Application of Lightweight Deep Learning Model in Landscape Architecture Planning and Design

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***Abstract*—The holistic view of garden construction is firstly reflected in the integration of the elements that make up the garden, and the primary and secondary are distinguished from the perspective of the whole city, the continuation of the upper planning, the coordination with the surrounding groups and the harmony of the internal gardening elements. The primary goal of ANN (artificial neural network) learning is to understand the drawings and to convert information such as plant numbers and positions in digital drawings into standard digital formats for storage. In front of the SSD (Single Shot Multi-box Dettor) network model, a standard architecture network for image classification is adopted, called the basic network and is fused for comprehensive detection. This paper proposes the network model flow of the 3D object voxel modeling method based on the lightweight DL (Deep learning) model. The cyclic 2D encoder, cyclic 3D decoder and view planner are integrated into a unified framework responsible for feature extraction and fusion, feature decoding and view planning. The results show that the pixel accuracy, the average accuracy and the average IU value are the highest, with the pixel accuracy as high as 90.44%, the average accuracy as high as 93.15%, and the average IU value as 92.72%. In landscape image processing, it provides a certain foundation for future landscape planning and design.**

Keywords*—Deep learning; landscape architecture; landscape element; neural network; artificial neural network; view planning

I. Introduction

Traditional landscape architecture planning and design methods mainly rely on designers' accumulated and improved experience. For large-scale landscape planning applications, designers must have solid design theory, professional design skills and extensive artistic accomplishment [1]. Scale and pattern process is called two core issues of landscape ecology [2], and scale effect is the core of three major issues in scale grade research: scale effect, scale selection and scale deduction. In today's era of globalization, although economy, culture and customs learn from each other in mutual communication, the different civilisations hidden behind them cannot be converged. The discipline of landscape architecture is developing daily, and the industry is in a rapid development stage, bringing unprecedented opportunities and prosperity to landscape architects. With the development of the social economy and the improvement of people's spiritual level, more attention has been paid to environmental quality. Modern landscape architecture is a "scientific art", which cannot be separated from art, but also from the support of science. Therefore, the discipline of landscape architecture needs to form its own methodology and theoretical system and become a rigorous and mature discipline.

Landscape planning and design is a highly comprehensive design art that involves the planning and layout of multiple elements such as terrain, plants, water bodies, buildings, etc. In traditional garden planning and design, designers usually rely on experience and personal aesthetics to design. However, this approach often lacks precise data support and scientific decision-making basis, which can easily lead to low design efficiency or not meeting practical needs. The emergence of deep learning models provides new solutions for landscape planning and design. Through deep learning technology which can learn and analyze a large amount of historical garden design data, in order to uncover the laws and features hidden behind the design. These laws and characteristics can be used to optimize the design process, improve design efficiency, and enhance the scientificity and feasibility of design schemes. The application scenarios of deep learning models in landscape planning and design are very extensive. For example, digital terrain simulation is an important part of landscape planning and design, involving multiple steps such as terrain measurement, analysis, and modeling. By utilizing deep learning technology, it can quickly and accurately identify and analyze terrain data, providing designers with reliable terrain data support.

At present, with the development of China's landscape architecture industry, many excellent landscape architecture planning and design concepts have emerged, and they are committed to creating modern landscape architecture with Chinese characteristics based on local conditions—research on shape and space generation is controlled by focusing parameters. Systematic parametric design research has not been carried out according to the characteristics of landscape architecture planning and design; not only the practice of parametric landscape architecture design is rare, but also the research on the theory and method of parametric design of landscape architecture itself is even less. Aiming at the current industry situation, this paper mainly explores the application of the lightweight DL model in landscape architecture planning and design. It summarizes its reference and guiding significance for modern landscape architecture planning and layout to enrich and develop the theory and practice of modern landscape architecture planning and design in China to guide the future landscape architecture planning and design practice. Scientific intervention, adjustment, planning and design of landscape environment through parametric method are an

important development direction and research difficulty of modern landscape architecture planning and design. This article proposes a network modeling process for a three-dimensional voxel modeling method. Integrating the graphic planning of the encoder, the pixel accuracy is improved during the feature extraction process. The innovative points of the method adopted in this article are:

1) Lightweight DL models have lower model complexity and computational complexity, enabling fast training and inference under limited computing resources and memory constraints, making 3D object voxel modeling more efficient and real-time.

2) Lightweight DL models can improve the accuracy and detail representation ability of 3D object voxel modeling through network structure and algorithm optimization, thereby better reflecting actual 3D scenes and objects.

3) Lightweight DL models have a small model volume and parameter quantity, which can be deployed and run on various devices, facilitating model updates and upgrades, thereby supporting the diversity and scalability of 3D object voxel modeling.

II. Literature Review

Since the 1950s, the destruction of the natural environment caused by industrialization has become increasingly serious, and people have begun to attach importance to the role of natural ecological elements in planning. Various ecological planning schools, led by landscape suitability evaluation methods, have successfully proposed a series of planning strategies to coordinate natural and human elements [3], [4]. Thorne et al. put forward the suitability evaluation method, the core of which is to synthesize and screen all kinds of environmental factors and socio-economic factors in time order to solve practical planning problems [5]. Economic elements are integrated and screened to solve practical planning problems, so it is also called "a thousand-layer cake" figuratively. Parris et al. store all kinds of landscape elements on the map in the form of raster data or vector data and give them specific structures and attributes. This change in the storage mode of map information makes the amount of information in a map much larger than the traditional map [6]. Ankita et al. used Arcview GIS and visualization software to create three-dimensional effects for environmental assessment. If landscape architects can accept such a technology, it will be fundamentally incorporated into the design process and can positively influence the social impact of design [7]. Shuvo et al. segmented the image by the color of the flowers, extracted the features based on texture analysis, and finally combined it with SVM (support vector machine) and other methods to realize the classification and recognition of flowers [8]. DL (Deep learning) is very important in computer vision. With the continuous progress of its technology, its application in the classification and recognition of flower images has greatly improved the effect of classification and recognition [9]. Wei et al. adopted the CNN model of the Keras DL framework and trained the Oxford flower data set to greatly improve the accuracy of flower species identification [10]. Qiang et al. combined the self-coding network structure with the classification network and, through the post-processing of graphic synthesis technology, input a single-view picture and output the predicted and synthesized three-dimensional model [11]; Li et al. put forward a three-dimensional RNN (Recurrent Neural Network). By building a three-dimensional RNN, pictures taken from multiple perspectives are received, and the network's hidden layer is used to implicitly represent the geometric structure of the current reconstruction, thus establishing a DL three-dimensional reconstruction framework combining single and multiple perspectives [12]. Wang et al. obtained better simulation results than multi-dimensional time series by adopting the fluctuating time series simulation method. Fluctuating time series is a method of making the series conform to Fourier series by using difference, and usually monotonous data can be changed into fluctuating type by contrast [13].

III. Research Method

A. General Principles of Landscape Design

The holistic view of garden construction is firstly reflected in the integration of the elements that make up the garden, and the primary and secondary are distinguished from the perspective of the whole city, the continuation of the upper planning, the coordination with the surrounding groups and the harmony of the internal gardening elements. By protecting the natural and cultural landscapes in the site, it can pay attention to the spirit of the site, respect each specific area and strive to create its complementary design and interpret the traditional spirit with modern techniques to achieve the unity of natural harmony with the site itself [14], [15]. Planning and symbolically creating different landscape forms (people and designers transfer their landscape views to space, city and landscape), bringing about spiritual changes.

The technical evolution of the superposition method expands its operation mode and technical purpose. In other words, today's overlay method is no longer limited to a specific technical means or operation process but a set of tools oriented by cascading thinking, which includes a series of techniques. General maps tend to show as much information as possible in one map, while thematic maps focus on expressing one or several elements. This feature of the thematic map makes the main information to be expressed emphasized, while the secondary data is weakened as much as possible.

The thematic map is no longer limited to the traditional division of physical and geographical elements but is replaced by the distribution of various diseases in the study area, and the degree of incidence is expressed by color depth. It should be noted that the superposition between thematic maps of factors or elements is not necessarily the superposition of all drawings. Still, the superposition is carried out selectively according to the research needs. From this, it can summarize the general operation steps of the overlay method as shown in Fig. 1:

The main difference between the application of the superposition method in the above three cases lies in the theoretical basis followed by users and the final results of the superposition method. The theoretical basis determines the classification of landscape elements and the splitting method of their corresponding factors. At the same time, the final result of

overlapping images depends on the goal orientation of landscape architecture planning and design itself. Therefore, the final superposition should draw thematic maps of various diseases, population density maps and environmental maps of health and diseases and also superimpose these maps again to explore the relationship between the elements.

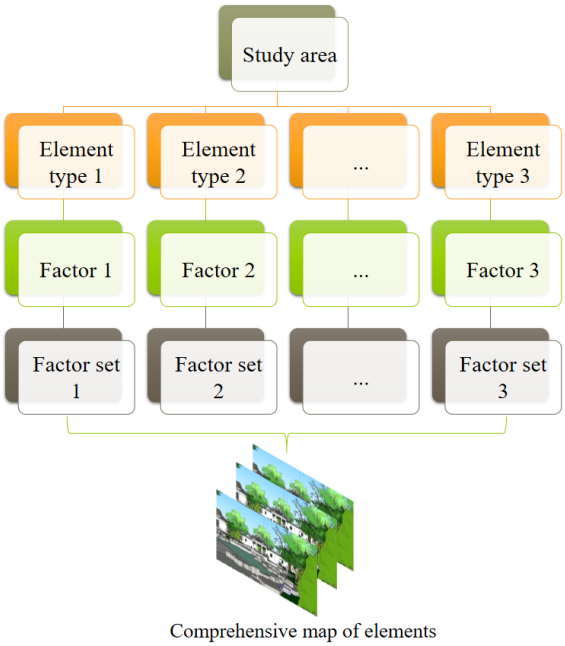

Fig. 1. General operation steps of the superposition method.

According to the connotation of the mechanism, it need to grasp it from two aspects: First, the system, that is, something is a system composed of multiple parts, and each piece is related, which is also the premise of the existence of the mechanism; The second is the operation mode, that is, the specific action mode of the mechanism to coordinate the relationship between various parts of things. Design mechanism, like the "invisible hand" directing the design, guides design behavior and generates design results. As the same research on scientific design methods, compared with design patterns, design mechanism pays more attention to the explanation of action mechanism, the grasp of laws and the exploration of design essence, which is more flexible and instructive. In addition, the design mechanism can be transformed into corresponding design patterns according to different juice designs, which is more suitable and practical.

The core of ancient Chinese culture is local culture, and the countryside is a world close to nature and with disputes over rights, which have always been yearned for by scholars. The essence it pursues is a kind of life close to nature. In the eyes of Western scholars, geography is to explain "the relationship between man and earth". The interaction between human beings and landscape, social and personnel variation will also cause natural changes. Although mixed with some metaphysical colors, its essence reflects the theory of base selection and site planning and design of residential environments such as houses, villages and towns in China. People plan for experience. First of all, it is a clear purpose or experience, and secondly, it is a conscious design with the form and space quality to achieve the project's space effect or create according to the goal set by the task book. Only through the best experience and expressing functions can the most optimized planning experience be produced.

B. Plant Configuration in Landscape Planning and Design

The analysis and prediction of regional socio-economic status and development trend of planning is the starting point and important basis for planning. In the early stage of planning, it should focus on analyzing the current situation of social and economic structure in the planning area and its dynamic change law, and analyze the impact of social and economic system environment on land use to provide a real and reliable social and economic background for the formulation and implementation of the planning scheme. Through comprehensive balance and full coordination, the planning scheme can reasonably determine the scale and spatial layout of agricultural land, construction land, ecological protection areas, land development and consolidation, and key construction projects. It can reasonably determine the main control indicators such as cultivated land quantity, cultivated land occupied by construction, basic farmland protection area, land development and consolidation area, and the scale of construction land in major cities and towns.

People's cognitive activities begin with feelings. It reflects the objective things, the sensory perceiver touches through the sensory organs. It takes the objective things as the source, the subjective interpretation as the way and result, and the subjective image of the objective things in the mind. People's environmental identification aims to gain a foothold of complete mastery of thinking. If the system needs clarification, a familiar and comfortable environment with a clear and clear orientation system will give people affinity. In contrast, an unfamiliar, monotonous environment with an unclear orientation system will make people feel lost.

The spatial scale effect is a phenomenon that ecological objects show different characteristics and meanings with the change of spatial scale. The spatial dimension of scale can be changed by granularity and amplitude [16]. Time granularity refers to the frequency of object occurrence or the time interval of its dynamic change; Time range refers to the duration of an object in time. The time scale effect is a phenomenon in which ecological objects show different characteristics and meanings with the time scale change. When studying other objects, it should choose the appropriate time scale. Generally speaking, the high level of a nested system is composed of low levels, and the relationship between two adjacent levels is completely contained and completely contained [17], [18].

Taking plant configuration as an example, the primary goal of ANN (artificial neural network) learning is to understand the drawings. This understanding is not to identify what plants are in the drawings like people in the conventional sense or why they are matched like this, but to convert information such as plant numbers and positions in digital drawings into standard digital formats for storage. Many factors will influence the design process of plant configuration, and there are a lot of uncertain nonlinear conditions in the process, so there is a diversity of design results towards the target under specific conditions, similar to the non-convexity of ANN.

The neuron is the basic component and processing unit of the neural network. The structure of the artificial neuron model mainly includes the following three elements: group input and the intensity of input signal is expressed by the weight of each input neuron. The summing unit is used for weighting and summing all input signals. The activation function limits the output value of neurons in a certain range [19].

The θ_k threshold (or offset $b_k = \theta_k$) is expressed mathematically as follows:

$$v_k = \sum_{j=1}^{p} w_{kj} x_j \quad (1)$$

$$\mu_k = v_k + \theta_k \quad (2)$$

$$y_k = \phi(\mu_k) \quad (3)$$

$x_1, x_2, \cdots, w_{k1}, w_{k2}, \cdots, w_{kp}$ is the weight of the neuron, the activation function is $\phi(\cdot)$, and is the output of the kth neuron.

BP is the most commonly used ANN model in time series prediction, which is essentially a static network model. The input samples are random, and there is no correlation trend. From a mathematical point of view, the neural network is a nonlinear function. A time series $\{X_n\}$, which can be predicted by the following formula:

$$X_{n+k} = f(X_n, X_{n-1}, \cdots, X_1) \quad (4)$$

The static network is used to fit the function f, and then the future value is predicted. This is the basic idea of a neural network for time series prediction.

When the actual design work is carried out, it is necessary to consider the functional requirements put forward by the owner or the government, which requires the system to have certain control and guidance on the design results. Therefore, when constructing the network model, it is necessary to set the result-oriented control ability and the bottom-up generation logic. At the same time, it can adjust the threshold and incentive function of input data and influencing parameters. Fig. 2 shows the model structure of the self-generated system.

Assuming that the garden environment is W, the boundary is, and all polygon obstacle areas in the area are Q_i, then:

$$W = \{WSB, Q_1, Q_2, \cdots, Q_m\} \quad (5)$$

Where is the number of polygon obstacle areas?

SVD (Singular value decomposition) is an algorithm that can be applied to any matrix decomposition. For example, assuming that the input data of the full connection layer is $u \times v$ in size and the weight matrix is W, the calculation formula of the output data of the full connection layer is:

$$y = Wx \quad (6)$$

Its computational complexity is u, v. It W is subjected to SVD and $W$is approximately replaced by the first important eigenvalues after decomposition; the decomposition formula is:

$$W = U \sum V^T \approx U \sum_t V^T \quad (7)$$

U represents an orthogonal matrix of dimension. Represents a diagonal matrix corresponding to the first values in the original diagonal matrix with dimension $t \times t$. It represents an orthogonal matrix of dimension.

Neural networks and traditional regression analysis are similar; both try to find the best fit for the function by minimizing the model's error. The fitting error of its model is given by Formula (8):

$$E = Y - f(X) \quad (8)$$

Because the value of the deviation term is always 1, its weight has the same function as the constant term in the regression model. Similarly, the network with HL (hidden layer) is similar to the nonlinear regression model, and for one HL, it is given by the following formula:

$$y = G\left(\sum_{j=1}^{k} \beta_j G\left(\sum_{i=1}^{m} \gamma_{ji} x_i\right)\right) \equiv f(x, \phi) \quad (9)$$

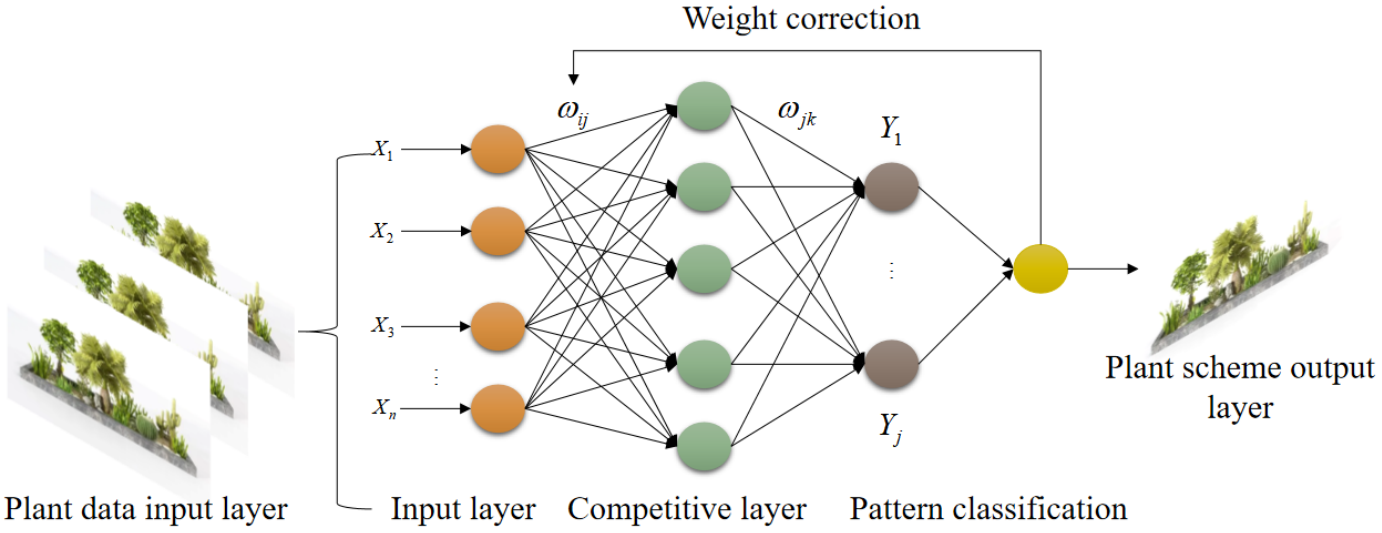

Fig. 2. Self-generated system model structure.

G is the transformation function of HL and output layer in the neural network; h is the number of HL neurons; m is the number of input units; β_j is the weight between output neurons and HL neurons, and is the weight between HL neurons and input neurons; φ is all the relevant weights in the network, x_i is the input value, and is the output value.

C. Voxel Modeling Method of a Three-Dimensional Object based on Lightweight DL Model

In the emergence and development of regional humanistic features, the region's natural features play a great role. In the final analysis, no regional culture can exist and develop independently of its dependent environment, no matter how free human beings are in their choice of culture. Historical background, it can deeply study the development context of the region and understand the origin and changes of regional human characteristics. When designing, only by putting the thinking of the land parcel in an overall and macroscopic background of time and space and fully investigating and understanding the historical background of the region can it have a clear and comprehensive understanding of the emergence and development of the humanistic characteristics of the region, and then it can have a targeted and well-founded theory in the middle and later stages of design.

Western gardens are also more influenced by the agricultural rural landscape. No matter the grand royal gardens or the quiet private courtyards, you can see the shadow of the rural landscape at that time. This is completely different from the oriental garden, which has always been greatly influenced by the natural landscape and is good at imitating the natural mountain water potential in the garden construction.

Landscape planning and design is a discipline that integrates space art and time art, and landscape works, as an aesthetic entity, exist in space and time at the same time. Compared with architectural language, the biggest feature of garden design language is that it changes dynamically with time. Landscape elements such as vegetation and water in gardens will change dynamically with the seasons. Find a stable and lasting structure in the present situation of the base, and then plan a whole system based on various parameters, which must evolve with time and produce special coping methods with evolutionary ability.

Positioning and mapping are the position of the image observation point and the corresponding relationship between the observation point and the reconstructed model. In the shooting scene without camera position calibration, it is necessary to position the camera in the shooting process to judge the conversion relationship between the pixels and the 3D model and finally build the 3D map in the global coordinate system. You can use the characteristic point method or the direct method to complete a visual odometer. Taking the feature point method as an example, firstly, the features of the image are extracted, and the features between adjacent frames are matched. Then, based on the matched elements, the epipolar geometry method or nearest point iteration method is used to solve the pose change of the camera.

According to the transformation formula between homogeneous coordinates and pixel coordinates in the world coordinate system, the two-dimensional feature points are transformed into signposts on the three-dimensional map. The transformation relationship is as shown in Formula (10):

$$P_{uv} = KTP_w \qquad (10)$$

Among them are the camera's internal reference matrix, which is fixed after the camera leaves the factory, and its external reference matrix, which represents the camera's rotation and translation and changes with the camera's position.

Landscape images are developing vigorously. Although many drawings, drawings and landscape models are used now, the content brought by different image media is completely different. Now, the task of landscape architects is to keep learning and find suitable image media so that their works can be better displayed and expressed.

When semantically segmenting different landscape pictures, because it is impossible to correctly segment every object, sometimes the landscape element category in a certain image is regarded as another category [20]. In this paper, the model based on CNN (Convective Neural Network) can achieve the goal of semantic segmentation of landscape pixels in complex landscape images. The final output digital result is regarded as the final result of landscape element classification in the final landscape image to judge the final result of landscape element classification in the landscape image. Deep learning reinforcement learning (RL) algorithms can be used to optimize the design process, such as finding the best building materials, design elements, or layouts [21]. This can be achieved by training neural networks to learn and improve based on project requirements and constraints (such as budgets, regulations, etc.). Deep learning can be used to automatically generate 3D models of buildings. These models can not only be used for visualization, but also for structural analysis and optimization [22]. Deep learning can be used to achieve parameterized design, which means that every decision in the design process can be fine-tuned as a variable. For example, the design scheme can be optimized based on factors such as sunlight conditions, wind direction, terrain, etc. [23].

This paper represents the number of pixels that belong to class semantics and are judged to be class and is used to describe the total number of semantic categories. The formula used to calculate the average accuracy is shown in Formula (11):

$$A_{avg} = \frac{1}{n_{cl}} \sum_i \frac{n_{ij}}{t_i} \qquad (11)$$

According to the theoretical discussion of 3D image reconstruction methods, it can be concluded that the DL method can make up for the limitations of traditional methods in view angle number, illumination, reflection, etc., to some extent and use less information to complete more efficient reconstruction.

In front of the SSD (Single Shot Multi-box Dettor) network model, a standard architecture network for image classification is adopted, called the basic network and is fused for comprehensive detection. Fig. 3 shows the network model flow chart of the 3D object voxel modeling method based on the lightweight DL model.

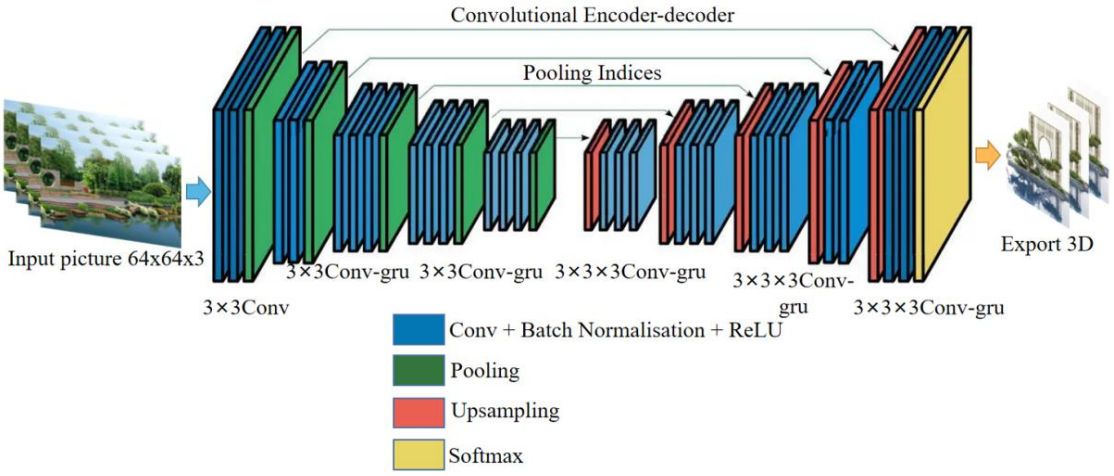

Fig. 3. Network model flow chart of voxel modeling method of a three-dimensional object based on lightweight DL model.

In the network, the cyclic 2D encoder, cyclic 3D decoder and view planner are integrated into a unified framework, which is responsible for feature extraction and fusion, feature decoding and view planning, respectively, so that the system can dynamically plan the view independently and update the reconstructed model in a time step sequence.

In terms of network depth, because the size of the original image is large, redundancy may occur, so the feature changes of the original texture details can be captured by large convolution. When the original image is input, multiple convolution kernels repeatedly act at different positions to extract features in the convolution layer.

If convolution kernels convolve the input image, a n feature map is obtained, and the operation formula is shown in Formula (12):

$$X_n^m = f\left(\sum_{i \in P_x} x_i^{m-1} * k_{in}^m + b_n^m\right) \quad (12)$$

The above formula represents the n th characteristic graph of the convolution layer in the m -th layer, f is the activation function of this layer, P_n represents the set of input images, and b is the corresponding offset.

Because the batch gradient descent method needs to traverse all samples to update parameters, the experimental process is slow, so SGD (Stochastic Gradient Descent) is adopted in this experiment. Use the loss function of each sample to derive the partial derivative of the weight w:

$$w_j^i = w_j + \left(y_i - h_\theta(x_i)\right)x_j^t \quad (13)$$

Where $h(x)$ is the function to be fitted, $j(w)$ is the loss function, θ is the number record, and j is the number of parameters?

$W := T[W]$ Is defined, and the SVD of $W = UDQ^T$ is W, then:

$$\hat{V}_k^c(j) = U_{(c-1)d+j,k}\sqrt{D_{k,k}} \quad (14)$$

$$\hat{H}_k^c(j) = Q_{(n-1)d+j,k}\sqrt{D_{k,k}} \quad (15)$$

Where $\left(\hat{H}, \hat{V}\right)$ is the solution $P1$, and is the filter called a low-rank constrained filter?

The 32 × 32 × 32 grid is used to represent the three-dimensional shape. After the three-dimensional decoding features are obtained, the Sigmoid activation function predicts the occupancy probability. The mathematical formula of the Sigmoid function is shown in Formula (16):

$$Sigmoid\ (x) = \frac{1}{1+e^{-x}} \quad (16)$$

All the calculations of hidden layers are changed to convolution operations to retain the ability to extract spatial neighbourhood relations by convolution calculation, and all the operations on input are all connected layers. After obtaining one-dimensional vectors, the fully combined layers are deformed into three-dimensional features, and the gate calculation with hidden layers continues.

IV. Analysis and Discussion of Results

A simulation test is carried out to verify the algorithm proposed in this paper. Hardware environment: Intel Core i7 2.8 GHz quad-core CPU, 8 GB memory. The simulation environment is Windows 7 operating system and Matlab simulation software.

According to the analysis of the network structure of SSD and MobileNet, in order to reduce the number of parameters and calculation of SSD and improve the detection rate, the lightweight MobileNet network can be applied to SSD. After that, four groups of convolution layers are added, and the output features of six convolution layers are extracted and fused to detect the target to be seen comprehensively. The added network structure of SSD MobileNet V2 is shown in Table I:

The experimental results of the training test data set used in this experiment are shown in Table II and Fig. 4. The speed of MobileNet is slower than that of SSD. Still, on the whole, the model size can be reduced to 15MB, and the rate is about 35 frames/s based on the SSD-fused MobileNet network with the same accuracy, so this algorithm makes it possible that target detection can be transplanted and applied to embedded and mobile devices.

TABLE I. ADDED NETWORK STRUCTURE

Input layer	Step length	Output channel
Conv2d_10	1	1280
Conv2d_11	2	512
Conv 2d 12	2	256
Conv 2d 13	1	128
Conv 2d 14	1	128
Conv 2d 15	2	64

TABLE II. EXPERIMENTAL RESULT

Target class	SSD	SSD_MobileNet V1	SSD_MobileNet V2
Aeroplane	0.7984	0.8477	0.8261
Bicycle	0.8394	0.8984	0.8035
Bird	0.8073	0.8515	0.8791
Boat	0.8088	0.7118	0.8321
Bottle	0.607	0.8897	0.9272
Bus	0.5985	0.7949	0.8898
Car	0.8023	0.7586	0.9221
Cat	0.7009	0.767	0.8466
Chair	0.6777	0.7896	0.8635
Flower	0.8837	0.8818	0.8539
Tree	0.7574	0.7462	0.8611
Pavilion	0.9332	0.7872	0.8758
Streamlet	0.6063	0.8177	0.8431
Crowd	0.6117	0.8975	0.864

In the process of plant growth, with the competition of individuals for available water, nutrients and light, individuals at a disadvantage gradually die, that is, self-thinning, also known as density-related death. The stand density calculated from the data of all sample plots in each year was used, and the overall regression analysis was carried out among the values of different density indexes to judge the similarity degree of other density indexes. The regression relationship between the stand density index and the Nilson density index shows some differences between the stand density index and the Nilson density index (see Fig. 5), which needs further analysis.

When the density index based on the self-thinning theory measures the uncultivated forest land, it will be larger than the recognized maximum density value to a certain extent, which makes the density index decrease in the late growth stage of the stand. Affected by natural disasters, this decline will start early or increase the number of unnatural death plants. Figure 6 reflects the Nilson density index of sample plots with the same initial density as shown in Fig. 6.

However, the density of Nilson reflects that the density of sample 1 with moderate site conditions in the previous N years is the highest, and the density of sample 3 with the best site index before the disaster is higher than that of sample 1. In different stages, the two density indexes show that the stand density of the medium and best site is the highest, indirectly indicating no obvious linear relationship between density and site index.

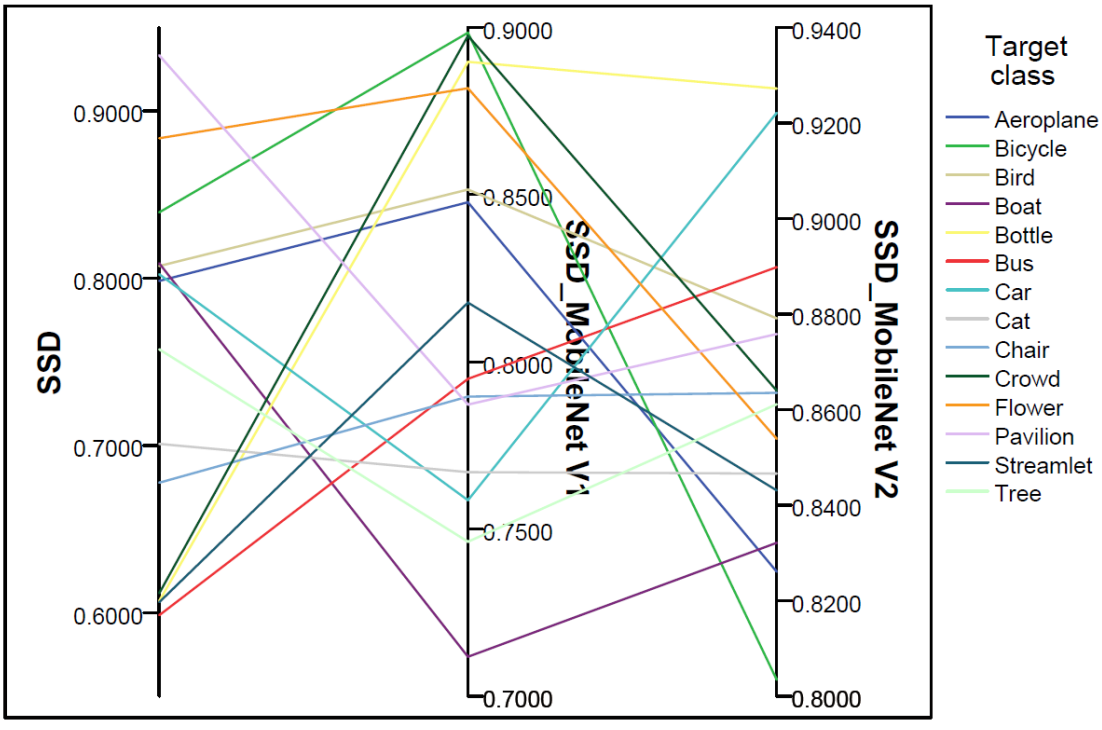

Fig. 4. Experimental results can be viewed.

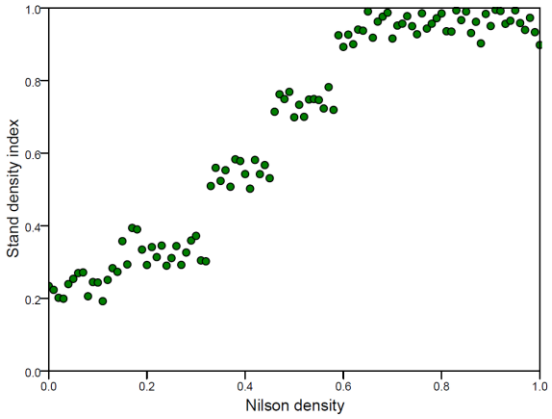

Fig. 5. Relationship between stand density index and nilson density.

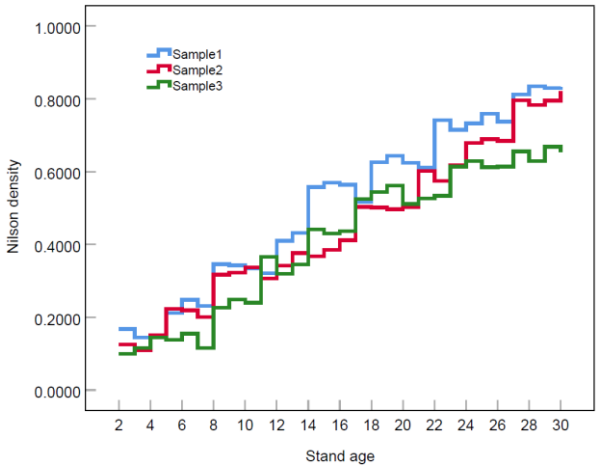

Fig. 6. Nilson density index of sample plots with the same initial density.

After three stages of training, the 3D object voxel modeling system based on the lightweight DL model can dynamically obtain the optimal visual angle around the object to be reconstructed and the corresponding visual information under the visual angle, and finally reconstruct the 3D voxel through the object reconstruction module. To evaluate the reconstruction quality, IoU (Intersection over Union) is used for quantitative comparison. The experimental results are shown in Fig. 7 and Fig. 8.

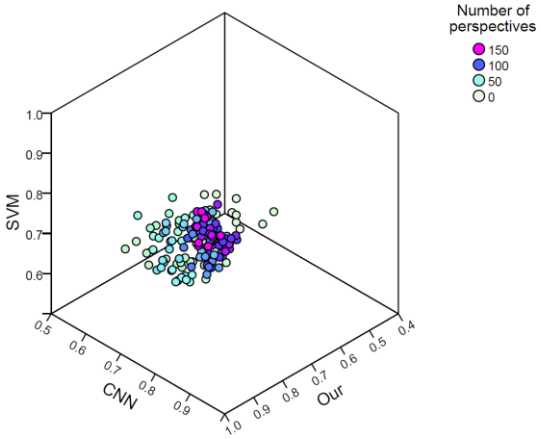

Fig. 7. IoU values of reconstructed voxels with different perspective prediction methods.

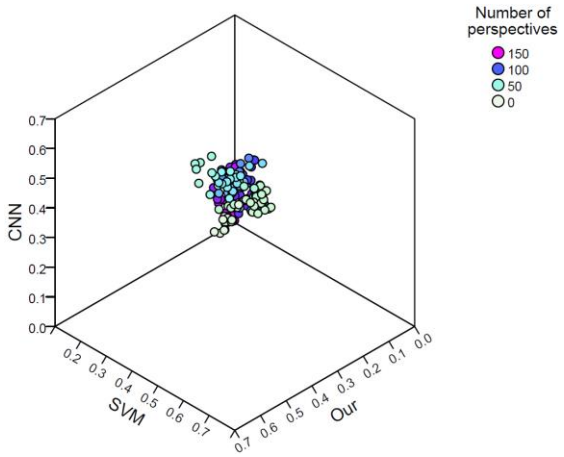

Fig. 8. Information acquisition with different perspective prediction methods.

It can be seen that with the increase in the number of perspectives, the perspective sequence predicted by the network is planned with the perspective of this paper, and the reconstruction quality increases faster, which shows that the method of this paper can obtain more information suitable for object reconstruction and help improve its reconstruction quality. In this paper, the Shannon entropy of the perspective planning network decreases the most, which indicates that more new information can be acquired from the perspective of prediction, thus verifying the information acquisition ability of the network.

Table III shows the results of semantic segmentation, and Fig. 9 shows the accurate comparison between SVM, CNN and three different upsampling structures of this method. By comparing the values of these three upsampling structures, it can find that the pixel accuracy, average accuracy and average IU value of this method are the highest, with pixel accuracy as high as 90.44%, average accuracy as high as 93.15% and average IU value as 92.72%.

TABLE III. SEMANTIC SEGMENTATION RESULTS OF LANDSCAPE ELEMENTS

Evaluating indicator	SVM	CNN	our
Pixel accuracy	0.8377	0.8283	0.9044
Average accuracy	0.8474	0.9041	0.9315
Average IU	0.8734	0.8964	0.9272

Landscape planning and design are faced with a comprehensive and complex system. Although the system itself is unique, the components of the system are changeable, and the change of a certain variable will have a series of changes, thus affecting the whole system. Accordingly, each element in the system does not exist in isolation, and each element is in a certain position and plays a specific role in the system. The elements are interrelated and form an inseparable whole. Because of the multi-objective design, it has the attribute of a system, that is, the integration and optimization of parameters in the system. It should be noted that the result of system simulation is not planning itself but provides the possibility of open thinking for various possibilities of planning and design.

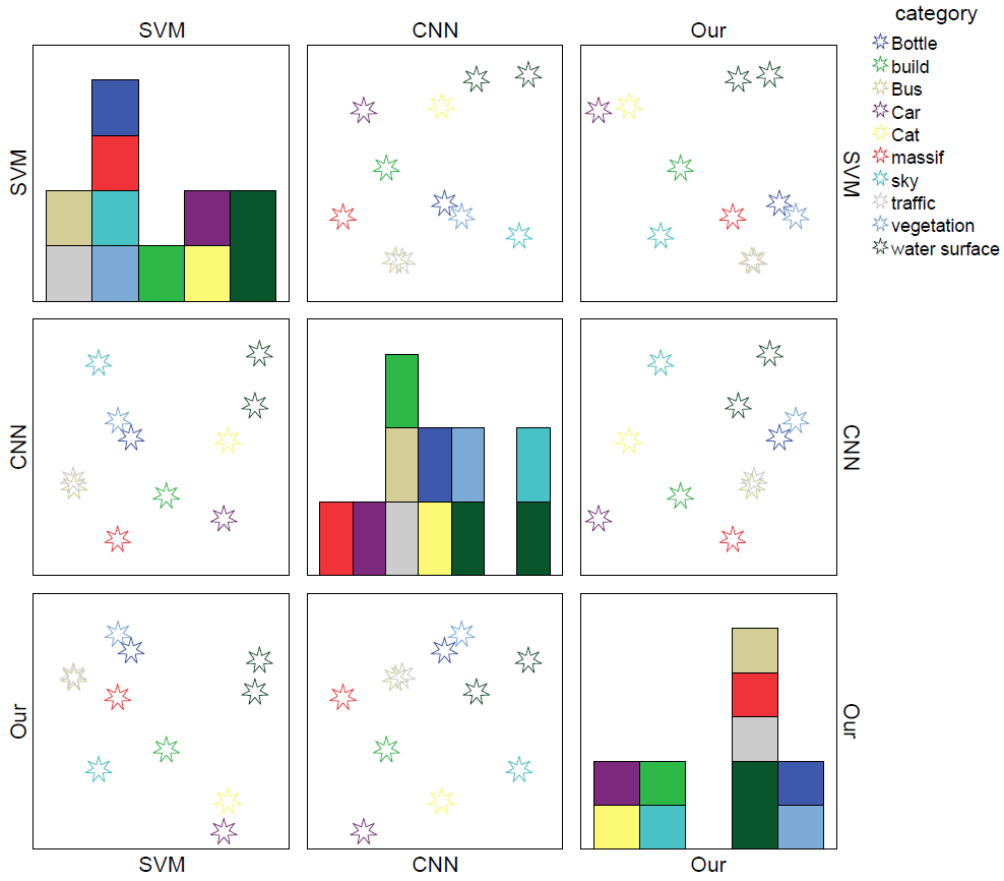

Fig. 9. Accuracy distribution of landscape element classification.

The urban environment in any period will reflect the level of scientific and technological development in that period and the aesthetic consciousness of the times and these restrictions will restrict the manifestation of the environment. The rational application of science and technology can make the created environment personalized, establish a modern expression technique that runs through the design from beginning to end, and form a unified expression style with the times. Reconstruct the spatial form of land parcels with modern gardening methods and unique spatial processing techniques, among which organizing garden space with an axis is a common design technique. The space axis can well reflect the value of space, and different space types can be organized together through the axis to form a complete spatial sequence for the viewer.

V. Conclusion

The discipline of landscape architecture is developing daily, and the industry is in a rapid development stage, bringing unprecedented opportunities and prosperity to landscape architects. With the development of the social economy and the improvement of people's spiritual level, more attention has been paid to environmental quality. Landscape planning and design is a discipline integrating space art and time art, and landscape works, as an aesthetic entity, also exist in space and time simultaneously. Scientific intervention, adjustment, planning and design of landscape environment through parametric method is an important development direction and research difficulty of modern landscape architecture planning and design. This paper presents the network model flow of the 3D object voxel modeling method based on the lightweight DL model. The stand density calculated from the data of all sample plots in each year was used, and the overall regression analysis was carried out among the values of different density indexes to judge the similarity degree of other density indexes. In this paper, it can find that the pixel accuracy, average accuracy and average IU value are all the highest, with pixel accuracy as high as 90.44%, average accuracy as high as 93.15% and average IU value as 92.72%. Realize the integration and optimization of parameters in the system. It should be noted that the result of system simulation is not planning itself but provides the possibility of open thinking for various possibilities of planning and design.

In the future, deep learning technology can be utilized to better utilize historical design data and planning experience, providing designers with real-time and accurate decision support. For example, a recommendation system based on deep learning can help designers find similar or better design solutions from a large number of historical garden designs based on established design goals. With the development of deep learning technology, it can train models to automatically perform routine and repetitive design tasks, such as landscape layout, vegetation placement, etc., thereby freeing up designers' energy and enabling them to focus more on innovation and detailed design.

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