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Computer-Aided Design AND APPLICATIONS

Optimization of Computer Aided Design Technology Based on Support Vector Machine in Landscape Art Design

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Abstract. As a combination of art and technology, landscape art design is gradually introducing computer technology to optimize its design process. Through computer aided design (CAD), designers can create 3D models and even use virtual reality (VR) technology to allow people to experience the completed landscape effects in advance. However, traditional CAD still has some problems, such as low design efficiency and insufficient accuracy. This article applies the Support Vector Machine (SVM) algorithm to the CAD optimization of landscape art design. By training the SVM model to learn the features and laws in landscape art design, the model is then used to guide the CAD modeling process. This method has achieved a maximum improvement of 26.55% in modeling accuracy compared to the comparison algorithm, and has shown significant advantages in processing time. These results demonstrate the effectiveness of SVM based methods in landscape art design. In summary, this study provides a new technical means for the field of landscape art design, which helps to improve design efficiency and quality, and promotes progress and development in this field.

Keywords: Landscape Art Design; Support Vector Machine; Computer Aided Design
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1 INTRODUCTION

Landscape art design is a comprehensive field that spans many disciplines, involving architecture, urban planning, landscape architecture, environment, ecology and many other aspects. Its core task is to coordinate the relationship between man and nature and create a harmonious and livable environmental space. With the acceleration of urbanization, parks, as an important component of urban public spaces, play an irreplaceable role in improving urban environmental quality, promoting residents' health, and enhancing community cohesion. Allik [1] analyzed the example of

Jubilemparken Park in Gothenburg, Sweden. Its landscape design fully embodies the concept of modern park prototype design, aiming to provide citizens with a healthy and pleasant leisure place. Through reasonable spatial layout and facility configuration, provide diverse activity venues for citizens to meet the needs of different age groups and activities. By preserving and restoring historical buildings and facilities, the park highlights its historical and cultural value, and enhances the cultural identity of citizens. Adopting green building materials and energy-efficient facilities to achieve sustainable development of the park. Choose suitable plant species based on climate and soil conditions to create a plant landscape with distinct seasons. At the same time, attention should be paid to the design and material selection of facilities to enhance the overall quality of the park. Preserve and restore the historical buildings and facilities within the park, such as ancient pavilions, sculptures, and pavement stones, so that citizens can feel the park's historical and cultural heritage. In landscape art design, designers need to consider terrain, vegetation, water, buildings, roads and other elements, and integrate them through artistic means to form a landscape with aesthetic feeling and functionality.

Immersive Virtual Reality (VR) technology provides us with the ability to simulate and create three-dimensional virtual environments. This technology has a significant impact on the scale estimation of design decisions. In a virtual environment, users can directly experience and interact, which allows designers to more accurately understand users' perception and response to spatial scales. Azarby and Rice [2] explore how user characteristics affect the scale estimation of spatial perception in immersive VR systems, and how to incorporate these factors into design decisions. Designers need to choose appropriate spatial scales based on user characteristics and needs. For large public spaces, people's mobility and interactivity need to be considered, while for private spaces, attention needs to be paid to privacy and comfort. Designers need to decide what information to display in a virtual environment and how to display it. Designers need to incorporate user feedback into design decisions. For example, user testing can be used to understand users' reactions and needs to different spatial scales, in order to adjust the design scheme. Immersive VR technology provides designers with a new tool that can simulate and create three-dimensional virtual environments. In this environment, both user and system characteristics can affect users' perception of spatial scale. Therefore, designers need to consider these factors in their design decisions in order to develop a spatial design plan that is more in line with user needs. As a combination of art and technology, landscape art design gradually began to introduce computer technology to optimize its design process. Traditional landscape art design methods often need a lot of hand-drawn and field surveys, while CAD can quickly complete complex calculations and graphic processing, greatly shortening the design cycle. Exposure to natural landscapes is believed to have a positive impact on human health and cognitive performance. However, the implementation of practical research faces many challenges, such as geographical location, environmental conditions, and ethical issues. Therefore, simulation experiments have become an effective method for studying the impact of natural landscapes. Browning et al. [3] explored the impact of method selection on human health and cognitive performance in simulated natural landscape experiments. The design of simulated natural landscape experiments should focus on experimental control and standardization, while maintaining a true reflection of the characteristics of the natural environment. Experimental design should consider factors such as exposure level, duration, subject age, and health status. In addition, it is also necessary to consider the safety of the experimental site and the comfort of the subjects. In simulating natural landscape experiments, method selection plays a crucial role in studying the impact of human health and cognitive performance. Correct experimental design and data analysis methods can improve the reliability and effectiveness of research, thereby better understanding the benefits of natural landscapes on human health and their impact on cognitive performance. In future research, greater emphasis should be placed on the selection and innovation of methods to promote further development in this field.

The computer can be accurate to every pixel or data point to avoid errors caused by human factors, thus improving the accuracy of design. Ceylan [4] revealed the significant impact of digital tool knowledge on students' perception of architectural design by comparing their changes in perception before and after using digital tools. Despite some challenges, with the continuous development of digital technology, we have reason to believe that digital tools will play a more important role in the future field of architectural design. For educators, how to integrate digital tools into architectural design and help students better master and apply these tools will be an important topic that needs to be paid attention to and studied in the future. The research results indicate that students' mastery of digital tool knowledge is closely related to their perception of architectural design. As students deepen their understanding and application of digital tool knowledge, their perception of architectural design gradually shifts from traditional two-dimensional drawings to more intuitive three-dimensional models. After applying digital tools, students' perception of architectural design becomes more holistic and comprehensive. They can pay more attention to the details and overall structure of architectural design, which has a positive significance in improving their design ability and the quality of building products. In computer software, designers can easily modify the design scheme and check the adjustment effect in real time, which greatly improves the flexibility of design. Through CAD, designers can create 3D models, and even let people feel the landscape effect of the design in advance through VR technology. CAD can easily exchange and cooperate with other fields, such as architecture, urban planning, environmental engineering, etc., and promote collaborative design among multiple disciplines.

With the continuous development of technology, virtual reality (VR) technology has provided a new environment for language learning. In such an environment, learners can simulate real language usage scenarios, thereby obtaining a richer and more authentic language usage experience. Chen [5] explores the impact of pre task planning on English learners' oral performance in a three-dimensional multi user virtual environment. The 3D multi user virtual environment provides a simulated and immersive learning environment for language learners. In such an environment, learners can engage in real-time and face-to-face communication with other learners, thereby obtaining a more authentic and rich language usage experience. At the same time, this environment also provides more opportunities for interaction, which helps improve learners' oral output ability. Effective pre task planning can help learners better prepare and organize their thinking, thereby increasing their confidence in oral output. This helps to reduce learners' anxiety and improve their motivation for oral learning. In a 3D multi user virtual environment, learners can collaborate and communicate through pre task planning. This helps cultivate learners' collaborative ability and teamwork spirit, while also improving the quality and efficiency of oral output. CAD has become an indispensable part of landscape art design. However, there are still some problems in traditional CAD, such as low design efficiency and insufficient accuracy. Therefore, how to optimize CAD to better meet the needs of landscape art design has become a problem worthy of study. The rapid development of machine learning technology provides new ideas for researchers to solve this problem.

Chen et al. [6] explored the methods of point cloud segmentation and object information extraction in photogrammetry and their applications in creating virtual environments and simulations. Point cloud segmentation is one of the key steps in processing 3D point cloud data, with the goal of dividing the point cloud data into several independent groups or collections, each representing a part of an object or scene. Photogrammetric point cloud segmentation mainly relies on the recognition and classification of spatial points and geometric attributes. By using photogrammetry technology to obtain 3D point cloud data of buildings, point cloud segmentation and object information extraction methods can be used to create realistic virtual models of buildings for use in architectural design and planning. Game developers can use photogrammetry technology to obtain three-dimensional scene data from the real world. Through point cloud segmentation and object information extraction methods, the real scene can be transformed into a virtual environment in the game, improving the realism and immersion of the game. The film production team can use photogrammetry technology to obtain three-dimensional point cloud data of the scene, and use point cloud segmentation and object information extraction methods to create realistic special effects scenes and simulated animations, improving the production quality and visual effects of the movie. As a powerful machine learning algorithm, SVM algorithm has high accuracy and efficiency in dealing with classification and regression problems, and can deal with high-dimensional data and nonlinear problems, which makes it have great potential in CAD optimization. Based on the above background, this article proposes an optimization method of landscape art CAD modeling based on SVM. This method applies SVM algorithm to the CAD modeling process of landscape art design, learns the characteristics and laws of landscape art design by training SVM model, and then uses this model to guide the CAD modeling process, so as to realize design optimization and improve design efficiency and accuracy. This method can not only improve the design efficiency, but also ensure the design quality, which provides a new and effective CAD optimization approach for landscape art design.

In terms of theory, this article applies machine learning algorithms to landscape art design, enriching the research methods and technical means in this field; Moreover, the research results can also provide reference and reference for research in other related fields. In practice, this method can improve the quality of landscape art design, reduce design costs, and promote the growth and progress of the landscape art design industry. In the following article, the principle, implementation process, and experimental results of the SVM based landscape art CAD modeling optimization method will be introduced in detail, further proving the effectiveness and superiority of this method. I hope that this study can provide certain reference value for researchers and practitioners in related fields, and jointly promote the integration and progress of technology and art. Based on this, the following innovations were made in this study:

(1) This article applies SVM algorithm to CAD optimization of landscape art design. The efficiency and accuracy of SVM in handling classification and regression problems enable it to play a unique role in landscape art design.

(2) This article not only introduces the SVM algorithm into landscape art design, but also further applies it to optimize the CAD modeling process. By training SVM models to learn the features and patterns in landscape art design, and then using this model to guide the CAD modeling process.

(3) The research work reflects the perfect combination of technology and art, and optimizing the process of artistic design through technological means has enlightening significance for promoting the integration of technology and art, and promoting the common progress of the two fields.

This article first elaborates on the research background and purpose of landscape art CAD modeling methods, and points out the problems and shortcomings of traditional methods. Then, relevant research work was introduced to lay the foundation for subsequent method proposals. Next, the principle, steps, and advantages of the method proposed in this article were elaborated in detail, and the effectiveness and performance of the method were verified through experimental design and result analysis. Finally, the results of the entire article are summarized, and the shortcomings and future development directions of the research are pointed out.

2 OVERVIEW OF LANDSCAPE ART DESIGN

With the rapid development of digital technology, virtual environments have deeply impacted every aspect of our lives, especially in the field of urban design. Urban design is a process that requires multiple parties to participate, communicate, and collaborate, and virtual environments provide an unprecedented platform for ordinary people to participate in this process. Chowdhury and Schnabel [7] explore how virtual environments can serve as a medium for communication and collaboration among ordinary people in urban design. In a virtual environment, designers from different fields can design simultaneously, and ordinary people can also participate in the design through online platforms. This multi-party collaborative design approach strengthens communication and cooperation among all parties, and also makes urban design more democratic and in line with public needs. The virtual environment provides an unprecedented platform for the public to participate in urban design. Through online exhibitions, discussions, and voting, the public can express their views and needs, thereby having a substantial impact on urban design. By using digital technology, both designers and the public can participate in the entire process of urban design, strengthening communication and cooperation among all parties, and improving the democracy and inclusiveness of urban design. With the rapid development of technology and the promotion of digital transformation, the landscape architecture industry is facing unprecedented challenges and opportunities. Digital technology has not only changed our way of life, but also the way we view and design the world. Digital landscape architecture education has emerged to adapt to this changing era and cultivate landscape architects with innovative thinking and practical abilities. Fricker et al. [8] explored the position and direction of digital landscape architecture education, with the aim of providing some insights for the development of the industry. Digital landscape architecture education emphasizes practical operations and emphasizes students' hands-on abilities.

Through practical operation, students can better understand the application of digital technology in landscape architecture design and cultivate the ability to solve practical problems. Digital landscape architecture education encourages students to cross disciplinary boundaries and explore the intersection of design, art, engineering, computer science, and other disciplines. This interdisciplinary learning approach helps students develop comprehensive design thinking and skills. As an emerging field of education, digital landscape architecture education is facing unprecedented opportunities and challenges. Our position is to cultivate landscape architects with innovative thinking and practical abilities to adapt to the changes in the digital era. Virtual reality rendering technology has played an important role in many fields due to its unique interactivity and immersion, including training deep learning models, analyzing landscapes, and preventing virtual reality diseases. Fukuda et al. [9] provided a detailed introduction to virtual reality rendering methods in these application areas. The training process of deep learning models often requires a large amount of data, and virtual reality environments can provide a simulated and reusable training environment, greatly enriching the training data of deep learning models. Virtual reality rendering technology can also simulate various environmental conditions and task scenarios, making the training of deep learning models closer to practical application scenarios and improving the model's generalization ability. By using virtual reality rendering technology, researchers can easily visualize and debug deep learning models to optimize model structure and improve model performance. By simulating different lighting conditions and seasonal changes, virtual reality rendering technology can help researchers analyze the visual effects and spatial perception of landscapes, providing important basis for landscape design and planning. By using virtual reality rendering technology, different usage scenarios and modes can be simulated to study their impact on health. Lee [10] analyzed computer technology, which provides the possibility for digital modeling of Korean gardens. By using 3D modeling software, designers can accurately construct garden models for virtual design and planning. This technology not only improves design efficiency, but also identifies and corrects problems in the design before construction. Virtual reality (VR) and augmented reality (AR) technologies enable designers and users to experience and interact in a more intuitive way. Through these technologies, designers can better understand user needs and feedback, and users can also feel the designer's intentions and design effects more clearly. Computer technology can process a large amount of data and provide detailed analysis reports. These reports can help designers better understand the performance and operational status of gardens, thereby optimizing design.

Computer assisted landscape design is a comprehensive discipline that integrates computer science, engineering, aesthetics, and ecology. With the continuous development of technology, computer-aided design (CAD) software has become an important tool for landscape designers. However, traditional teaching methods often focus on imparting theoretical knowledge, neglecting the cultivation of practical operations and innovative abilities. To this end, Li et al. [11] introduced a flipped classroom teaching model based on rainwater classrooms, aiming to improve students' learning enthusiasm and practical abilities, and cultivate innovative thinking. In computer-aided landscape design teaching, we have adopted a flipped classroom teaching mode based on rainwater classroom. Students solve problems and complete corresponding design tasks through group collaboration, practical operations, and other means. Finally, teachers summarize and evaluate students' learning outcomes, providing feedback and guidance. Through the practice of flipped classroom teaching mode based on rainwater classroom, we have found that students' learning enthusiasm and practical ability have been significantly improved. At the same time, students' innovative thinking and teamwork abilities have also been exercised. However, flipped classrooms require students to have a certain level of self-directed learning ability and self-discipline. For some students who lack self-discipline, more measures may need to be taken to guide and supervise them. Urban landscape design is a complex and diverse system engineering that involves numerous design parameters and influencing factors, such as terrain, climate, culture, economy, etc. Traditional urban landscape design methods often only focus on empirical and normative factors, while ignoring the influence of nonlinear factors. Liu et al. [12] focused on the application of nonlinear theory in urban landscape design. By using nonlinear programming methods, the objective function and constraint conditions of urban landscape design can be optimized to obtain the optimal design scheme. Through nonlinear geographic information systems, the spatial distribution and evolution of urban landscapes can be simulated, providing scientific basis for urban planning and management. The theory and methods of nonlinear ecology can be applied to study the dynamic changes and stability of ecosystems in urban landscapes. Multi-dimensional urban landscape design parameter simulation is a simulation method based on computer technology, which can simulate multiple dimensions of urban landscape, such as spatial dimension, temporal dimension, social dimension, etc. Through multidimensional simulation, the feasibility and effectiveness of urban landscape design can be comprehensively evaluated. In today's digital age, computer technology has had a profound impact on many fields, one of which is the restoration and reconstruction of cultural heritage. By utilizing advanced technologies such as virtual reality (VR) and augmented reality (AR), we can preserve, restore, and rebuild cultural heritage in a more precise and vivid manner. Pietroni and Ferdani [13] explore in detail the terminology, methodology, visual representation techniques, and cognitive models of virtual restoration and reconstruction of cultural heritage. The process of restoring cultural heritage through digital technology and computer software. This process does not involve actual physical repairs, but rather simulates repairs through a virtual environment. The process of reconstructing cultural heritage that has disappeared or been damaged using digital technology and computer software. This reconstruction is carried out in a virtual environment with the aim of restoring the original state of cultural heritage. Based on the virtual model, perform virtual repair and reconstruction. This includes adjusting, modifying, and optimizing the model to achieve the best repair and reconstruction results. Through 3D rendering technology, realistic 3D images can be generated, enabling people to more realistically experience the charm of cultural heritage. Dynamic simulation technology can enable cultural heritage to move in a virtual environment, such as displaying its historical scenes or usage processes.

Environmental art design is a creative process aimed at meeting people's material and spiritual needs through planning, designing, implementing, and managing the human living environment. With the continuous development of technology, 3D virtual reality technology is widely applied in environmental art design, providing new tools and methods for designers and planners. 3D virtual reality technology can create spatial environments that cannot be achieved in the real world, and designers can achieve optimal spatial planning by designing and adjusting virtual spaces. In addition, this technology can also predict potential problems before project implementation, saving time and costs. In urban planning, 3D virtual reality technology can simulate the style and layout of the entire city, providing a comprehensive perspective for urban planners. This helps to identify problems in planning and make timely adjustments to achieve the best urban planning solution. Through 3D virtual reality technology, designers can predict the impact on the environment before project implementation, thus adopting more sustainable design solutions. 3D virtual reality technology can provide an immersive experience, allowing users to have a deeper understanding and participation in the design process [14]. Wu et al. [15] explored an immersive virtual reality learning system based on spherical videos and its application in landscape architecture students' learning. Spherical video is a comprehensive, 360-degree video shooting technique that uses a fisheye lens or multi camera array for shooting, and then undergoes post processing to convert the video into a spherical perspective. Immersive virtual reality technology is a technology that can provide a highly realistic virtual environment, allowing users to experience the virtual world firsthand through devices such as headsets and controllers. Through spherical videos, students can immerse themselves in a virtual environment and enhance their understanding and experience of landscape architecture design. Spherical videos allow students to observe landscape architecture design from various perspectives, improving their spatial perception and design abilities. Immersive virtual reality technology enables students to operate and interact in a virtual environment, improving their participation and interest in learning. In the era of COVID-19, distance education has become particularly important. The immersive virtual reality learning system based on spherical videos can enable students to learn anytime and anywhere without being limited by location. Learning in a virtual environment avoids potential security risks in actual operations.

3 APPLICATION OF CAD IN LANDSCAPE ART DESIGN

The core of landscape art design lies in exploring and dealing with the relationship between man and nature, and creating a harmonious living environment through artistic means. It is not only about design, but also a comprehensive consideration of various aspects such as environment, society, culture, economy, etc. The purpose of landscape art design is to organically combine natural and artificial elements through creative thinking and artistic design methods, creating a beautiful, functional, and ecological landscape environment.

In landscape art design, designers need to follow principles such as ecology, aesthetics, and culture, while considering various elements such as terrain, vegetation, water bodies, buildings, and roads. They need to use various artistic design techniques, such as spatial layout, color matching, material selection, etc., to achieve overall harmony and local refinement of the landscape. Nowadays, more and more designers are paying attention to the ecological restoration and sustainability of landscapes, advocating for green buildings and low-carbon living. The widespread application of CAD has also brought unprecedented convenience and possibilities to landscape art design. As an important tool in the digital age, CAD plays an increasingly important role in landscape art design. It has greatly changed the traditional design method and provided strong support and help for landscape art designers. Through CAD software, designers can quickly and accurately create 3D landscape element models such as terrain, buildings and vegetation. Compared with the traditional hand-drawn method, CAD modeling is more accurate and can be modified and adjusted at will, which greatly improves the design efficiency.

CAD software is usually equipped with high-quality rendering and visualization tools, and designers can preview the effect of the design scheme and its appearance under different lighting and environmental conditions in real time. CAD system can integrate GIS (Geographic Information System) and other data analysis tools to help designers carry out terrain analysis, sunshine simulation, rainwater runoff simulation and so on, making the design more scientific and reasonable. CAD files are easy to share and edit, and it is convenient for landscape designers to cooperate closely with architects, urban planners, civil engineers and other professionals. CAD software can significantly reduce the repetitive and mechanical work in design, such as drawing lines and calculating area, so that designers can spend more time on creativity and design thinking. Accurate modeling and measurement tools provided by CAD software can reduce human error and improve the accuracy and reliability of design. Digital design files are easy to store, back up and reuse, which saves a lot of paper and space and facilitates designers to reuse previous design elements in different projects.

4 OPTIMIZATION OF LANDSCAPE CAD MODELING BASED ON SVM ALGORITHM

Firstly, a large quantity of data is collected from the existing landscape project cases, including the parameters and attributes of various elements such as topography, vegetation, buildings and water bodies. These data are preprocessed, such as normalization and feature extraction, to meet the input requirements of SVM algorithm. Using the processed data, train one or more SVM models. These models will be trained and optimized according to different types of landscape elements (such as terrain, vegetation, etc.) to guide the CAD modeling process. In CAD software, combined with SVM model and designer's creativity, landscape elements are modeled. For example, according to the historical data of terrain and SVM model prediction, a reasonable and beautiful terrain design can be generated quickly. After the modeling is completed, the design scheme is evaluated. If it does not meet the requirements, the parameters of SVM model are adjusted and re-modeled until it meets the requirements of designers.

In the optimization research of landscape CAD modeling based on SVM algorithm, the extraction of landscape artistic style is a key step, which involves dividing the landscape image into different regions or objects in order to better understand and apply its artistic style. In order to effectively segment the image and extract the artistic style of landscape, it is necessary to extract the features of the image. This can include features such as color, texture, shape and spatial layout. On the basis of feature extraction, an appropriate image segmentation algorithm is used to segment the image into different regions or objects. After the image segmentation is completed, the landscape artistic style can be extracted by analyzing the characteristics of the segmented region or object. By constantly adjusting the parameters of SVM model and combining the designer's creativity, landscape optimization design based on specific artistic style can be realized. The image segmentation stage of landscape art style extraction is shown in Figure 1.

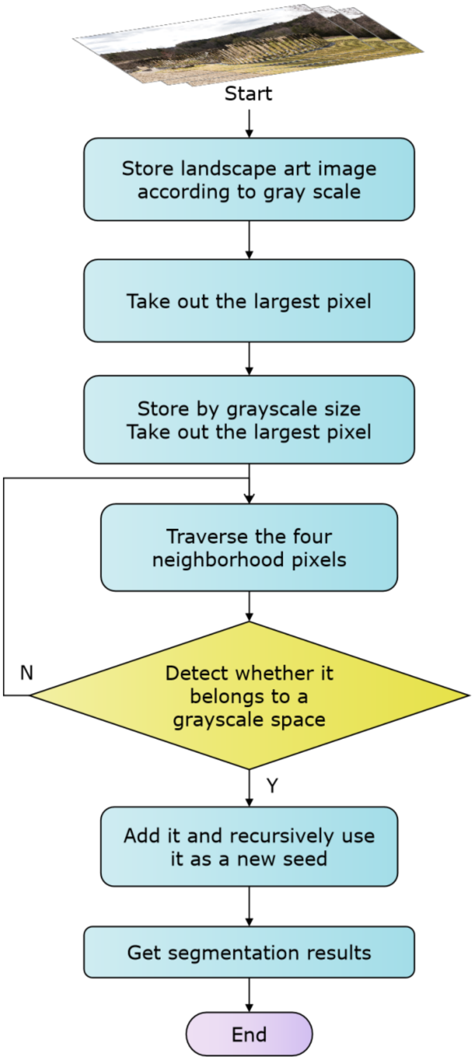

Figure 1: Landscape art style extraction.

This process uses image segmentation technology to divide landscape images into different regions or objects, and extract corresponding artistic style features. These features can be used to guide the optimization process of landscape CAD modeling based on SVM algorithm, thereby achieving more intelligent and efficient landscape design. The landscape art feature detection window is shown in Figure 2.

Figure 2: Detection window of landscape art features.

Let the gray value range of the original landscape 3D image $f(x,y)$ be $[g_{\min}, g_{\max}]$, select an appropriate threshold T, and:

$$g_{\min} \le T \le g_{\max} \tag{1}$$

Image segmentation with single threshold can be represented by the following formula:

$$g(x,y) = \begin{cases} 1, & f(x,y) \ge T \\ 0, & f(x,y) < T \end{cases} \tag{2}$$

where $g(x,y)$ is a binary image.

In the research of landscape art design, the original point cloud data is an important information source to describe the shape and structure of landscape surface. However, these original point cloud data are often affected by noise, outliers or other errors, so it is necessary to preprocess them to extract accurate and reliable features. Firstly, the original point cloud data of the landscape surface are obtained by lidar, 3D scanner or other measuring equipment. These data include a large quantity of 3D coordinate points, which represent the geometric shape and spatial distribution of the landscape surface. In point cloud data preprocessing, median filtering can be applied to the neighborhood of each point. For each point, the coordinate values of all points in its neighborhood are selected for median calculation, and the calculated median value is used to replace the original coordinate values. After the median filter is completed, further post-processing steps, such as data reduction and normal vector calculation, can be carried out to prepare for subsequent analysis and application. Using median filtering to preprocess the point cloud data in the original point cloud image, the output value after preprocessing is:

$$\psi_{i,j} = median\left[\Lambda_{i+m,j=n}; (m,n) \in w\right] \left(\Lambda_{ij}; (i,j) \in Z^2\right) \tag{3}$$

Where w and Z^2 respectively represent the plane window specification and the serial quantity of the 2D data string; Λ_{ij} and $\psi_{i,j}$ respectively indicate that the point cloud coordinates on the image are the output values of (i,j) after median filtering.

The minimum value of the sum of squares of the distances between the vertical projection point of the space point g and the pixel point $\hat{\omega}$ is calculated as follows:

$$\min = \sum_{g=1}^{g}\sum_{a=1}^{A} v_{ga} d\left(E_a S_g, \hat{w}\right)^2 \tag{4}$$

Spatial characteristics analysis of landscape art is an important link in landscape art design, which aims to extract and interpret the spatial layout, element relationship and overall artistic style of landscape. Feature extraction is carried out for each landscape element or area, including shape, size, direction, texture and so on. These characteristics are described quantitatively by mathematical and statistical methods, such as calculating the area and perimeter of the area, or the average height and density of elements. Using charts, images and 3D models, the analysis results are presented visually. Report the analysis results and optimization suggestions to relevant decision makers or designers for their reference and implementation. See Figure 3 for the network structure model of landscape art spatial characteristics analysis.

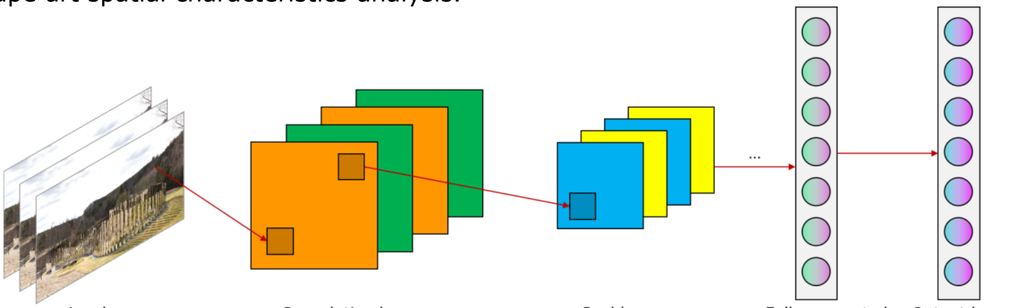

Figure 3: Network structure of spatial characteristics analysis of landscape art.

The crowding degree of landscape space is an important consideration factor, which directly affects people's viewing experience, comfort, and the layout rationality of landscape elements. Optimizing landscape space based on its crowding degree can improve space utilization efficiency and enhance the attractiveness of the landscape. Based on the congestion assessment results, identify frequently congested areas and peak hours in the landscape. Analyze the characteristics of these areas and time periods to understand the reasons for congestion, such as excessive popularity of certain scenic spots and unreasonable spatial layout. For congested areas, it can be considered to reduce congestion by adjusting the layout of landscape elements. For example, increasing traffic width, setting up scenic spots to disperse pedestrian flow, and creating multi-level viewing spaces. The crowding degree of landscape space is expressed as:

$$SC_b = \frac{\sum_{i=1}^{n} V_{bi}}{\max\left(H_b\right) \times A} \tag{5}$$

The component complexity of 3D landscape image is:

$$F = CR \times TY \tag{6}$$

The dimension of the average score of landscape architecture is calculated as follows:

$$FD_b = \frac{1}{n}\sum_{i=1}^{n} 21n\left(\frac{P_{bi}}{4}\right) / \ln S_{bi} \tag{7}$$

In the formula, P_{bi} is the perimeter of the bottom area of the landscape i. This article establishes a fineness function $D\left(O,d,m\right)$ to describe the fineness of the object:

$$D = \begin{cases} 0 & d > d_0 \\ D\ O,d,m & d \leq d_0 \end{cases} \tag{8}$$

Among them, O is the identification of the object, d is the distance of the object from the viewpoint.

The perceptual fusion model for landscape art information fusion is a comprehensive model aimed at integrating multiple sources of landscape art information and obtaining a more comprehensive and accurate description through perceptual fusion. Perform necessary preprocessing on each source of information to ensure they are on the same standard. Construct a perceptual fusion model using machine learning or deep learning techniques. The function of this model is to accept information from multiple sources and output a unified description that integrates this information. Apply the final trained model to actual landscape art design and test its performance and adaptability in actual scenarios. The fitness function of landscape art information fusion is as follows:

$$fitness\ \vec{x} = \begin{cases} f\ \vec{x} & If\ feeasible \\ 1 + rG\ \vec{x} & Otherwise \end{cases} \tag{9}$$

Constructing the visual resolution model of landscape ecological space environment:

$$\begin{aligned} W_u\ a,b &= e^{i2\pi k \ln a} \times \frac{K}{\sqrt{a}} \left\{ \left[\frac{ae^{\frac{j2\pi f \min}{a} b - b_a}}{f_{\min}} - \frac{e^{\frac{j2\pi f \max}{a} b - b_a}}{f_{\max}} \right] \right. \\ &\left. + j2\pi\ b - b_a \left[Ei\ j2\pi f_{\max}\ b - b_a\ - Ei\left(\frac{j2\pi f_{\min}}{a}\ b - b_a \right) \right] \right\} \end{aligned} \tag{10}$$

Among them, $b_a = 1 - a\left(\frac{1}{af_{\max}} - \frac{T}{2}\right)$, $Ei\ \cdot$ is the output of visual information characteristics of landscape ecological space environment, and the landscape ecological design is carried out by combining model recognition method.

At the initial stage of design, SVM model can be used to analyze historical project data and provide designers with design inspiration and direction. Through data-driven way, assist designers to quickly determine the preliminary design scheme. In the middle stage of design, SVM model is used to evaluate and optimize the design scheme. For example, the layout and configuration of landscape elements are predicted by the model, which reduces the trial-and-error process of designers and improves the efficiency and quality of design. In the later stage of design, SVM model can be used to visualize and present the design scheme. Through the high-quality renderings generated by the model, designers and customers can understand the design results more intuitively, which is convenient for communication and modification. By combining SVM algorithm and CAD, this method is expected to bring more intelligent and efficient workflow to landscape art design.

5 EXPERIMENTAL RESULTS AND ANALYSIS

The goal of the experiment is to verify the performance of the landscape art CAD modeling method based on SVM. In order to comprehensively evaluate the performance of the method, several landscape image data sets with different pixel numbers of feature information are used. These data sets cover a variety of scenes such as urban landscape and natural scenery, which ensures the diversity and universality of the experiment. Figure 4 clearly shows the visual effect of landscape art design before and after optimization. Through comparison, we can clearly see that the optimized landscape design has shown obvious improvement in many aspects.

In the design before optimization, some areas may appear too crowded, while others are too empty. This unbalanced layout leads to visual disharmony. The optimized design has obviously improved this point, and the layout between various elements and regions is more harmonious and layered, with no obvious sense of crowding and no wasted space.

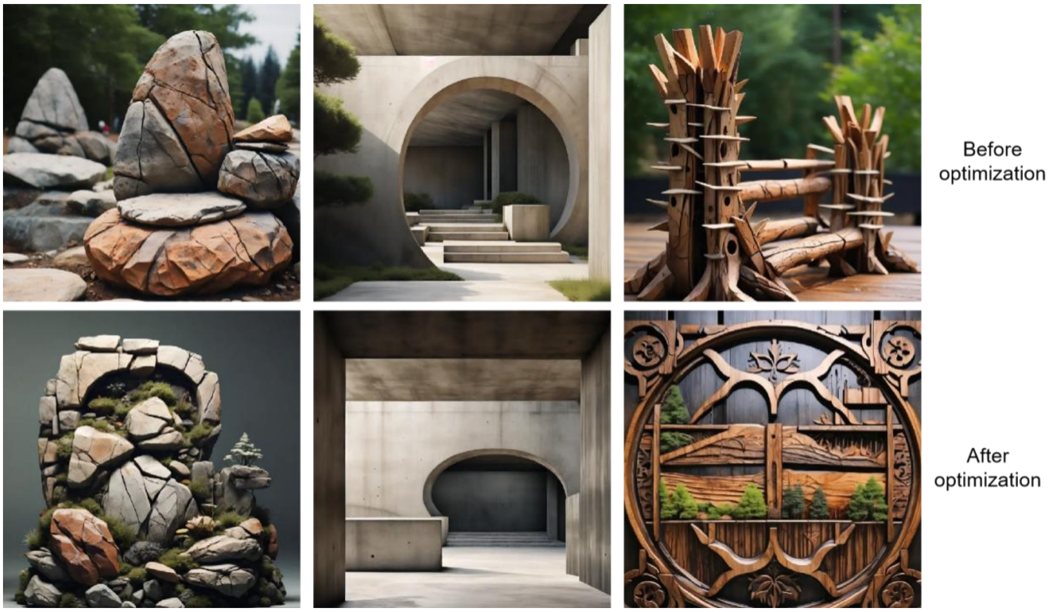

Figure 4: Landscape art design effect before and after optimization.

The optimized landscape design is richer and more harmonious in color and texture. The color matching between various elements is more elegant, and there is neither too dazzling nor obvious color conflict. This optimization not only enhances the artistry of the landscape, but also improves the viewing experience of tourists, fully demonstrating the comprehensiveness and complexity of landscape design.

The data shown in Figure 5 clearly reflects the observer's subjective assessment of the improved landscape art CAD modeling method and the traditional design method. The improved method gets a higher score, which means that this method has obvious advantages from the observer's point of view.

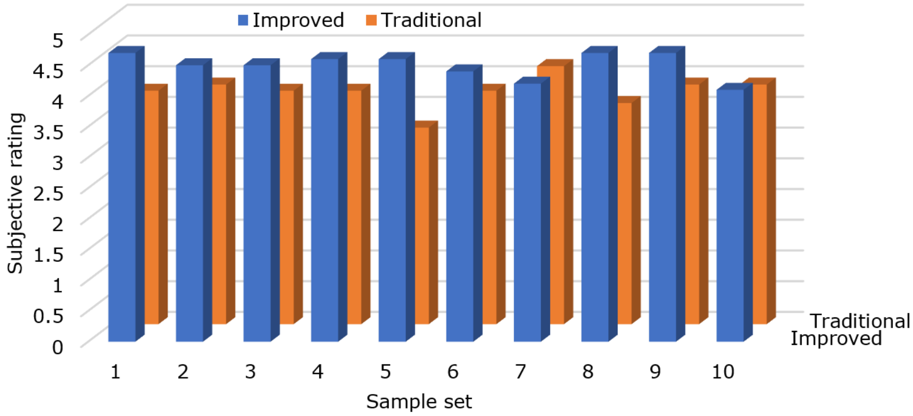

Figure 5: Subjective assessment of modeling images given by observers.

The subjective assessment test results shown in Figure 5 prove the effectiveness and superiority of the improved landscape art CAD modeling method. This means that this method has been improved in modeling accuracy, detail expression and artistic beauty. The improved method better captures the artistic style and characteristics of the original landscape, and at the same time, more design elements and optimization strategies are added in the modeling process, which makes the final modeling result closer to the real landscape and has higher artistic value. Traditional methods may rely more on the designer's experience and intuition, but lack objective assessment criteria and optimization tools, which may lead to certain limitations and deficiencies in the design results.

Figure 6 clearly shows the performance of the landscape art CAD modeling method based on SVM proposed in this article and other comparison algorithms in accuracy.

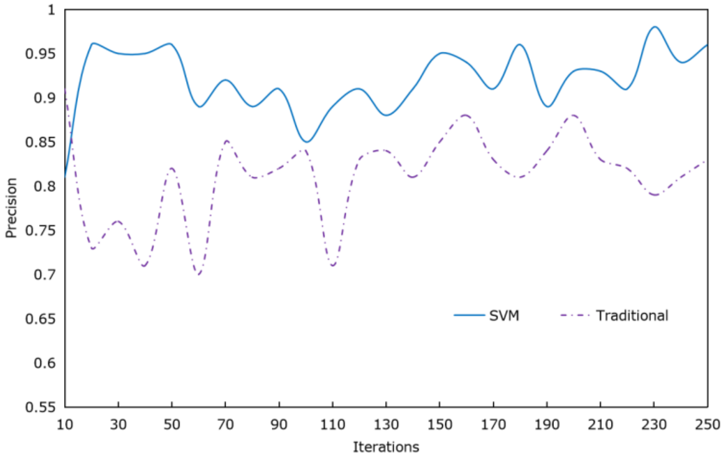

Figure 6: Accuracy results of different algorithms.

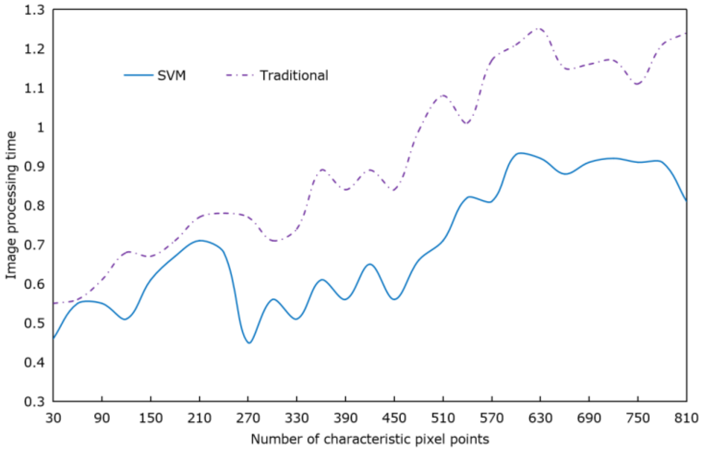

Figure 7: Time-consuming process of landscape image CAD modeling with different methods.

In landscape art CAD modeling, SVM is used in key steps such as image segmentation, feature extraction and texture recognition. This method can effectively deal with the problems of unclear and stereoscopic images, which shows that SVM can distinguish and extract key features more effectively when dealing with such problems, thus generating clearer and more stereoscopic landscape images. Compared with traditional image processing algorithms or deep learning algorithms, SVM has unique advantages in some aspects. Traditional image processing algorithms may be disturbed by noise, illumination and other factors, while deep learning algorithms may need a lot of training data. However, SVM method can achieve better performance with relatively few training samples, and it also has good processing ability for nonlinear problems.

Figure 7 shows the time-consuming comparison of different methods in dealing with landscape image CAD modeling. It can be clearly observed from the figure that with the increase of the quantity of pixel points of feature information, the time-consuming of image processing effect of landscape image CAD modeling is also increasing. In this process, the algorithm in this article shows obvious advantages.

The complexity of landscape images is usually positively related to the quantity of pixel points of feature information. With the increase of the quantity of pixels, the details and feature information contained in the image also increase, which undoubtedly increases the processing difficulty and calculation amount of CAD modeling. In landscape design or related fields, the improvement of processing efficiency means that we can respond to design requirements and iterate schemes faster, which is helpful to improve the work efficiency of designers.

Through high-precision modeling, designers can express their design ideas and creativity more accurately and reduce the gap with the actual landscape. This helps to ensure that the final design realization is closer to the original design intention. The high score of subjective assessment reflects the observer's recognition of the improved design method. This means that the method in this article can better meet the aesthetic and functional needs of users, thus improving user experience and satisfaction. The reduction of processing time means that designers can complete design iterations and modifications faster and accelerate the design cycle. This is especially important for fast-paced projects and environments, which can help designers to output more design schemes in a limited time. High-precision and efficient processing methods provide designers with more creative space. Designers can be more daring to try complex and delicate designs without worrying too much about the difficulty and time-consuming of technical implementation.

6 CONCLUSIONS

The core task of landscape art design is to coordinate the relationship between man and nature and create a harmonious and livable environmental space. In landscape art design, designers need to consider terrain, vegetation, water, buildings, roads and other elements. This article presents an optimization method of landscape art CAD modeling based on SVM. This method applies SVM algorithm to the CAD modeling process of landscape art design, learns the characteristics and laws of landscape art design by training SVM model, and then uses this model to guide the CAD modeling process, so as to realize design optimization and improve design efficiency and accuracy. Through experiments and analysis, this method shows remarkable advantages in accuracy, subjective assessment of users and time-consuming processing. This research not only brings technical progress to the field of landscape design, but also provides designers with more powerful and efficient tools in practical application. Landscape art design is not only a simple image processing and modeling, but also an art, which requires comprehensive consideration of space, color, texture and other factors. The method proposed in this article injects technical power into this artistic creation process, enabling designers to express their creativity and ideas more freely and accurately. SVM method shows great potential in landscape art CAD modeling. In the future, this method will be further optimized and improved to meet the more complex and delicate landscape design needs.

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