Research on Architecture Aided Design Methods and System Based on Deep Learning

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Abstract. The utilization of deep learning in the field of building aided design has broad space and potential, especially to improve the perfection of architectural design, the visualization of functionality, the construction progress and the construction cost. Based on this, this paper first analyses the concept and connotation of deep learning, then studies the utilization value of deep learning in building aided design, and finally gives the utilization strategies and meanss of deep learning in building aided design.

Keywords: Architecture Aided Design, Deep Learning, Utilization

1. Introduction
With the iterative progress and maturity of computer tech, it has been widely and deeply studied and popularized in many fields, especially in the field of building aided design, which greatly promotes the level and quality of building aided design. On the other hand, as an intelligent and info tech, in-depth learning can realize the compensation of architectural design data info and the transmission of distributed data, so as to realize the real-time process display of design distributed data in the training terminal [1]. With the progress and growth of social economy, all kinds of infrastructure and buildings emerge in endlessly, but people put forward higher and higher requirements for the functionality and comfort of buildings, which makes the challenges of architectural design more and more severe [2]. In this context, the utilization of deep learning in the field of building aided design has broad space and potential, especially to improve the degree of perfection of architectural design, functional visualization, construction progress and construction cost.

As the key link of construction engineering, architectural design plays an important function and influence on the key activities of construction engineering, especially the smoothness and enforceability of construction [3]. The utilization of deep learning in architecture assisted learning can expose the potential problems in the construction process in advance, and realize the mutual cooperation and cooperation from the aspects of material preparation, construction organization and construction. In the process of contemporary architectural design, architectural designers usually use a variety of computer-aided tools to optimize the design process, which can not only reduce the workload of designers, but also significantly improve their work efficiency [4]. However, the function of the existing computer-aided software is relatively simple, which can only simplify the drawing process of the drawings, but cannot intelligently assist the design scheme and design process of the
architectural designer, resulting in the fundamental improvement of the efficiency and quality of architectural design.

In addition, the continuous progress of deep learning tech has been applied in several fields as shown in Figure 1 below, and has achieved outstanding success. At present, there are few researches on the utilization of deep learning in the field of building aided design, but its utilization and development space and potential are high. With the help of deep learning to carry out model training, the function of the building is divided, and the image of the function division is automatically generated [5]. The internal structure of the generated building image is designed, and the reasonable building layout and configuration are finally designed. The trained model is fused organically, so that the architectural design image can be automatically output for any architectural contour input.

![Utilization fields of deep learning](image)

**Figure 1. Utilization fields of deep learning**

In short, with the progress of economy and the popularization of urbanization, the social demand for multi-functional buildings is still growing. If deep learning is involved in the architectural design process, it can optimize the architectural design scheme; realize the inevitable selection of multiple results, the intervention of user needs and evaluation, and the output of design drawings. It can be seen that the utilization of deep learning in the field of architectural design can play a huge function and effect, especially the realization and promotion of economic benefits [6]. Therefore, it is of great economic and engineering value to study the means and system of building aided design based on deep learning.

2. The concept and connotation of deep learning

2.1. The concept and principle of deep learning

As a learning means based on unsupervised feature learning and feature hierarchy, deep learning can achieve good feature expression, which plays a key function in the accuracy of the final algorithm. The main computation and testing time of recognition system is mainly concentrated in the feature extraction part. At present, the style of feature is generally designed manually, and the feature is extracted manually [7]. Traditional pattern recognition meanss have limited MKL performance on common features. In machine learning, obtaining good features is the key to successful recognition. At present, there are a large number of artificial design features, different research objects have different characteristics, and the features are diverse. In the process of building aided design, manual selection of features is time-consuming and laborious, which requires heuristic professional knowledge and largely depends on experience. The difficulty of deep neural network training can be overcome by layer by layer initialization, which can be realized by unsupervised learning.

2.2. Functions and utilization advantages of deep learning

Through the construction of multi hidden layer model and massive training data, it could learn more useful features, and ultimately improve the accuracy of classification or prediction. Depth model is the means of building aided design, and feature learning is the purpose [8,9]. Deep learning clearly highlights the significance of feature learning. By layer by layer feature convert, the feature express of prototypes in the original space is transformed into a new feature space, so that classification or prediction is easier. Compared with the means of constructing features by artificial regulations, using
big data to learn features can better describe the rich internal info of data. By learning a deep nonlinear network structure, the complex function approximation can be realized, and the distributed express of input data can be represented. The process of deep learning training is shown in Figure 2.

![Figure 2. Deep learning training process](image)

3. The utilization value of deep learning in building aided design

3.1. The feasibility of the utilization of deep learning in building aided design

With the continuous rise of construction engineering, a variety of multi-functional and complex buildings are emerging. Architectural design not only has its own uniqueness, but also has rich space functions [10]. The utilization of deep learning in building aided design requires the utilization of relevant algorithms and frameworks, especially the acquisition of building configuration resources. In the current knowledge sharing platform, there are a large number of resources to obtain architectural configuration resources, especially the plane drawings of architectural design. It could use the crawler algorithm to quickly obtain a variety of basic drawing databases with various functions. It can be seen that the utilization of deep learning in building aided design has high feasibility and operability.

3.2. Utilization of deep learning aided architecture design framework

The utilization of deep learning in architectural aided design can significantly shorten the time of architectural design, reduce the design cycle, and improve the design efficiency and design level. The compensation info of deep learning design distribution data is transmitted to the cloud server, and the scheduling client is created to send the originating design model to the client. The intermediate process of building aided design updates the design model based on iterative algorithm, and transfers the model to the server, and then optimizes the design model through the integration algorithm to obtain the target design model. The transmission of design model in the cloud server can effectively improve the accuracy of the machine learning model, and reduce the network transmission cost of building aided design. The design processes directly participate in the architectural design process, optimizes the actual resources, and can significantly reduce the work intensity of architectural designers. The main algorithm logic flow of automatic generation of building configuration diagram based on deep learning is shown in Figure 3 below.
3.3. Architecture aided design means based on deep learning

First of all, in the principle level of building aided design, it needs to be carried out according to the times; refinement, flexibility and scene, so as to ensure that the architectural design can not only meet the needs of different customers, but also has high adaptability and functionality. Secondly, in the basic functional space configuration level, according to the spatial attribute classification, it can be divided into internal space and public external space. In addition, at the level of the combination relationship of the basic space of the building, the basic space function modules should be effectively distributed according to the organization regulations, and classified according to the function configuration of different user types.

4. Architecture aided design system based on deep learning

4.1. Deep learning algorithm for building aided design

In the process of building aided design, after inputting random prototypes, the depth model will produce a distribution. Through the function with parameters to adjust the distribution of the generated image, the generated data points are closely matched with the real data points, and the parameters are changed through training iteration to make it better match the distribution. The derivative models of depth model include depth convolution, hierarchical generation, matching data image generation and non-matching data image generation. On the principle level of generation model and discriminant model, the generation model generation discriminator can't distinguish the true and false images, and the generation result of the generator can't make the discriminator difficult to distinguish the true and false images, which is an ideal result.

4.2. Meaness and strategies of architecture aided design based on deep learning

First of all, based on the basic functional space module classification design different functional modules, determine the building supporting facilities, building area, basic width, and basic depth and so on. Secondly, based on the classification of building space user types, the building space forms corresponding to different core user types are determined. For example, according to different user types such as social type, private type, storage type and minimalist type, the deep learning discrimination model of access design experience is determined. In addition, according to the knowledge evolution layer, the user's cognitive info of things is extracted from the prototype info obtained from the population evolution layer, and the evolution of the discriminant model is guided by the evolution guiding function, which reduces the number of future artificial evaluation. The architecture aided design based on deep learning tech can better meet the improvement of diversity, timeliness and economy.
5. Conclusion
In summary, with the help of deep learning to carry out model training, the function of the building is divided, and the image of the function division is automatically generated. The internal structure of the generated building image is designed, and the reasonable building layout and configuration are finally designed. This paper analyzes the functions and utilization advantages of deep learning by studying the concept and connotation of deep learning. Through the analysis of the utilization value of deep learning in building aided design, this paper studies the framework of deep learning in building aided design. Through the research of the architecture aided design system based on deep learning, the architecture aided design means and strategy based on deep learning are given.

Acknowledgments
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