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Computer-Aided Design AND APPLICATIONS

3D Rendering and Optimization Algorithm for Landscape Architecture of Digital City

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Abstract. Digital city is to realize digitalization, automation and networking of urban information management, and 3D modeling technology is essential to realize 3D visualization of landscape architecture. Visualization of urban 3D modeling refers to the 3D description and analysis of the space within the urban area through the 3D visualization system, which can realize the combination of visual reality and virtual reality. Due to the rapid growth of sci & tech, 3D visualization technology has been widely used. Because landscape design, regardless of scale, hopes to achieve the effect of one scene at a time and the landscape moves with the pace in spatial organization, it is very important for designers to show the design works in an all-round, real and even dynamic way, which will help to accurately express the design ideas of landscape designers. The simulation results show that the comprehensive performance of 3D landscape drawing and optimization algorithm based on artificial intelligence and computer aided design (CAD) has obvious advantages compared with traditional landscape planning methods, which can provide reference for related research.

Keywords: Digital City; Landscape Architecture; CAD; Artificial Intelligence; 3D Landscape
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1 INTRODUCTION

Terrain is an important garden element, and digital terrain is a very important tool for CAD. Visualization is the use of complex computing techniques and modeling methods to transform various data, symbols and other information into a visible image. Cui [1] conducted generator training and analysis model construction of network structure through deep learning. By measuring the feedback of the discriminator on the dataset, it divided the types of geographic information. Using carefully annotated color texture extraction planning, it integrates the land quality of the dataset in land planning. In the process of landscape reconstruction analysis from flat block diagrams, it helps improve the efficiency of the structural drawing of flat gardens. The research on 3D visualization of landscape architecture, the application of 3D visualization technology in the construction of digital cities, and the growth of people's description of urban landscape status and planning and design from 2D maps and 3D physical models to computer 3D spatial representation can make decision makers, designers and users have a vivid and intuitive understanding and deeper understanding of urban landscape status and planning and design blueprint. Deng et al. [2] conducted a virtual walkthrough method for 2D image landscape design in the field of landscape architecture. By constructing the value of landscape architecture in garden design, the effect analysis of image and landscape architecture was carried out in the field of architectural virtual roaming analysis. The research provides a diverse visual information effect optimization development experience for the exploitable analytical value of garden design. 3D landscape visualization technology replaces abstract map symbols with intuitive 3D terrain and objects. This makes the map go beyond the traditional symbolization of geographical information, the levelization of spatial information and the solidification and stillness of map content, and enter the dynamic, time-space transformation and multi-dimensional interactive map era. Duca et al. [3] conducted a scanning architectural design analysis of garden landscapes. It constructs the visual observation results of laser rice seedlings, and analyzes the analysis quality of Contour line of accurate point clouds. It conducted loss mapping and detection of the impact of mobile laser scanning. This has helped to protect the historic architectural heritage for the Balance of nature of the construction city. Driven by the digital earth, the digital city has developed rapidly, which is an important aspect of the digital earth. How to establish, express and apply 3D digital terrain model in computer is an important work in landscape digital technology. Erdolu [4] conducted interactive pattern analysis through alternating reviews of computer-aided projects. By analyzing the limitations of the interrelationships among factors considered, it explores the conceptual framework of augmented reality. During the material fusion process of alternating technology, it mediated the exploration of virtual reality systems. Each subsystem of the city can be directly reflected in the computer, and it is convenient to centrally and effectively manage and control all kinds of logistics and information flow in the city.

Landscape design is a process of close combination of aesthetics and technology, science and environment. The current digital genre of multimedia information processing is constantly developing. The use of computer information compression as a means of processing frame synthesis has become the main way of extracting information media. Guo and Li [5] conducted a synthesis scenario analysis of the decompression drawbacks of the smallest auxiliary unit in computer video images. By simulating and analyzing different processing scenarios, it can optimize traditional video retrieval. Digital earth expresses the natural environment on which human beings depend in the form of digital virtual earth. Digital city is the derivative content of digital earth. Kahlon and Fujii [6] conducted a Japanese garden rock design for spatial configuration. Through the analysis of the high-level conceptual framework of module space configuration of the building architecture, the Integration testing of CAD system allocation was carried out. By integrating allocatable improvements into the AD environment reasoning of configurable spaces, it has made great efforts to improve the framework meaning that can be achieved. Digital city integrates all kinds of basic geographic information of the city and stores it on the computer. It can provide a virtual reality scene of the city for visiting users through the network, so that they can feel immersive and easily obtain all kinds of urban information. The 3D landscape design simulation system of digital city meets the needs of landscape designers. This system can not only create any complex and accurate landscape model quickly, and make realistic 3D realistic renderings, but also feel the effect of being in the scene in the form of 3D animation, and realize the virtual presentation of 3D scenes well.

A city is the center of social, political, economic, cultural and scientific development. To some extent, urban development represents social development and human progress. At present, informatization and digitalization have gradually penetrated into all aspects of social life with the arrival of the new century, and urban informatization has become the mainstream of global urban development. The modeling of landscape architecture needs to integrate advanced technology. If it is only done by hand, it will consume a lot of time and need a lot of manpower and material resources to support it. Therefore, the application of CAD software in it is very necessary, and it will gradually become the leading factor in building model making. City 3D visualization refers to the visualization of city 3D spatial information, that is, using GIS technology, CAD modeling technology and database technology, the city spatial information is input into the computer, and the computer uses visual, auditory, tactile and other ways to express the city spatial information. Although there are many real-time rendering engines that can feedback the rendering effect in real time, it still takes a lot of time to configure the scene to get the ideal result. In this article, the algorithm of 3D landscape drawing and optimization of landscape architecture based on artificial intelligence and CAD is studied;

⊖ This article introduces the basic principle of 3D landscape model of landscape architecture, and establishes a 3D digital landscape model of landscape architecture. At the same time, a spatial data model based on CAD is proposed to describe urban spatial objects, and it is used as the basic data structure for 3D modeling of urban spatial characteristics.

⊜ This model applies the Generative adversarial network (GAN) technology in artificial intelligence to feature extraction and optimization of garden landscape digital images, providing support for garden landscape CAD 3D landscape rendering and optimization.

⊛ The 3D landscape CAD design system adopts object-oriented parameterized 3D solid modeling methods to achieve visualization functions such as 3D solid modeling, construction drawing, real-time 3D virtual rendering of scenes, rendering and animation production.

The first section is the introduction, which mainly elaborates on the background and significance of the topic selection of the paper. The second section mainly summarizes the current research status in the field of landscape design both domestically and internationally, and proposes the viewpoint of combining CAD with CAD based on this. The third section proposes a 3D landscape rendering and optimization algorithm based on CAD technology. The fourth section is the experimental section, which verifies the correctness and effectiveness of the proposed method. The fifth section is the conclusion and outlook. The research results of this article are reviewed, and the shortcomings and areas for improvement of this article are proposed.

2 RELATED WORK

Łabędź et al. [7] conducted laser sculpture radar measurements of three-dimensional buildings. By analyzing the sampling frequency of building facades using radar frequency in photography, the application of geometric shapes in photogrammetric models was constructed. This is very beneficial for grid construction with sampling frequency. Lavorel et al. [8] conducted a spatial Sensitivity analysis analysis of the diversity of mountain geographical models. By synthesizing land use from different fragmented landscapes, a heterogeneous intensity functional construction of ecosystem services was constructed. In the process of heterogeneous analysis of fragmented multi landscapes, the dominant ecosystem of the interaction between the intensity of land scale was constructed. The research results indicate that different regulatory effects are mutual, and under the premise of computer-aided simulation, the interaction of landscape fragmentation can be improved. Li [9] conducted an analysis on the construction participation of urban landscape planning. Through the model technology planning of digital information, it has constructed a relevant urban landscape computer-aided means architecture. In its proposed urban landscape model exploration spatial system, the decisive factor of land planning is parameterized analysis and design. This has had a significant impact on the real CAD assistance experience. Lochhead and Hedley [10] conducted an analysis and exploration of the geometric shape of geographical spatial landscapes. By exploring the construction of graphic science information theory for flat surfaces, it analyzed the visual assessment risks of 3D resolution. In the development and application process of the workflow, experiments were conducted to plan and measure different methods of complex mechanisms. At the same time, implicit demand graph data was obtained in the simulation of real features in all analog digital spaces.

Ma et al. [11] conducted an environmental combinatorial analysis framework component for fractal dimensional data. Through analyzing the edge structure complexity of image preprocessing for natural and artificial elements, it effectively evaluates the visual image of the building environment. This method performs a pseudo-evaluation of natural and artificial elements for detecting redundant interference in human visual features. Therefore, it has built different combinations of computer garden scenarios. Michalek et al. [12] analyzed the impact of soil invasion on landscape terrain control in high-risk areas. Compared with the main tools of different sediment erosion, it provides a connectivity index construction analysis result for low land basins. The study considered coupling relationships in the process of enhancing regional connectivity in controlling the degree of watershed use in land use. The study gained widespread support from the positional model by constructing and analyzing the coupled spatial model of the new tool. Redweik et al. [13] conducted an analysis of geographic information system protection in public management. It collected spatial data sources through the systematic development of geographic information for different gardens. In the developed spatial data organization database, it constructs the rule interactive scene model of computer architecture, and completes the retrieval of spatial planning organization Structural rule model database with the help of Computer-aided design of geographic information. During the user's information investigation process, they constructed a constructive 3D model of the botanical garden features for the project. Shan and Sun [14] conducted a preliminary discussion on the field of computer-aided three-dimensional landscape urban construction. By analyzing the simulation application analysis and construction of three-dimensional scenes, the experimental evaluation of urban guidance indicator system was conducted through visual perspective. In the experiment, it dynamically applied and recognized the visual features of the overall and single factor landscape city distribution. The research results show that, compared with the evaluation of landscape development of visual resources, the proposed Spatial analysis fuzzy analytic hierarchy process has a good pricing evaluation effect. Teppand et al. [15] analyzed the landscape optimization process of modern green building support structure aesthetics and greening. By using computer assistance to vertically combine the prefabrication price of concrete materials for CNC machining machines. It undergoes material isomerization and the performance assembly manufacturing of raw material elasticity.

Wang et al. [16] conducted an analysis of the urbanization of garden landscapes for flat viewing. By analyzing the tortuous difference index of the Grand View Garden, it constructed the difference between modern gardens and traditional gardens. At the same time, it uses CAD technology to quantify the design of construction path indicators for garden scale. This framework has certain concentration constraints on the style generation of garden paths. At the same time, it has played a certain role in protecting the inheritance of garden landscapes. Huizhou gardens are an important heritage of the current architectural landscape in China. Yan and Gong [17] conducted a reference analysis on the architectural regularity of the gardens in Huizhou and the regularity effect. It constructed a CAD led architectural courtyard layout analysis and optimized the layout decoration of the perspective rendering. By paying attention to landscape architecture, it hopes to receive important support from relevant construction units. Yang and Yang [18] analyzed and constructed the renderings of the current CAD plans using computer-aided landscape design. It introduces the application skills of CAD application transmission in landscape application. Through the PS processing of the plan, it conducted a process transfer analysis of the creation of the landscape plan. Protecting the ecological environment of gardens has become an increasingly inevitable responsibility. The sustainable management of the environmental areas that currently affect land and soil cannot be shirked from causing environmental damage. Yu et al. [19] constructed a management system for garden soil, which utilized Web Service technology for computer-aided regional difference analysis. By analyzing the diversity of nutrient cycling of soil microorganisms in different regions, it has improved the actual beautification level of modern gardens. Zhao [20] conducted a systematic three-dimensional digital analysis of the garden through virtual reality technology information simulation of garden landscapes. The current construction of traditional virtual garden simulation technology has the problem of insufficient spatial organization and a huge amount of building simulation data. It utilizes the immersive technology of 3D geography and virtual parameter driven analysis to construct dynamic optical cropping for 3D digital terrain simulation. This improves the rendering effect of digital rendering techniques for garden landscapes.

3 METHODOLOGY

3.1 3D Modeling of Digital City Landscape Architecture

The three-dimensional modeling of digital city landscape architecture is one of the core technologies in current digital city construction. It provides important technical support for urban planning, architectural design, virtual tourism, and other fields by simulating real city buildings, landscapes, and other elements through computers. This article will summarize the research background, current status, importance, and future development trends of 3D modeling of digital urban landscape architecture, and explore the challenges and future development directions it faces. With the rapid development and popularization of computer technology, digital technology has been widely applied in various fields of urban construction. As an important direction of urban development, digital cities aim to integrate and utilize various information and resources in the city through digital means, in order to improve the planning, management, and service level of the city. The three-dimensional modeling of digital city landscape architecture is one of the core contents of digital city construction. Its purpose is to simulate real city buildings, landscape and other elements through computers, providing technical support for urban planning, architectural design, virtual tourism and other fields.

At present, significant progress has been made in the 3D modeling technology of digital urban landscape architecture. In terms of modeling methods, there are mainly two methods: manual modeling and automatic modeling. Manual modeling is the process of manually drawing or taking photos to obtain information about the shape, texture, and other aspects of a building, and then modeling through image processing software. Automatic modeling is the process of automatically recognizing and processing image data through computer programs to complete the three-dimensional modeling of buildings. In terms of application, the 3D modeling technology of digital urban landscape architecture has been widely applied in fields such as urban planning, architectural design, and virtual tourism.

In urban planning, three-dimensional modeling technology can simulate the elements of real cities such as buildings, roads, and greenery, helping planners better understand the actual situation of the city and carry out more scientific and reasonable planning and design. In terms of architectural design, 3D modeling technology can help architects better express design concepts, predict and evaluate the appearance, structure, and function of buildings. In terms of virtual tourism, 3D modeling technology can simulate the landscapes and buildings of real cities, providing tourists with a more realistic and immersive tourism experience. The 3D modeling technology of digital urban landscape architecture plays an important role in the construction of digital cities.

As the development direction of urban informatization, "digital city" is a vital core part of digital earth. 3D geographic information is the basic spatial information of digital earth and the core basic information of digital city. Once the digital city is established, it can provide human beings with all-round real and intuitive scene information, and can enter the city model from their own perspective to experience the real scene. Digital city visualization needs to build a 3D dynamic visual landscape to accurately reflect the objective world on which human beings depend. The relationship between 3D landscape modeling of landscape architecture and digital city is similar to that between map and GIS, and 3D landscape modeling of city is the basis of realizing digital city and the visual expression of digital city. In the process of 3D digital city construction, 3D landscape database is an important part of 3D digital city. Because 3D landscape meets the needs of users in the most intuitive form. Obtaining modeling data is the primary task of 3D modeling. Because the city belongs to the concentration of economy, culture, politics and building facilities, the amount of data will be very large and complicated.

In virtual simulation, the amount of data is huge and needs to be processed in real time, and the fineness directly determines the processing speed of data. If the fineness of the model is too high, the data processing speed will be reduced accordingly, and if the fineness is too low, the expected display effect will not be achieved. The core component of 3D model is the 3D model of existing buildings and structures, which is mainly composed of ground features and some ancillary facilities. Because this 3D model has many elements, it consumes a lot of time and needs to invest a lot of manpower and material resources, so it is necessary to choose different modeling methods according to different accuracy during this work. 3D models of buildings and structures include models of buildings, traffic facilities, vegetation and other urban elements. These data include 3D coordinates, terrain texture and terrain attributes. 3D coordinate data can be obtained by scanning plane topographic maps and design drawings, field collection, GIS acquisition, remote sensing or aerial photography.

GAN is a complex machine learning algorithm, which uses neural network with multi-layer perceptron to construct a hierarchical model structure similar to human brain, and gradually extracts features from the bottom to the top of input data. Thus, the mapping relationship between high-level semantics and low-level data is established, and the understanding of data is realized. In the field of GAN, loss functions are mainly divided into regression loss function and classification loss function. Sparse encoder mainly introduces the characteristics of sparse regularization, then combines the bias training network of multiple hidden codes in self-coding, and finally outputs sparse hidden units. Firstly, the automatic encoder of denoising tries to learn a powerful representation, which can reconstruct damaged or impure input data. The process of 3D landscape modeling in landscape architecture is shown in Figure 1.

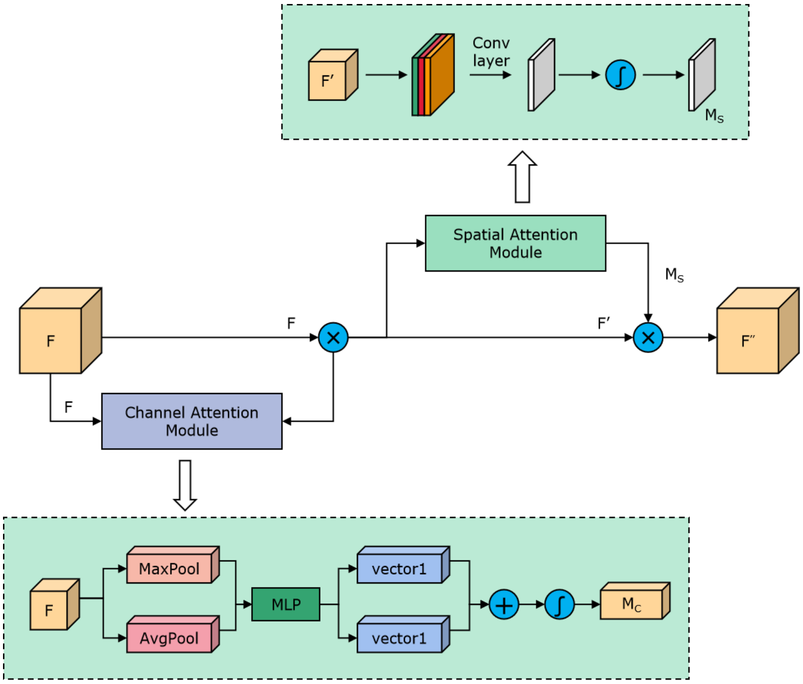

Figure 1: 3D landscape modeling GAN model of landscape architecture.

If the requirements for buildings and structures are not high, the basic surveying and mapping data can be used to model, and the textures of some regular buildings and the top of buildings should be combined with high-resolution photos to produce textures; For irregular buildings, image processing is needed first, and then manual modeling can ensure the fidelity and beauty of the building model. In the conceptual design stage, the architect mainly transfers and externalizes the content of thinking in his mind into a media object, that is, a conceptual design sketch or model, through computer operation processes such as drawing and modeling, so that the architect can look back on what he thinks and creates from a new perspective and gain new experience from it to promote the next round of thinking cycle. Architects need to use some convenient and fast CAD modeling tools to support architects' opening, jumping and exploring thinking at this stage.

3.2 Realization of 3D Landscape Model Visualization

Artificial intelligence is a theory and method that studies how to use computer technology to simulate some intelligent behaviors of humans, enabling computers to handle tasks that previously required human intelligence to complete. 3D technology is a highly integrated product of multimedia technology, digital network technology, information technology, and artificial intelligence. The growth of computer graphics enables the realization of 3D representation technology. These 3D representation technologies enable people to reproduce objects in the real environment in the computer and express this complex information with 3D objects. In 3D modeling, establishing a local coordinate system on or near an object can bring many conveniences and flexibility to the representation of the object. When reconstructing a 3D spatial object model based on original vector data, it is only necessary to care about whether the geometric shape of the spatial object is similar to the actual shape, without caring about its size, actual position, etc.

In order to meet the needs of urban visualization and information query, this article divides the spatial features of digital cities into the following categories: ⊖ Urban buildings. ⊜ Urban road traffic. ⊛ Urban pipeline network system. ④ The terrain and landforms of the city Vegetation. The centroid of the target point cloud obtained from 3D instance segmentation in the transformed coordinate system is not the true centroid of the object. The coordinates of the objects in each cone need to be further converted to a coordinate system range with the center of the object as the origin; By transforming the mathematical model, a new coordinate origin is reset to optimize the calculation results for further calculation.

The crowding degree of landscape architecture space can better describe the openness of vision in 3D space and reflect the density of landscape distribution in 3D space. The greater the index value, the higher the congestion and the lower the openness, which can be expressed as:

$$SC_b = \frac{\sum_{i=1}^{n} V_{bi}}{\max\{H_b\} \times A} \times 100\% \tag{1}$$

In the formula, SC_b represents the crowding degree of the landscape building space, V_{bi} represents the ith building volume, and $\max\{H_b\}$ represents the maximum height value of the landscape building. The component complexity of a 3D landscape image can reflect the color of the landscape and the diversity of its constituent elements, which can be expressed as:

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

In the formula, CR represents the number of types of the main colors of the landscape, and TY represents the number of types of the landscape. The dimension of the average score of landscape architecture is calculated as follows, the larger the value, the more complex the shape of the building is:

$$FD_b = \frac{1}{n}\sum_{i=1}^{n} 2 1n\left(\frac{P_{bi}}{4}\right) / \ln S_{bi} \tag{3}$$

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

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

Among them, O is the identification of the object, d is the distance of the object from the viewpoint, and m is the importance weight of the object.

Using a 2D matrix composed of word vectors of words contained in an image and executing the ma3D model after the convolution layer is rich and complex information integrating points, lines and surfaces. After using 3D spatial data structure and texture mapping to model the urban landscape, it is necessary to put these solid object models in the corresponding scenes according to their spatial positions, and finally display the whole scene on the computer screen in the form of 3D graphics. Applying 3D visualization technology to the construction of digital cities, people's description of urban landscape status and planning and design has developed from the representation based on 2D maps and 3D solid models to the representation of computer 3D space, thus making decision makers, designers and users have a vivid, intuitive and deeper understanding of urban landscape status and planning and design blueprints. Through construction drawings, GIS, images, lidar and aerial photography, 3D elevation data can be obtained. The surface data of ground objects can be obtained by aerial photography, close-range photography and computer simulation drawing. The 3D rendering of the scene is controlled by man-machine interaction, so that users can roam in the 3D scene, and the rendering quality is improved by using the accelerated rendering algorithm.

The output of a certain layer in the middle of the network can be used as the characteristic expression of data. This feature expression is a feature obtained through learning, and it has the ability to describe the laws and characteristics of data. Figure 2 shows the feature extraction of landscape architecture images based on GAN. There are two kinds of candidate network node inputs: one is a network set characterized by candidate nodes, that is, a network target and node sequence that users can click. The characteristics of the function extractor are realized by extracting the variable data input by GAN function.

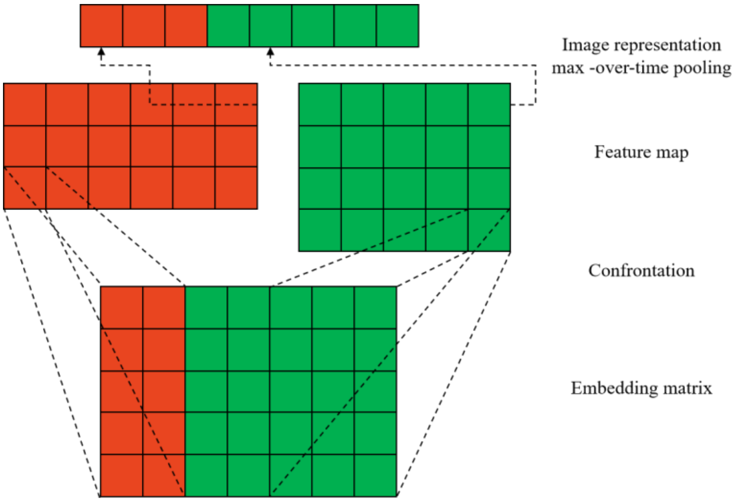

Figure 2: Feature extraction of landscape architecture images based on GAN.

The original GAN model has many shortcomings, such as the generation process is too free, which makes it difficult to control the generation of high-pixel pictures. Therefore, this article adopts an improved Conditional Generation Antagonistic Network (cGAN), which introduces the conditional variable y into both the generating network G and the discriminating network D, thus improving the quality of image generation. Firstly, the image given by the user is input, and the input image and the image generated by the generation network G are input to the discrimination network D for judgment. Through training, cGAN can be used to get the most corresponding output image:

$$G^{\bullet} = \arg\min_{G}\min_{D} L_{cGAN}(G,D) + L_{L1}(G) \tag{5}$$

cGAN realizes the learning of image $y : G : (x,z) \leftarrow y$ by inputting image x and random vector z, and its objective function is:

$$L_{cGAN}(G,D) = E_y[\log D(y)] + E_{x,z}[\log(1 - D(G(x,z)))] \tag{6}$$

$$L_{L1}(G) = E_{x,y,z}[\|y - G(x,z)\|] \tag{7}$$

In the neural network, the data will be decomposed into layers with different pixel sizes, so when generating the design, the input room inputs the pixel array of 2D pictures or the voxel model of 3D. In the modeling of deep neural network, 3D point clouds can be directly input into the network for modeling and identification. Rotating the point cloud model at any angle will not change the shape of the point cloud, and translating it to any position will not change the shape of the point cloud.

To translate the 3D model, you need to place the model in the (x,y,z) coordinate axis. Suppose the original 3D model is $F(x,y,z)$, and the model after translation is $I(x,y,z)$. Its formula is expressed as:

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

Scaling refers to scaling the 3D model in equal proportions on the three dimensions of the spatial coordinate axis, otherwise geometric distortion will occur. If the $L \times M \times N$ size 3D model $F(x,y,z)$ becomes a $KL \times KM \times KN$ size new 3D model $I(x,y,z)$, it is represented by the following formula:

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

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

When $k > 1$, the 3D model is reduced; when $k < 1$, the 3D model is enlarged, and a new 3D model can be constructed by formula (8).

4 RESULT ANALYSIS AND DISCUSSION

With the great improvement of computer hardware performance, the high efficiency of computing speed and the storage capacity of large memory make it possible to realize automatic generation. On the other hand, in the context of the era of big data, the magnitude and richness of data have greatly increased, enabling machine learning to have a large number of data training models. In this article, Python language is used to construct a point network model under the framework of TensorFlow platform. ReLU function is used as activation function, and Adam is used as optimization algorithm for training. Because the depth model has a large number of learning parameters, we should try to save time in training and testing. In the experiment, the point cloud data is rotated twice, and 50% of the points are copied. See Table 1 for specific training parameters.

Serial number	*Parameter*	*Set*
1	Enter points	2048
2	Maximum Epoch	360
3	Batch Size	30
4	Initial learning rate	0.003
5	Normalization method	Batch Normalization
6	Classification number	20

Table 1: Training parameter Settings.

The 3D system data studied in this article mainly consists of spatial data and attribute data. Spatial data mainly includes digital elevation model data, images and 3D models. Spatial data is stored in Geodatabase database. Geodatabase is a geographic data model for managing, editing and storing geographic information in ArcGIS. Geodatabase is a unified and intelligent spatial database based on DBMS, which can organize geographical elements according to certain rules and define the access and storage methods of all data types in ArcGIS. Half of the data in each category is used for training set and test set respectively. In this model, the projection view is not de-averaged and pre-whitened, but randomly divided into blocks. Table 2 shows the main data layers stored in Geodatabase.

Serial number	*Layer name*	*Element type*	*Spatial type*	*Explain*
1	Ludeng	Point	Point	Street lamp position point
2	Shumu	Point	Point	Tree position point
3	RoadCenter	Polyline	Line	Road center line
4	Building	Polygon	Face	Building contour surface
5	ShapesBuilding	MultiPatch	Polyhedron	Building model
6	Tree	MultiPatch	Polyhedron	Independent tree model
7	Meshes	MultiPatch	Polyhedron	Stadium and lawn model
8	StreetNetwork	MultiPatch	Polyhedron	Road model
9	Image	Raster	Grid	Remote sensing image of study area

Table 2: Main data stored in geodatabase.

The selection of initialization parameters needs to exist in the confidence region of network settings, and exceeding this limit will lead to a lot of side effects. For example, if too many initial parameters are selected, the parameters will be enlarged in each layer of training, which will lead to training failure. The error rate of front view, side view and top view trained by CNN is compared with the average error rate of three views obtained by cGAN proposed in this article. The specific gravity of the front view is 0.5, the specific gravity of the side view is 0.3 and the specific gravity of the top view is 0.2. The experimental results are shown in Figure 3.

As can be seen from Figure 3, the error rate of the proposed method in front view, side view and top view is lower than that of the traditional CNN, so it has more advantages in the efficiency of 3D landscape drawing and the optimization of landscape architecture pattern.

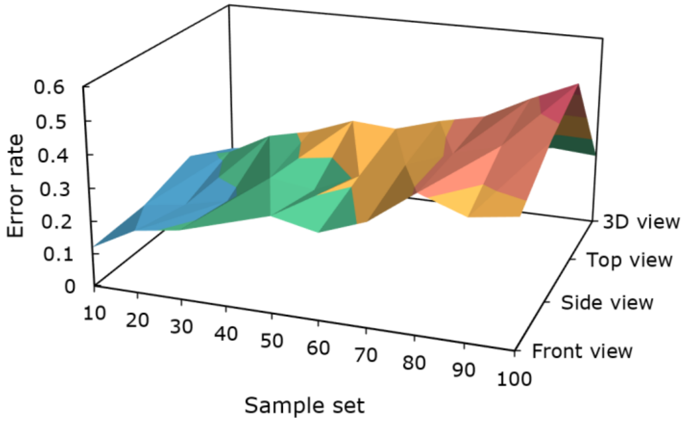

Figure 3: Error rate results.

After a series of complicated translation, rotation and scaling of the 3D model, the processed 3D model is processed by parallel projection, and the three-view projection view of each 3D model in the 3D model standard library is obtained, and each projection picture is normalized. The net recognition rate-iteration number curve is shown in Figure 4.

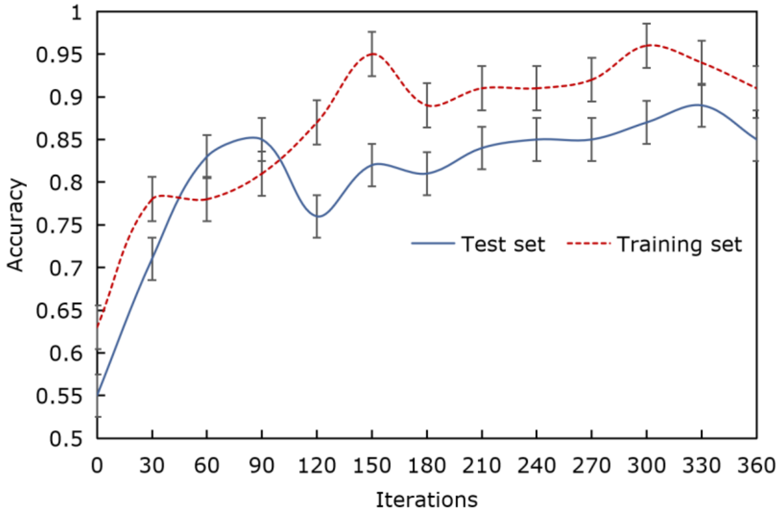

Figure 4: PointNet recognition rate-iteration number curve.

It can be seen that after 1350 iterations, the training curve tends to be stable, and the accuracy of the training set is about 96.31%, while the accuracy of the test set is about 89.94%. In some complex models, the use of realistic texture can not only improve the level of detail and realism of the model, but also reduce the number of polygons of the model without increasing the complexity of 3D geometric modeling.

In order to improve the training efficiency, the influence of normalization method on neural network model is analyzed. When the training batch is 32, batch normalization and grouping normalization are used to train the model respectively. The experimental results are shown in Figure 5.

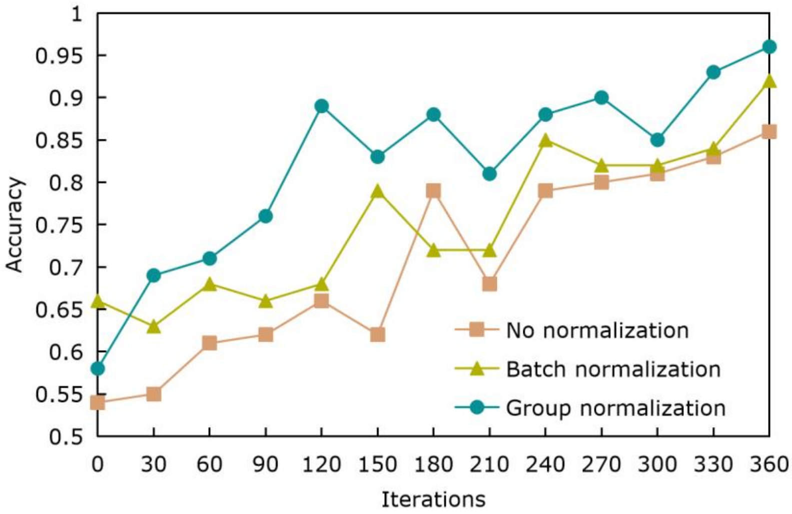

Figure 5: Influence of normalization method on network model.

It can be seen from the results that the batch normalization method or the grouping normalization method can effectively improve the recognition accuracy and speed of the network compared with the non-normalization method. After normalization, the accuracy can reach more than 85%.

When the point cloud data is input into the neural network, the order of each point is random and can be arbitrarily arranged, and this arbitrary arrangement represents the same point cloud model data, so the neural network needs to have output invariance to this arrangement input order. Batch normalization changes the distribution of input data to normal distribution, thus ensuring the uniform distribution of inputs at all levels of the network. With the increase of network layers, the distribution changes gradually. Figure 6 shows the comparison between batch normalization and group normalization when BatchSize=4 or 16.

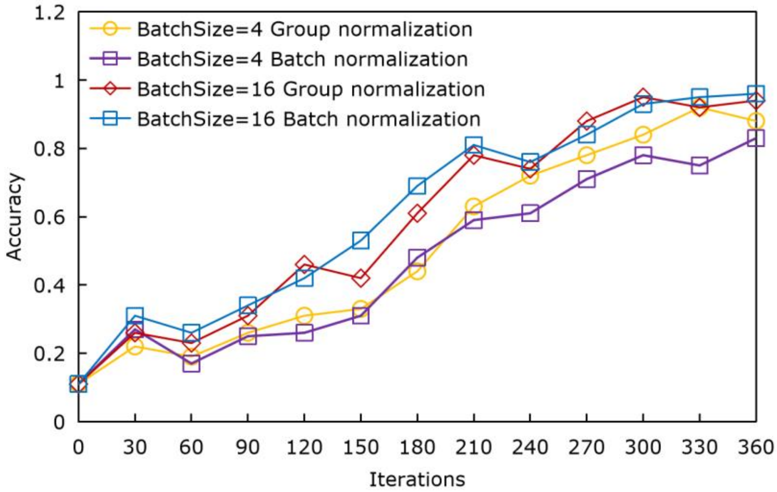

Figure 6: Comparison of batch normalization and group normalization when batch size = 4 or 16.

In order to improve the rendering speed and quality of the scene, the system only needs to process the polygons with visible views, pick out the invisible polygons and stop the calculation.

In a 3D scene, with the change of the viewpoint position, the occlusion relationship and the back of the objects in the scene will also change. When drawing a scene, the geometric surface facing away from the line of sight is eliminated, thus reducing the number of polygons drawn and improving the efficiency of 3D scene drawing. The modeling precision result of this algorithm is shown in Figure 7.

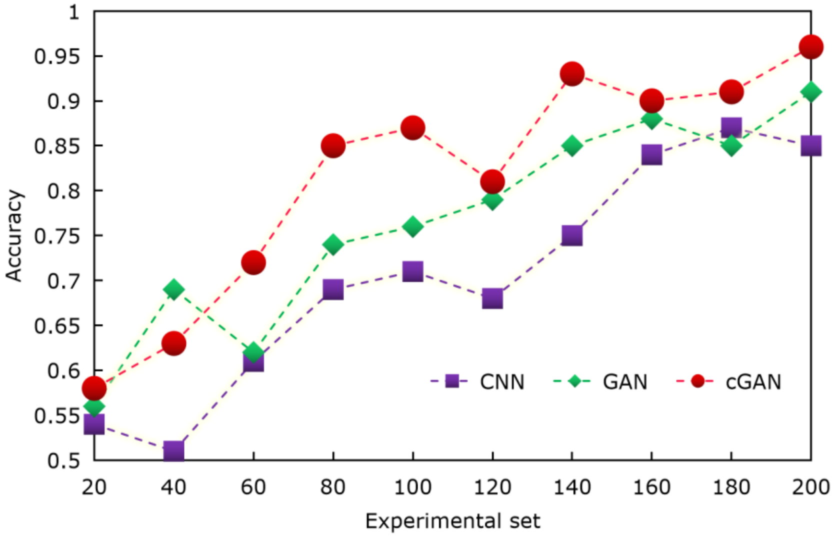

Figure 7: Comparison of modeling precision of algorithms.

It can be seen that the precision of this algorithm is higher than the other two algorithms. In addition, considering the flexibility and expansibility of the system architecture, the growth of all functional modules of the system is based on unified plug-in engine technology. Experiments in this section show that the proposed algorithm has certain superior performance. The accuracy of 3D landscape drawing and optimization algorithm based on artificial intelligence and CAD can reach over 96%, which is about 15% higher than other methods, which verifies the rationality of the proposed algorithm. GAN can realize end-to-end identification of 3D models based on data driving, and can automatically extract the features of 3D models.

5 CONCLUSIONS

Landscape design is a process of close combination of aesthetics and technology, science and environment. Once the digital city is established, it can provide human beings with all-round real and intuitive scene information, and can enter the city model from their own perspective to experience the real scene. Visualization of 3D landscape model is a method and technology to transform 3D landscape model into graphics or images displayed on computer screen by using computer graphics and image processing technology. In this article, the principle of GAN algorithm, the structure of deep neural network used to identify point cloud model, and its identification principle are studied, and a 3D landscape drawing and optimization algorithm based on GAN and CAD technology is proposed. Experiments show that the proposed algorithm has certain superior performance. Based on artificial intelligence and CAD, the accuracy of 3D landscape drawing and optimization algorithm of landscape architecture can reach over 96%, which is about 15% higher than other methods. This verifies the rationality and optimality of the proposed algorithm, and can be applied to 3D landscape drawing and optimization of landscape architecture. The method proposed in this article is the initial application of GAN in the functional layout of buildings, but there is still the problem of unstable model training. In the future, further optimization and treatment of GAN are needed to provide designers with a more powerful layout scheme.

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