented in the form of high precision in the computer. This not only improves the design accuracy, but also allows designers to simulate and test more accurately. Moreover, VR provides a realistic and 3D visual environment for designers, in which they can evaluate the design in all directions. This real visual effect and interactivity enable designers to understand the design more intuitively and accurately, so as to better evaluate and optimize it. Generally speaking, reduce resource consumption, and provide a brand-new and intuitive evaluation method for designers. In

the future, we look forward to seeing the wider application and expansion of this technology in the landscape design field.

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