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Computer-Aided Design AND APPLICATIONS

Optimization of Environmental Art Design Automation Method Based on CAD and Neural Network

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Abstract. Environmental art design is more and more widely used in daily life and commercial fields. Through computer-aided design (CAD) technology, designers can conveniently perform operations such as modeling, rendering and material mapping on the space, which greatly improves the design efficiency and quality. In environmental art design, Neural network (NN) technology can be used to extract the characteristics of environmental art space, and on this basis, the 3D model of environmental art can be automatically generated. The research aims to combine CAD and NN technology to provide an efficient, intelligent and visual automatic design method for environmental art design. This method can improve the quality of environmental changes, and also realize large-scale production and replication of design schemes, providing new ideas and methods for industrial production of environmental design. The results show that this method can realize the large-scale production and replication of the design scheme. Moreover, the visualization and interactivity of NN technology have also been significantly improved, and designers can adjust and optimize the design scheme in real time according to the actual situation.

Keywords: CAD; Neural Network; Environmental Art Design; Automation
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1 INTRODUCTION

Environmental art design is an organic combination of space, color, modeling, light and shadow to create an artistic form that meets people's aesthetic and functional needs. In the course of microelectronic circuit design, students need to learn how to use these computer-aided design tools. Specifically, students need to understand the functions and usage methods of various tools, and master how to use these tools for the design, simulation, simulation, and manufacturing of microelectronic circuits. In addition, students also need to learn how to optimize and improve circuits to improve their performance and reliability. Abugharbieh and Marar [1] Circuit simulation tools can

help designers simulate and verify circuits during the design and testing stages to ensure that their performance meets expectations. The circuit schematic editor is used to create and edit circuit schematics, allowing designers to clearly express their design intentions. In microelectronic circuit design, CAD software typically provides a comprehensive toolset to support the entire design process from concept to production. These tools include circuit simulation tools, circuit schematic editor, PCB layout tools, signal integrity analysis tools, etc. Environmental art design is more and more widely used in daily life and commercial fields. However, the traditional design method mainly relies on the designer's manual operation and experience accumulation, and the design process is cumbersome and inefficient, and the quality of the design scheme is difficult to be guaranteed. Intelligent deduction is a technology based on computer simulation that can help designers predict the future effects of architectural design. Through the application of empowerment algorithms, intelligent deduction can more accurately predict the performance of design schemes under different conditions, providing designers with more decision-making basis. For example, Monte Carlo simulation algorithms can be used to predict and evaluate the reliability of building structures, helping designers optimize structural design solutions. Especially for novice designers, how to use empowerment algorithms to assist architectural design, improve design efficiency and quality, is a problem worth exploring. Chen et al. [2] introduced the application scenarios, advantages and disadvantages of empowerment algorithms in architectural design, as well as how to use empowerment algorithms to assist in architectural design. Algorithms that can optimize design schemes by adjusting parameters. In architectural design, the relationships between building form, structure, materials, and other aspects, improving design quality and efficiency. Enabling buildings to have better structural performance and space utilization while meeting functional and aesthetic requirements.

Due to the different personal preferences and skill levels of designers, there are often great differences in design schemes, and it is difficult to realize large-scale production and replication of design schemes.

Li et al. [3] analyzing its application advantages and practical cases, it is concluded that flipped classrooms based on rainwater classrooms can enhance students' learning interest and initiative, enhance teaching effectiveness, and cultivate students' innovative and practical abilities. Flipped classroom is a new teaching mode that combines traditional classroom teaching with online learning. In flipped classrooms, students can preview course content through online videos, courseware, and other learning resources before class, while conducting in-depth discussions and practical operations in the classroom. This teaching mode can stimulate students' interest and initiative in learning, and improve learning effectiveness. Teachers create courseware, videos, and other teaching resources on "landscape plant configuration", including the characteristics, configuration principles, and methods of different types of plants, and publish them on the teaching platform. In the classroom, the teacher guides students to discuss the application scenarios of different types of landscape plant characteristics, configuration principles and methods, as well as how to configure plants according to customer needs in actual projects. At the same time, teachers can use case studies, group discussions, and other methods to help students deeply understand this knowledge point. After class, teachers can verify students' mastery of the knowledge of "landscape plant configuration" through online tests, assignments, and other methods, and track and guide students' learning. Therefore, how to improve the environmental design and reduce the influence of human factors on the design results is one of the urgent problems in the field of environmental design. With the arrival of the big data era, enterprises are facing massive data challenges. How to effectively utilize these data and discover their value has become the key to enterprise development. And the adoption and implementation of big data analysis technology. Gong and Janssen [4] explored the role and capabilities of enterprise architecture in the adoption and implementation of big data analysis technology. Enterprises can improve the efficiency of data utilization by optimizing organizational structure and establishing cross departmental data sharing mechanisms. Enterprises can adopt advanced big data analysis technology, establish a comprehensive data analysis platform, and improve data processing and analysis capabilities. By optimizing organizational, technical, and business structures, enterprises can better utilize data, improve competitiveness, and innovation capabilities. When implementing big data analysis technology, enterprises need to establish a

comprehensive implementation framework, including data collection, data processing, data analysis, and other aspects. Only in this way can we better realize the value of data and promote the development of enterprises.

Through CAD technology, designers can easily perform modeling, rendering, material mapping and other operations on the space, which greatly improves the design efficiency and quality. The streaming technology provides artists with new creative methods and ideas. Guo and Li [5] detailed the concept and application of video streaming, as well as the process and cases of computer-aided art design and production. Finally, they explored the advantages and limitations of video streaming technology. Video stream refers to video data transmitted through a computer network, which has the characteristics of real-time and continuous transmission. Video streaming technology is widely used in fields such as dynamic image processing, real-time interactive design, and virtual reality. Artists can use video streaming technology to dynamically adjust and optimize their artwork to achieve richer visual effects and interactive experiences. For example, in digital painting, artists can use video streaming technology to capture the motion trajectory and color information of the brush in real-time, and convert it into digital image data, thereby achieving a more natural and smooth painting effect. For example, designers need to manually set modeling parameters and rendering parameters, which makes it difficult to achieve automation and intelligence; Moreover, the visualization and interactivity of CAD technology are poor, and designers need to spend a lot of time and energy on debugging and modification. Flat landscape, as a part of urban green infrastructure, has multiple functions such as improving the urban environment and enhancing ecological benefits. At the same time, it is also an important task in urban planning and construction. However, how to evaluate the performance of flat landscapes and better leverage the role of green infrastructure has always been a challenge for urban planners and builders. Therefore, this study has important practical significance and value. As an important urban green infrastructure, the planning and construction of flat landscapes have become increasingly important. Hendricks et al. explored the importance and methodology of flat landscapes as a green infrastructure assessment tool for service-learning products [6]. NN technology can automatically extract features from data and perform tasks such as classification and prediction based on these features. Jin and Yang [7] using a graphical interface and operating buttons, the design process is made more intuitive and convenient. Designers can quickly select and adjust different design elements according to actual needs, achieving rapid expression and modification of design ideas. By selecting appropriate furniture, colors, lighting, and decorative elements, the design effect of the entire space can be directly rendered using computer-aided design software. This not only saves time, but also avoids frequent paper communication and modifications in traditional design. The application of computer-aided design software enables students to design and draw more conveniently, improving design efficiency. At the same time, the rendering and animation production functions provided by this software can help students better showcase design solutions and enhance their communication and expression skills. Teachers can guide students to use SketchUp for conceptual design and scheme analysis, helping them establish a sense of three-dimensional space and improve their abilities in spatial planning and functional layout. At the same time, students can also add elements such as materials and lighting to preliminarily present the design scheme. AutoCAD can be used to draw detailed design drawings, including floor plans, elevations, sections, etc. By using AutoCAD, students can better understand the details and specifications of design, and improve their drawing skills. 3ds Max can be used to create high-quality renderings and animations to showcase the overall effect and dynamic presentation of design solutions. This helps students to more intuitively evaluate the feasibility and effectiveness of design solutions. In environmental art design, NN technology can be used to extract the characteristics of environmental art space, and on this basis, the 3D model of environmental art can be automatically generated. Kerr and Lawson [8] explored the application of augmented reality in landscape architecture research and its advantages and disadvantages. Through literature review and case analysis, we have found that augmented reality technology can help students' architectural space and environment, improve their practical ability and innovation awareness. Augmented reality technology can enable students to engage in practical operations in virtual environments, enhancing their practical abilities and innovative awareness. Secondly, augmented reality technology can help

students better understand and experience architectural space and environment, and improve their cognitive abilities. Finally, augmented reality technology can reduce practical costs, reduce resource waste, and improve practical efficiency. In this article, NN technology is applied to the automatic design of environmental art. Through NN technology, the spatial characteristics of environmental art can be automatically extracted and identified, and then the 3D model of environmental art can be automatically generated on this basis. Moreover, the visualization and interactivity of NN technology have also been significantly improved, and designers can adjust and optimize the design scheme in real time according to the actual situation.

In the field of environmental design, many scholars have made corresponding research results and contributed to the growth of this field to varying degrees. These research results provide important ideas and methods for the growth of environmental design, and provide designers with more efficient and intelligent design tools. The innovation of this study is mainly reflected in:

(1) The automatic method of environmental design based on NN proposed in this article can automatically extract the characteristics of environmental art space, and automatically generate a 3D model of environmental art on this basis.

(2) Through the NN technology, designers can adjust and optimize the design scheme in real time according to the actual situation, and realize the large-scale production and replication of the design scheme. Moreover, this method can also automatically adjust the design scheme according to the needs of users, and realize personalized customization.

The research contents of this article mainly include the following aspects: firstly, the existing environmental art design methods and NN technology are summarized and analyzed; Secondly, this article introduces the concrete realization stage of the automatic method of environmental design based on CAD and NN. Thirdly, the validity and feasibility of this method are verified. Finally, the research content of this article is summarized and prospected.

2 THEORETICAL BASIS

Immersive technology is a highly immersive virtual environment created through computer technology and virtual reality technology. It can completely surround users in a simulated environment, allowing them to fully immerse themselves in the environment. In the field of architecture, immersive the internal and external environment of buildings, enabling designers and construction personnel to have a more intuitive understanding of design schemes and construction effects. Khan et al. [9] found through SWOT analysis that the integration of AEC BIM and immersive technology has advantages in improving building quality, reducing energy consumption, and enhancing collaborative capabilities. But there are also disadvantages such as high technical requirements and high costs. The future development direction should be to further promote and apply these two technologies, especially to leverage their advantages in large and complex projects. At the same time, it is necessary to strengthen the training of technical personnel and technological research and development to reduce costs and technical barriers. In addition, attention needs to be paid to data security protection issues to ensure the security and stability of the BIM model. Landscape architecture is a highly practical discipline, so in the learning process, it is important to focus on practical and project experience accumulation. By participating in practical projects, participating in design competitions, or independently carrying out design practices, apply the knowledge learned to practice. This helps to deepen the understanding of theoretical knowledge, improve one's design ability and problem-solving ability. Newman et al. [10] aim to evaluate the issues, preferences, and student needs in online education related to design, in order to provide some reference and suggestions for future online education. Online learning of landscape architecture requires learners to possess certain professional knowledge and self-learning ability. By selecting appropriate online courses and resources, emphasizing practical and project experience accumulation, cultivating critical thinking and innovation abilities, and strengthening online communication and cooperation abilities, the learning effectiveness and quality of landscape architecture can be improved. At the same time, it is necessary to arrange learning time and energy

reasonably to ensure good learning outcomes. Environmental art design is an art form that organically integrates elements such as space, color, and material. With the continuous development of technology, people's demand for environmental art design is also increasing. Researchers continuously explore new technologies and methods. Among them, the optimization of environmental art design automation methods based on CAD and neural networks has become a research hotspot. Saleh et al. [11] explored how to use CAD and neural network technology to optimize automation methods for environmental art design, with the aim of providing useful references for the development of this field.

In recent years, CAD SketchUp PS integrated software technology has gradually improved its design, providing designers with more efficient and convenient design tools. Song and Jing discussed the application prospects. CAD SketchUp PS integrated software technology can help designers quickly create 3D models and design spatial layouts and landscape elements. By presenting the design scheme through visual effects, designers can more accurately grasp the feasibility and effect presentation of the scheme. Song and Jing [12] use modeling and rendering, presenting modern and green design solutions. Through communication and coordination with clients and team members, a high-quality design solution that meets the needs of all parties was ultimately achieved. This case fully demonstrates the practical application and value of CAD SketchUp PS integrated software technology in landscape planning and design. Site scale landscape design is an important component of urban planning and construction, which is of great significance for improving the quality of life of urban residents and promoting community development. Therefore, utilizing social media data to understand site scale landscape design has great potential. Song and Zhang [13] used Seattle Expressway Park as an example to explore how to use social media data to understand and improve site scale landscape design. Utilize social media data to understand and improve the site scale landscape design of Seattle Highway Park. Through literature review and field investigation, we have understood the impact of user needs and preferences on site scale landscape design. Through social media data analysis, we found that users have different evaluations and suggestions for the site scale landscape design of the park. Based on these results, some improvement suggestions have been proposed site scale landscape design in the park. Digital archiving can protect and inherit architectural cultural heritage. Architectural space is a cultural heritage with historical and cultural value that needs to be recorded and protected. Computer aided design software can accurately measure and record building spaces through digital technology. And generate various forms of digital archives such as 3D models, images, and data to permanently preserve and inherit this precious architectural cultural heritage. Improved design efficiency, optimize spatial layout, and enhance user experience. Tai and Sung [14] discussed the concepts, technical principles, and practical cases of computer-aided digital archiving for architectural spatial perception experiences. Architectural spatial perception experience refers to the comprehensive perception of architectural space and its surrounding environment by people through various senses such as visual, auditory, tactile, and olfactory senses. Computer assisted digital archiving is a process that utilizes computer technology to digitize, store, and apply building spatial perception experiences. Through digital technology, the structure, materials, colors, lighting, and other factors of the building space can be comprehensively recorded, while also incorporating people's feelings and feedback, thus forming a comprehensive digital archive.

Toledo and Scognamiglio [15] propose a design method for agricultural photovoltaic systems based on digital evaluation models. This model is based on experimental data and quantitatively evaluates the performance and sustainability of the system by establishing a mathematical model. Specifically, the model will consider the following factors: power generation efficiency of the system, crop growth status, utilization efficiency of soil and water resources, protection of biodiversity, and improvement of the atmospheric environment. By applying the evaluation model, we can better achieve the sustainable landscape vision and provide strong support for the optimization design of agricultural photovoltaic systems. In order to verify the practical application effect of the above descriptive model, this article selects an actual case for case analysis. This case is located in an area with a suitable climate and sufficient sunlight. The design goal of the local agricultural photovoltaic system is to provide electricity support for agricultural production while reducing environmental

impact. With the growth of global population and the acceleration of urbanization, the demand for agricultural landscapes and food security in metropolitan areas is becoming increasingly prominent. In this context, Yacamán et al. [16] explored the importance of green infrastructure planning in metropolitan areas and how to improve connectivity between agricultural landscapes and food security through planning. The importance of green infrastructure planning in metropolitan areas was elaborated from the perspectives of ensuring food security, improving ecological benefits, and promoting sustainable development. At the same time, the principles and specific measures of green infrastructure planning were introduced, and an analysis was conducted based on the case of Shanghai. Plan and construct an urban greenway network to connect various green spaces and nature reserves in the city, forming a complete green corridor. At the same time, we will strengthen the construction of community green spaces and improve the quality of the green environment for citizens. Encourage and support the development of ecological agriculture, and promote the transformation from traditional agriculture to ecological agriculture through policy support and technical guidance. At the same time, strengthen citizens' understanding and acceptance of ecological agriculture. Strengthen water resource protection and water environment governance to ensure the safety and quality of water sources. At the same time, we will strengthen the ecological restoration and protection of water bodies, and improve their ecological service functions.

The history of environmental landscape art design can be traced back to ancient times, when design mainly relied on the experience and intuition of designers. However, with the development of technology and social progress, people's demand for environmental landscapes is no longer satisfied with traditional static and linear design. Therefore, we need a new design method to meet this requirement. Dynamic nonlinear parameterized environmental landscape art design has emerged in this context. It introduces dynamic and nonlinear design elements to better adapt the environmental landscape to changes and meet people's diverse needs. Parametric environmental landscape art design is a method based on parametric design, which adjusts and controls the parameters of landscape elements to achieve dynamic and nonlinear design of the landscape. Yu et al. [17] established the park using software and parameterized elements such as terrain, plants, and water. Then, the designer achieved dynamic control of the park design by adjusting the parameters of these elements. In landscape design, color is a very important element. It can affect people's emotional, psychological, and environmental experiences. Reasonable color application can enhance the attractiveness of the landscape, enhance people's spatial perception and emotional experience. At the same time, color can also serve as a cultural symbol to convey the designer's intentions and concepts. Therefore, studying the color effect in landscape design has important practical significance and theoretical value. Color theory is the foundation of color application in landscape design. It includes the basic attributes of color, color matching principles, and color psychology. The basic attributes of color include hue, brightness, and chromaticity. Zhang and Deng [18] used different color matching techniques in the design process. By using reasonable colors, the attractiveness and spatial perception of the landscape can be enhanced. At the same time, it can also convey the designer's intentions and concepts. When carrying out landscape design, the application of color theory and the coordination with natural conditions and cultural environment. At the same time, consideration should also be given to issues such as functionality and practicality, as well as implementability and economy. Terrain is one of the important elements in landscape design, which can affect the spatial sense, landscape effect, and drainage of the garden. By optimizing the design of the terrain, gardens can be made more natural and harmonious. For example, terrain can be used for landscape zoning, so that different areas have different landscape characteristics and functions; Terrain can also be used for drainage design, making the drainage of the garden smoother and more natural. Taking a certain urban park as an example, the park adopts the design concept of modern gardens, emphasizing the functions of ecological protection and leisure entertainment. Zhao [19] utilizes 3D CAD technology for work such as scheme design, construction drawing, and rendering. The spatial sense, vegetation level, and terrain design of the garden have been optimized. Ultimately, it presents a natural, comfortable, and pleasant urban park. In traditional computer-aided design, the emotions of designers have a significant impact on design outcomes. When designers are in a positive emotional state, they are often able to generate more creativity and conduct in-depth exploration of

the design. When they are in a negative emotional state, it may limit the design and even lead to design failure. Therefore, designers should strive to maintain a positive emotional state to promote innovation and development in design. Designer emotions play an important role in computer-aided design. In traditional computer-aided design, the emotions of designers directly affect the quality and innovation of design results. In collaboration, designer emotions also have a significant impact on the formation and innovation of design proposals. Therefore, designers and managers should pay full attention to the emotional state of designers, take effective measures to stimulate positive emotions, and improve design quality and efficiency [20].

3 OPTIMIZATION OF AUTOMATION METHOD OF ENVIRONMENTAL DESIGN

3.1 Spatial Feature Detection of Environmental Art

Environmental design is an organic combination of space, color, modeling, light and shadow to create an artistic form that meets people's aesthetic and functional needs. Environmental art design involves architecture, interior design, landscape design and other fields, aiming at improving people's quality of life and working environment. In environmental art design, spatial feature detection and modeling is one of the key links. By extracting and modeling spatial features, we can better understand the structure and characteristics of space and provide basic data for subsequent design and optimization. NN can automatically extract features by learning sample data, and perform tasks such as classification and prediction based on these features. In environmental art design, NN can be used to automatically extract spatial features, and on this basis, automatically generate a 3D model of environmental art. CNN extracts and reduces the dimension of the input image layer by layer, and finally outputs the classification result or feature vector of the image. In environmental design, CNN can be used to extract the characteristics of spatial images and provide basic data for the generation of 3D models of environmental art.

Recurrent neural network (RNN) is a NN algorithm suitable for sequence data processing and text generation. RNN processes the input sequence data one by one through memory cells and recursion, and outputs the prediction results or feature vectors of the sequence. RNN can be used to process spatial feature sequence data and provide dynamic feature information for the generation of 3D model of environmental art. Generate adversarial networks (GAN) is the game between generator and discriminator to generate new data. The discriminator network discriminates the real data from the generated data and outputs the discriminating result. GAN can be used to automatically generate 3D models of environmental art, and the quality and diversity of models can be improved by continuously optimizing the network parameters of generators and discriminators.

Through CAD software, operations such as 2D drawing, 3D modeling, rendering and material mapping can be performed. In environmental art design, CAD technology can assist designers in space modeling, rendering, material mapping. Moreover, CAD technology can also transform the design scheme into standardized data format, which is convenient for subsequent data processing and analysis. The combination of NN and CAD technology makes the design process automatic and intelligent, which greatly improves the design efficiency and quality. However, there are still some problems in this automatic method, such as data quality, accuracy of feature detection and efficiency of 3D model generation. Therefore, it is needed to optimize this method to further improve the effect of environmental design. Aiming at the noise, redundancy and abnormal values that may exist in the original data, advanced data cleaning technology is adopted for preprocessing. Aiming at the problems existing in the existing NN model, CNN is introduced to increase the depth and width of the model and improve the ability of feature detection. In addition, transfer learning and other technologies are introduced to transfer the model trained on large-scale data sets to small-scale data sets, thus reducing training time and computing resources. In the aspect of feature selection, automatic methods are used to screen and optimize the extracted features, and the most relevant features are automatically selected according to the model performance, thus reducing feature redundancy and noise interference. In addition, feature generation technology can be introduced to

automatically generate new related features according to the existing features, which can increase the expression ability and generalization performance of the model.

The process of landscape feature analysis in 3D space of environmental design aims to understand and describe the important elements in the environment and their relationships. First, we need to collect 3D data about the environment. Data collection can be carried out in various ways, such as topographic mapping, aerial photography, laser scanning and so on. The collected data need to be preprocessed to remove noise, fill in missing values, standardize and so on, so as to facilitate the subsequent feature detection and analysis. These characteristics may include the ups and downs of the terrain, the types and distribution of vegetation, the shape and location of water bodies, etc. After understanding the meaning of landscape features, we can make a deeper analysis. For example, the relationship between different landscape features can be analyzed, or the use of the environment can be classified according to the landscape features. The analysis process of landscape characteristics in 3D space of environmental design is shown in Figure 1.

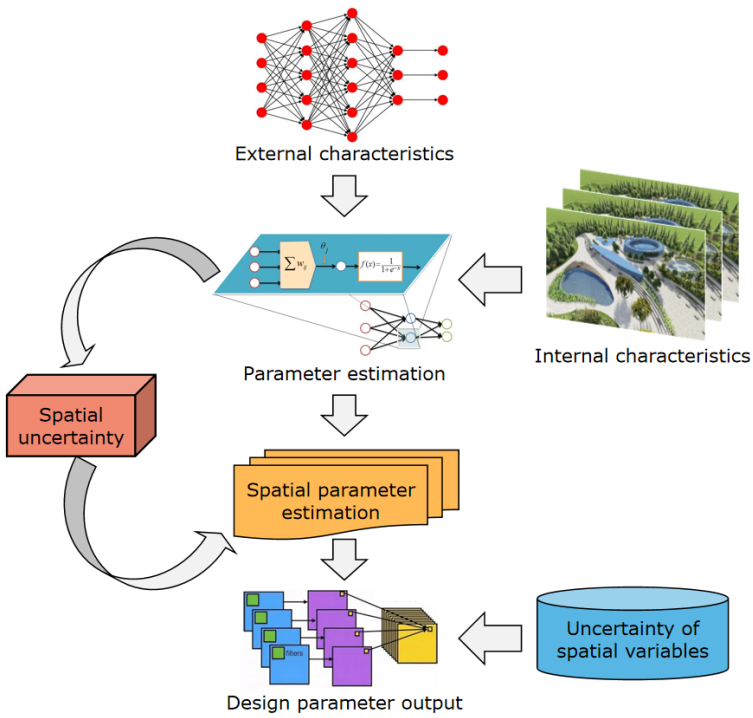

Figure 1: Analysis process of landscape characteristics in environmental design space.

The spatial feature detection of environmental art proposed in this article. The first stage is to calculate the obstacles that block the viewpoints in all directions from the determined viewpoints, and the second stage is to analyze the spatial distribution of obstacles, as shown in Figure 2.

Based on the analysis results of landscape characteristics, environmental design decisions can be made. For example, if the analysis shows that a particular vegetation type is beneficial to the aesthetics and functionality of the environment, then increasing the number or distribution of this vegetation type can be considered in the design decision. This process is non-linear, that is to say, in the analysis process, it may be needed to repeat the steps of data collection and preprocessing, spatial feature detection, landscape feature understanding and landscape feature analysis in order to get the most accurate results.

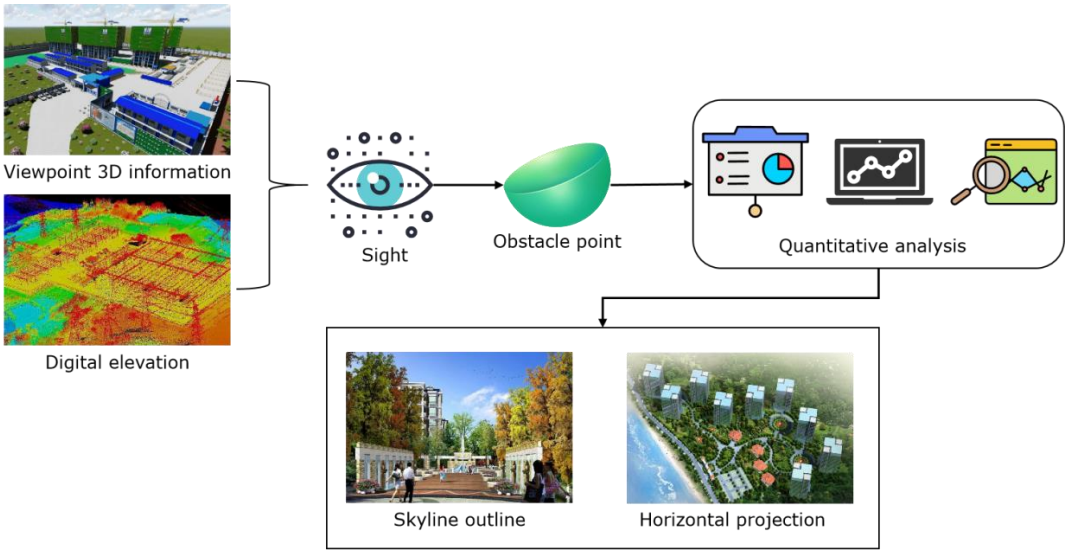

Figure 2: Implementation process of feature detection of environmental art space.

Describe the visual openness in 3D space using the crowding degree of environmental space:

$$SC_b = \frac{\sum_{i=1}^{n} V_{bi}}{\max\ H_b\ \times A} \tag{1}$$

$$F = CR \times TY \tag{2}$$

$$FD_b = \frac{1}{n}\sum_{i=1}^{n} 21n\left(\frac{P_{bi}}{4}\right) / \ln S_{bi} \tag{3}$$

$$D = \begin{cases} 0 & d > d_0 \\ D\ O,d,m & d \le d_0 \end{cases} \tag{4}$$

The acquired image can be 2D or 3D. The resolution, color and illumination of the image are all factors to be considered. The collected image needs a series of preprocessing to enhance the image quality and remove noise. Pretreatment includes graying, denoising and contrast enhancement. The extracted features need to be further used for recognition and classification. The information obtained by the above method needs to be used to understand the environment. This may include the structure, function and usage of the environment. The traditional image binarization method is to artificially determine a certain threshold T, and discuss the relationship between the gray value $f\ x,y$ of the image at a certain point x,y and the threshold T. The binarized image gray value is:

$$g\ x,y\ = \begin{cases} 255 & f\ x,y\ \ge T \\ 0 & f\ x,y\ \le T \end{cases} \tag{5}$$

Calculate the average gray value:

$$\mu_T = \sum_{i=0}^{255} ih\ i \tag{6}$$

The degree matrix is represented by D. Definition:

$$D_{ij} = \sum_{j=1}^{n} w \ \ i, j \tag{7}$$

Test the pixel value of a point x, y in the area to see if it has the original given value, so as to determine whether the point has been filled in the area.

3.2 Automatic Generation of 3D Model of Environmental Design

In the stage of 3D model generation, optimization strategy is introduced to monitor and adjust the model in real time. In this study, model simplification technology is used to reduce model complexity and improve rendering speed and display effect on the premise of ensuring model quality. In addition, by setting parameters and constraints, shape adjustment and material modification are carried out on the model to meet the actual needs and design intent. For the image data of environmental art, CAD software is needed to generate the model. This process can choose different algorithms and technologies according to the data type and precision requirements. For terrain data, triangular mesh generation algorithm can be used to build terrain model; For architectural drawings, line modeling or solid modeling technology can be used to build architectural models. The NN structure of environmental art CAD image segmentation is shown in Figure 3.

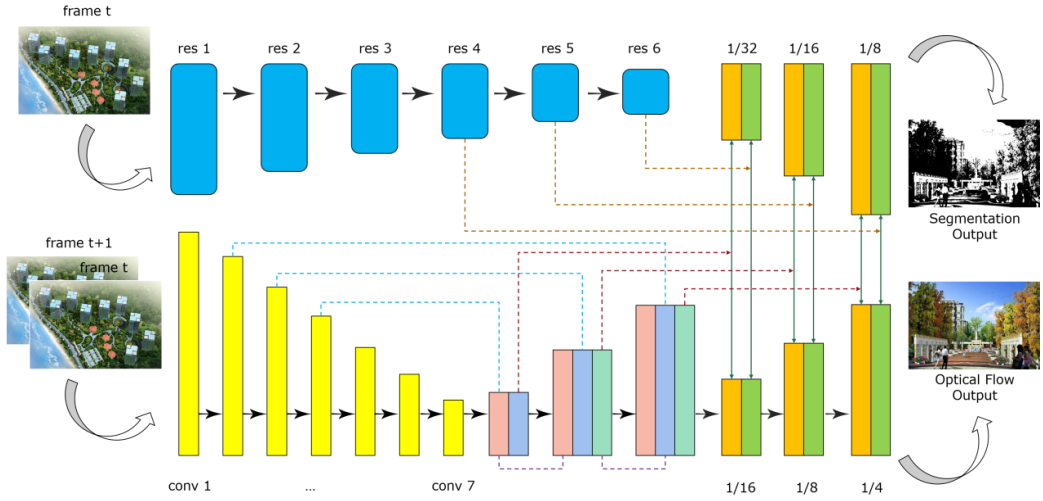

Figure 3: Network structure of 3D image segmentation of environmental art CAD.

After the model is generated, it needs texture mapping and material selection. This can be achieved by setting light sources, adjusting lighting parameters and shadow mapping. The generated model needs optimization and detail enhancement to improve its quality and fidelity. This may include reducing the quantity of polygons, optimizing texture mapping, and increasing the level of detail. Finally, according to the requirements of environmental design, each model is combined into a scene and rendered and displayed. Rendering can be realized by professional rendering engine or 3D visualization software to generate high-quality images and animations. The translated model is $I\ x, y, z$:

$$I\ x, y, z = F\ x - m_p, y - m_p, z - m_p \tag{8}$$

If the environmental model $F\ x, y, z$ of scale $L \times M \times N$ becomes the new environmental model $I\ x, y, z$ of scale $KL \times KM \times KN$, there are:

$$I\ x,y,z\ = F\ \text{int}\ c\times x\ ,\text{int}\ c\times y\ ,\text{int}\ c\times z \tag{9}$$

$$c = 1/k \tag{10}$$

When $k>1$, the model is reduced; When $k<1$, the model is enlarged.

4 EXPERIMENTAL ANALYSIS AND DISCUSSION

Collect data sets containing environmental art works, including image data under different angles and different lighting conditions and corresponding 3D model data. The data set is preprocessed, including image denoising, normalization, data cleaning and format conversion of 3D model. Optimization algorithms such as gradient descent are used to train the model, and the model parameters are adjusted to minimize the prediction error. For a given environmental art image, the trained NN model is used for automatic design. Input the image data into the model and get the corresponding 3D model output. Design a visual interface, so that designers can observe the design results of NN in real time and make adjustments.

The dynamic feature fusion method of environmental art images shown in Figure 4 is a key step in processing experimental data, and its main goal is to extract and integrate important features in environmental art images, so as to realize more accurate understanding and modeling in the process of automatic design. By this method, the characteristics of environmental art images can be extracted and understood more effectively, thus improving the process of automatic design.

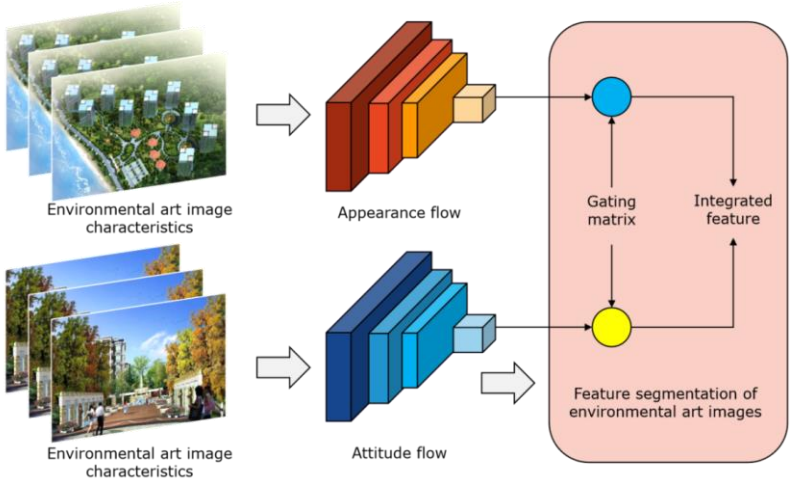

Figure 4: Dynamic fusion of environmental art image features.

These two normalization methods can solve the problem of internal covariant deviation, so that the input distribution of the network layer remains stable every time it propagates forward, thus speeding up training and improving the performance of the model (Figure 5).

In the process of training, the input distribution of each layer will change with the training, which leads to the instability of the training stage, easy to fall into the local optimal solution, and the training speed is slow. This may be because in the network without normalization, the weight of each layer will affect the shape of input data distribution, and the change of this distribution shape is constantly adjusted during the training process, thus leading to instability in the training process. Batch normalization and grouping normalization make the input distribution of each layer relatively stable when adjusting the weight by normalizing the output of each layer. From the results, the accuracy after normalization can reach more than 90%, which shows that the normalization method

is very effective in solving the problem of internal covariant offset. Moreover, it also shows the importance of normalization method to improve the performance of NN model. According to Figure 6, the modeling precision test results of different algorithms are shown.

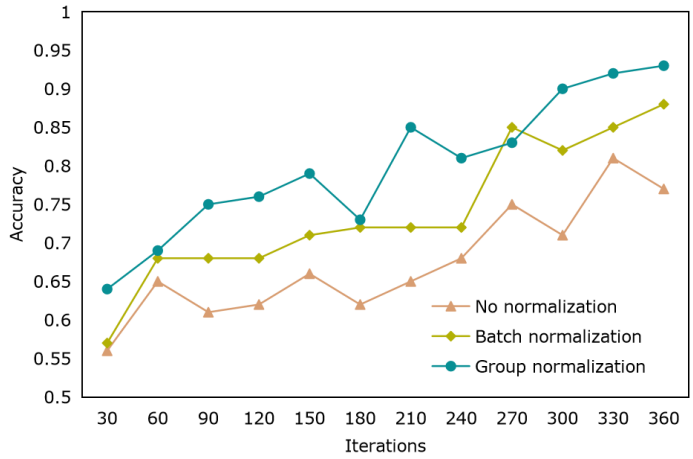

Figure 5: The influence of normalization on the model.

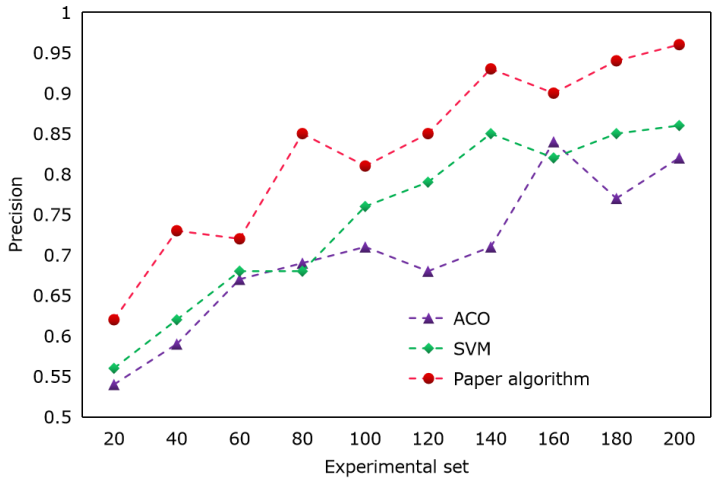

Figure 6: Modeling precision of the algorithm.

The precision of environmental art drawing and optimization algorithm based on this algorithm reaches 96.22%. This shows that the algorithm in this article has strong ability in modeling and optimizing environmental art. The algorithm adopts advanced data processing technology and machine learning algorithm, which enables the model to better capture various features and details of environmental art. The accuracy of SVM is slightly lower than that of this algorithm, which is about 86.22%. This may be because the generalization ability of SVM algorithm is slightly inferior to this algorithm when dealing with the highly complex and nonlinear problem of environmental art. The precision of ACO algorithm is also lower than that of this algorithm, which is about 84.33%. This may be because ACO algorithm needs to improve its optimization ability and search efficiency when dealing with the drawing and optimization problem of environmental art which requires high detail and precision.

According to the comparison results in Figure 7, the algorithm in this article takes the shortest time in environmental art image processing, which shows higher efficiency. This result further proves the superiority of the algorithm in processing environmental art images.

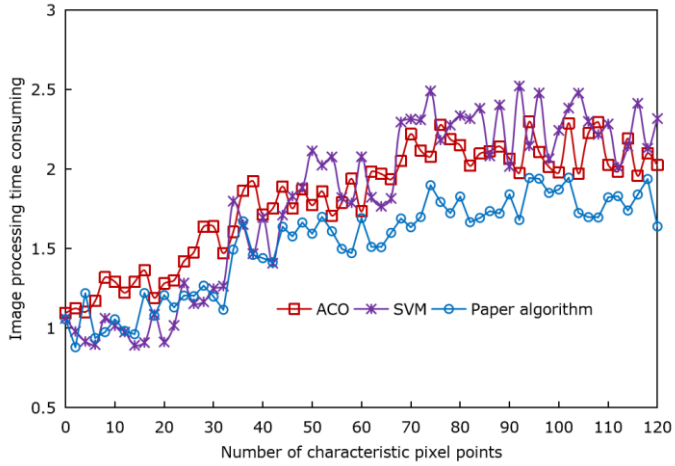

Figure 7: The effect of digital modeling of environmental art images by different methods is time consuming.

In this article, the algorithm is specially processed according to the characteristics of environmental art images. For the complex texture and color information in environmental art images, the algorithm adopts a more effective feature detection and representation method. This targeted optimization enables the algorithm to better process environmental art images, thus achieving high-quality processing results in a short time. This efficiency is not only reflected in the processing speed, but also in the accurate understanding and processing ability of the algorithm for environmental art images. These advantages and technologies enable this algorithm to achieve high-quality environmental art image processing in a short time.

Figure 8 shows that the error of the algorithm varies with the noise in the training set.

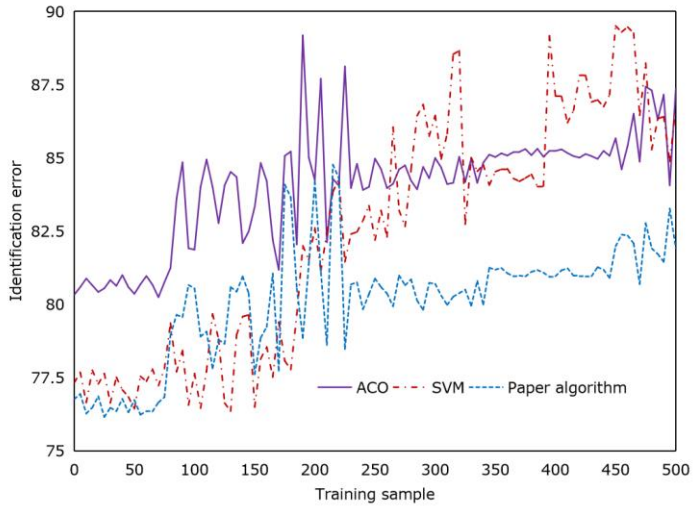

Figure 8: Changes of data errors.

In machine learning, data noise is a common problem, which will have a negative impact on the performance of the algorithm. Noise will degrade the quality of data, making it difficult for the algorithm to extract useful information from it. In Figure 8, as the noise in the training set increases, the error of the algorithm also increases, which shows that the influence of noise on the performance of the algorithm is significant. In this experiment, it is observed that when the noise reaches a certain level, the performance of the algorithm begins to decline. This shows that the robustness of the algorithm is limited. Robustness refers to the performance of the algorithm in the face of noise, outliers and missing data. Although this algorithm performs well on training data, its performance will decline when there is a lot of noise in the data. In order to improve the performance of the algorithm in noisy environment, we can consider developing more powerful noise reduction technology or designing more robust machine learning algorithm.

5 CONCLUSION

With the acceleration of urbanization and the improvement of people's aesthetic consciousness, environmental design is more and more widely used in daily life and commercial fields. How to improve environmental design and reduce the influence of human factors on the design results environmental design. In environmental design, NN technology can be used to extract the characteristics of environmental art space, and on this basis, the 3D model of environmental art can be automatically generated. In this article, NN technology is applied to the automatic design of environmental art. Through NN technology, not only the spatial characteristics of environmental art are automatically extracted and identified, but also the 3D model of environmental art is automatically generated. The results show that this method can improve the design quality, and realize the large-scale production and replication of the design scheme. Moreover, the visualization and interactivity of NN technology have also been significantly improved, and designers can adjust and optimize the design scheme in real time according to the actual situation.

In the final result, with the increase of noise in the training set, the error of the algorithm may also increase, which emphasizes the importance of noise reduction and data cleaning in the data preprocessing stage. When the noise reaches a certain level, the performance of the algorithm will decline. Therefore, the future research direction can be to develop more powerful noise reduction technology or design more robust machine learning algorithm.

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