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A DEEP LEARNING MODEL-BASED FEATURE EXTRACTION METHOD FOR ARCHITECTURAL SPACE AND COLOR CONNECTION IN INTERIOR DESIGN

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Abstract. In architectural interior design, color is one of the important design elements. Through the reasonable combination of various color elements, it can effectively improve the interior environment and create an atmosphere that meets the preferences and needs of users. And with the continuous development of social economy, the application of color in interior design is becoming more and more widespread. Using different colors in interior design to harmonize not only can relieve people's visual fatigue, but also can bring people a pleasant mood. Different colors have different meanings, therefore, the use of color in interior design should be more flexible and color matching should be more innovative. The warm and cold, near and far, expansion and contraction of color make the color space the most dynamic key element in design. The grasp of color and scale of architectural space and the flexible use of color will directly affect the quality of architectural space design. Color can strengthen the form of interior space or destroy its form. In order to accurately grasp the connection between architectural space and color in interior design, this paper proposes a deep learning model-based feature extraction method for the connection between architectural space and color in interior design. First, we construct a product color sentiment imagery dataset; then, we build a model for generating architectural interior space layout and color design schemes based on the product color sentiment imagery dataset and conditional deep convolutional generation adversarial network, and innovatively generate product color design schemes. This algorithm can better balance the chromaticity, saturation, and clarity of images. When determining the similarity of indoor space colors, depth features are superior to point-to-point pixel distance and aesthetic features of indoor space colors. Finally, the effectiveness and applicability of the proposed method are verified in relevant experiments.

Key words: Deep learning model, Interior Design, Architectural space, Color scheme

1. Introduction. Color is an important element of interior design, and its scientific use can not only enhance people's visual experience, but also improve the uniqueness and innovation of design. At the same time, different colors can bring different psychological and spiritual feelings to building users. In the current interior design industry, people-oriented design has become the first major principle, and the use of color has become more focused on the combination of culture, regional characteristics, personal preferences, functional needs and other aspects, in order to design a more humane interior environment [1-4]. In contemporary times, people spend more than half of their time indoors, and the quality of the indoor environment directly affects people's living conditions. The use of color is an important part of interior design, mainly divided into three parts, namely the main color of the interior space, accent color and background color, through the scientific use of these three parts of color, can play a role in optimizing the mood, stabilizing the user's emotions and reducing their psychological pressure.

And color should have an appropriate environmental state. For color, creating an appropriate color environment in harmony with the surrounding environment is its inevitable task, and to achieve this goal is bound to be constrained by the materials in the local environment. Therefore, the complementarity between materials, color and environment must be considered in an integrated manner [5-6].

The use of color in interior design can visually change the area and volume of the interior space, effectively improving the sense of constraint and oppression brought to the user by the lack of interior space and changing the poor size of the environment. For example, in a long and narrow interior environment, if warm colors are used as the main color of the ceiling and cool colors are used on both walls, it can visually improve the

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feeling of a long and narrow space and give the user a more comfortable psychological experience. In interior design, the use of color can often reflect the personality of the space user to a certain extent. In general, residents with cheerful, enthusiastic personality characteristics tend to choose warm tones as the main color of interior design, while more introverted, calm residents will choose cool tones for interior decoration; more straightforward personality will be more inclined to use light tones, with subtle, deep personality characteristics of people are more willing to choose dark and gray tones.

Color as an important factor affecting human psychology, in the use of interior design, the reasonable use of color is particularly important. If a variety of high-purity colors are used at the same time to form a strong contrast, it will give people a feeling of over-stimulation, which is also more likely to produce irritable psychology. If the color contrast is less or the use of color is too single, it will give people a feeling of coldness, easy to let users feel bored and empty [7]. Therefore, in the process of interior design, designers should select and match colors according to the character traits, occupational characteristics, gender, age, education level and other factors to meet the different needs of users visually and psychologically and should also select colors according to the purpose of each space to increase the rationality of the design.

As one of the important attributes of architectural space, color has a unique advantage in the expression of architectural space emotion and influences users' emotional preference and consumption decision to a large extent. Therefore, accurate grasp of users' emotional preferences and needs for architectural space color can significantly improve the success rate of architectural space color design, which is of great practical significance to improve the survival and competitiveness of enterprises [8-11].

In recent years, as an indispensable component of architectural works, color has become increasingly favored by people. Whether the combination of colors is suitable for architectural works, for the entire building, it can play an important role in icing on the cake; On the other hand, if color matching lacks certain artistic considerations and scientific rationality, it is very likely to cause the design style to be vulgar and not loved by professionals and the general public. Color is one of the visual form elements. For architectural forms, they often adhere to shape or light, and are particularly closely related to form. The colors in emotional expression often give a very vivid and intuitive overall visual impression, with strong regional and recognizable characteristics. At the same time, the generation of this visual impression is usually completed in an instant. Due to the "attractiveness" of colors, those that are eye-catching are more likely to attract people's visual attention, and have the power of "preemptive". Colors sometimes make everyday forms more eye-catching, transforming people's visual perception of shapes or greatly enhancing their language expression, playing a "finishing touch" role. However, colors are usually limited in terms of shape, and only when they are consistent with the language of the shape and cleverly combined with specific purposes can they achieve quite good practical effects. Color to a certain extent means life, and people's experience of color is often the most direct and common. If there were no color in this world, it would be unimaginable. Therefore, in addition to considering the physical characteristics of color itself, the matching of indoor colors must also take into account the social and cultural colors and emotional orientations of various ethnic groups, as well as the aesthetic psychology of each ethnic group. In addition, some folk customs and taboos closely related to folk culture also need to be fully mastered, which undoubtedly puts forward higher requirements for designers and requires continuous exploration and improvement of design

For example, under the theoretical framework of perceptual engineering, a neural network is used to build an architectural space color imagery evaluation model, and a genetic algorithm is used to optimize the model to generate an architectural space color design that meets the user's emotional imagery needs. Color is a medium that can infinitely evoke sensation, its inherent power to provoke significant and immediate psychological responses and is the symbolic language of the natural and man-made world. Color is gorgeous but at the same time it is silent, hiding a deep philosophical connotation under its incomparable bright veneer, which extends the use of architecture while significantly influencing the perception of architectural space and form. This paper proposes a deep learning model-based feature extraction method for the connection between architectural space and color, which can be used to realize the full integration of architectural space and color in interior design, and to ensure the unique connotation and aesthetic significance of color in a coordinated interaction with the interior environment space based on the reasonable matching of color itself aesthetic laws.

The color of traditional architectural spaces is mainly judged by human supervisors, which has significant errors and needs to be combined with intelligent computer technology for spatial color feature extraction. Therefore, this article is based on this motivation to improve the model and algorithm, conduct effective research on the model algorithm, and improve the extraction effect of the connection between architectural space and color features.

On the basis of summarizing and researching relevant work, this article proposes the research method, analyzes the acquisition of spatial color features, proposes a feature extraction implementation method based on evolutionary deep learning, and a model for generating architectural space color design schemes. Through experimental research, the effectiveness of this method is verified.

2. Related work.

2.1. Architectural space and color in interior design. The design and expression of architectural emotion relies on the most distinctive, concise, and representative design elements such as form, color, decoration and texture to form the result of comprehensive expression, and not just one element can be fully loaded and expressed clearly [12]. The architecture of the emotional space and color space are interdependent, mutually dependent, mutually constrained and mutually integrated; the structure of the emotional space cannot be separated from the color visual space orderly provisions; and the accurate coloring is based on the positioning of the architectural emotional information, is the factor, tool and means to create and express emotions, and the color itself is also emotional, different shades of color and it's in different environments.

Emotional space and color space exist together harmoniously in the visual language environment of architectural space, giving the best visual expression and appropriate and precise psychological potential for architectural space. Architecture conveys the emotion of architecture through its unique spatial structure relationship and artistic expression. This kind of specific architectural emotion is solidified and displayed by the structure of symbols with specific connotation of perceptibility, that is, the abstract emotional concept is transformed into perceptible symbols or visual vocabulary in the form of abstract symbols or figurative forms, and the transmission of emotion is completed by symbolic vocabulary [13-15]. The shape of Shanghai Jinmao Tower consciously draws on the changing rhythm of Chinese ancient pagodas to give people an association with the positioning of Chinese ancient pagodas. The sharply accelerated rhythm of the intensified modeling perspective extends layer by layer, increasing the tower's inherent sense of height, high and majestic, straight, and majestic.

The silver-colored tower is integrated with the sky background, while the red granite podium closely relates to the earth and sets off the silver-colored tower. The design eschews the imitation of figurative forms and the mechanical and rigid repetition of tradition, instead expressing the concept of traditional Chinese tower structure and tower culture in a bright, eye-catching, and condensed abstract form. The elevated overhead structural vocabulary not only conforms to the construction logic of the building and meets the internal space requirements, but also naturally serves as a visual element of the shape. The traditional Chinese architectural culture is transformed into a modern design vocabulary, which is preserved in the specific structure, thus showing the Chinese architectural culture and the spirit of extraordinary grandeur.

The shape and layout of architectural space cannot be separated from the decoration of colors. The reason why people can see objects is because they absorb colors of different frequencies, and then the unabsorbed color frequencies are reflected, allowing people to see the colors of the objects. In different regions, seasons, and climates, the layout of light sources in building spaces is also particular. The same light source, due to differences in atmospheric molecules in different environments, has different light intensity, and the colors in building spaces also show significant differences. Therefore, the layout of colors in building spaces cannot be separated from the reasonable design of light sources. Similarly, when designing architectural space colors, attention should also be paid to color contrast, color ratio, and coordination of various colors. The use of color contrast in architectural space can make the visual image of the building unified, with changes that fully reflect the overall image. The comparison of colors should pay attention to the moderation of subjectivity and subordination. Excessive contrast can cause excessive stimulation or dominance, while weak contrast appears meaningless. The comparison of colors in architectural space should also pay attention to the master-slave relationship. If the space is entirely monochromatic, it will appear dull. Harmonious color comparison includes color quantity comparison, color brightness comparison, and cold and warm color tone comparison. The color layout of architectural space must also consider the arrangement of color quantity in visual perception, which refers to the volume sense formed by the area occupied by colors and the purity of colors. In architectural space, within a specific range of human visual horizontal lines, color blocks are relatively rich, so that the space in the line of sight does not appear empty and boring; Floors and ceilings, which are located outside the visual horizontal line of sight, generally use large color blocks to distinguish the space within a specific range of visual horizontal lines, avoiding visual confusion. The layout of architectural space colors also appears more layered. In addition to using high-purity colors to attract attention in small areas of architectural space, colors with slightly lower brightness and purity are generally used in the overall architectural space, which is not easy to cause visual fatigue. In a high-purity color space for a long time, the human visual system, in order to balance the senses, automatically selects high-purity color contrast colors to form in the human visual nervous system, causing confusion in the sense of color in the space. The coordination of colors must also follow the aesthetic principles. The layout of colors in the space should pay attention to rhythm and rhythm, symmetry and balance, master-slave and key points, and appropriate proportions. Generally, there should not be too many color combinations in the building space. Three types are sufficient, and appropriate changes should be added to the overall design; But it also depends on the specific situation. In monotonous and simple building facades, color combinations can be appropriately enriched to make the facades more lively and vivid.

Color is an abstract symbol of representation. Color abstraction in a certain sense is a composite of abstract and figurative, sensual, and rational, universal and special, individuality and commonality. Representation and representation sometimes exist at the same time, color representational conformation and color emotional effect, and human inner emotions and other subjective forms of experience and association, under certain conditions, and cultural phenomena as the basis, which makes color has a certain system value. The subjective characteristics of color as the content of architectural science should also be taken seriously. Another major role of color in interior design is the regulation of interior light. Scientific studies have shown that the reflectivity of light varies from color to color, with the highest reflectivity being white, which can reach over 70% and up to 90%, and the lowest reflectivity being black, which is below 10%. Cool colors will have a relatively high reflectivity of light, and warm colors will have a relatively low reflectivity. Therefore, in the process of interior design, designers need to make scientific selection of colors according to the function of the room and lighting needs, the actual lighting situation, to ensure the scientific nature of color use.

2.2. Artificial Intelligence and Interior Design. The similarity between interior design and artificial intelligence is that from a disciplinary point of view, interior design is very comprehensive and involves the intersection and integration of several disciplines. For example, psychology and art and design can provide a wide scope for interior design. Interior design is a sub-discipline of architecture, which has developed along with the construction industry. The main work of interior design is to fully combine the geographical location and environmental conditions of the building, the functional nature of the building and some relevant requirements and standards, to design and create the interior space, to achieve a reasonable interior space and can fully meet the material needs of the interior occupants of the space and spiritual aesthetic needs [16-18].

Combined with digital image processing technology, and its application to the layout of architectural interior space, which is of great significance in the planning and design of architectural interior space. As the structure of building interior space becomes more and more complex, the requirements of building interior space for interior structure space layout are getting higher and higher. For this reason, researchers in this field have studied building interior space layout and achieved certain results. The method of architectural interior space layout feature extraction, i.e., the method of 3D visual feature information reconstruction, establishes a visual detection model of architectural interior space layout, and uses it to build a visual feature extraction system of architectural interior space layout to improve the ability of spatial feature extraction. The method extracts the features of spatial layout by 3D vision, and the extracted features help to optimize the spatial layout, but less consideration is given to specific spatial layout parameters, and certain extraction bias exists.

Based on the scale decomposition results of the visual image of building interior spatial layout, combined with the image recognition method and based on the regular feature distribution of the image, the visual analysis method of building interior spatial layout is obtained, to realize the visual feature extraction of building interior spatial layout. The method solves the problems of large ambiguity of key feature points and poor intelligent planning and design capability in visual feature extraction of building interior space layout. From coarse to fine spatial layout estimation method for indoor scenes, the method first divides the indoor space into different stages by obtaining local linear thresholds for indoor space; then, the full convolutional neural network method is invoked to extract spatial boundary feature values; finally, the feature values are fused to realize the extraction of features. This method can effectively extract the boundary features of the interior layout, but the extraction process is simple and incomplete.

Facing the problem of multidimensional emotional demand in architectural space color design, we use methods such as gray theory to establish a multidimensional emotional architectural space color design model, and use non-dominated sorting multi-objective optimization algorithm for design optimization, and finally build an architectural space color intelligent design system based on this method, which can quickly generate an architectural space color design scheme that meets the user's multidimensional emotional imagery demand. Based on YOLO algorithm and DFL-CNN algorithm, the intelligent evaluation model is constructed to realize the automatic annotation of architectural space category and modeling emotional semantics [19-20]. In the face of the current development of architectural space design trends, we use multi-labeling technology and generative adversarial networks to generate innovative designs for architectural space appearance, shortening the design cycle while mastering the direction of architectural space modeling development.

3. Methods.

3.1. Acquisition of color characteristics of architectural interior space. Based on the acquisition and pre-processing of the building interior spatial visual image pixel points, to realize the building interior spatial color feature extraction, it is necessary to obtain the spatial color feature quantity for its extraction. Through the edge parameter distribution detection method, the degradation feature evolution analysis model of the building interior spatial color visual image is constructed, and the sequence of building interior spatial color parameter distribution is obtained as [21]:

$$k(p) = k(p\Delta t), p \geq 0 \tag{3.1}$$

where Δt is the time interval of visual information sampling; p represents the set of pixels of color visual feature distribution in the building interior space. The color visual feature component of the building interior space as:

$$G^r = k(p\Delta t) + (fa^w + fa^m + fa^n)^2 \tag{3.2}$$

The higher order moments within the fuzzy feature distribution region of the color visual image of the building interior space are [22]:

$$\begin{gathered} cHc = \frac{1-k(p\Delta t)}{\cos^{-1}A + \sin^{-1}B} \\ A = \frac{k(p)}{2\pi}\sin\left(k(p\Delta t)^2\right) + (fa^w + fa^m + fa^n)^2 \\ B = \frac{k(p)}{2\pi}\cos\left(k(p\Delta t)^2\right) + (fa^w + fa^m + fa^n)^2 \end{gathered} \tag{3.3}$$

A high-resolution multidimensional spatial chunking combination method is used to obtain the set of pixels for the visual distribution of color in the building interior space as follows.

$$R_r(f) = \frac{G^r + v^r}{k(p\Delta t)}, v^r = 1, 2, 3, \cdots, n. \tag{3.4}$$

The first order and second-order parametric analysis models of the color visual images of the building interior space are established, and the rule function of the color visual fusion of the building interior space is determined using the hierarchical color characteristics of the building reflected by the feature parameters as [23]:

$$\mathrm{ret}_c = R_r(b) - \cos^{-1}A \tag{3.5}$$

In the feature map of the k-th layer, the visual information component of the building interior space color is extracted, to obtain the building interior space color feature quantity.

3.2. Feature extraction implementation based on evolutionary deep learning. In the process of building interior space color feature extraction, the determined feature parameters are disturbed by a variety of factors, resulting in poor convergence of feature extraction. Therefore, this paper adopts evolutionary deep learning algorithm to control the convergence of parameters, to ensure the extraction accuracy of interior spatial color features. Evolutionary deep learning is an artificial intelligence algorithm, which is widely used in several fields. It is an intelligent algorithm that integrates natural algorithms and evolutionary mechanisms and can find the optimal solution quickly, and the optimal solution obtained can solve the difficulties encountered in the research process. Therefore, this paper realizes the extraction of color features of architectural interior space with the help of evolutionary deep learning algorithm. The convergence threshold of evolutionary deep learning is set to satisfy [24]:

$$\text{tui}\ \ (h_1{+}h_2)+y(\overrightarrow{x})=0,y{\neq}0 \tag{3.6}$$

where $(\overrightarrow{x})$ is the grayscale pixel information of the visual component of the building interior space color? The information fusion detection with high resolution by linear filtering is combined with pixel reorganization in the edge region to achieve the segmentation of the color visual feature extraction of the building interior space. The segmentation equation is:

$$fg^i{=}qr{+}\frac{xcv}{vrt} \tag{3.7}$$

where qr is the resolution of color visual feature extraction of building interior space; xcv is the segmentation time interval parameter; vrt is the joint information entropy of feature extraction. The fitting coefficients of the resolved multidimensional spatial chunked images for the color visual feature extraction of the building interior space are obtained by the two-dimensional parameter fitting method. The multilevel chunking of architectural interior spatial color visual feature extraction within a single pixel value distribution region yields the interior spatial color multilevel feature information as [25]:

$$K^{im}{=}i(nc{+}nb){+}j(nm{-}nr) \tag{3.8}$$

According to the multi-scale machine learning results, the building interior space color visual image is reconstructed, and the quaternion is used to represent the building interior space color visual feature extraction fuzziness, and y^e is the entity set of building interior space color visual feature extraction. Combined with the result of constraint parameter resolution of the recovered image, the background value fusion of the color visual image of the building interior space is realized, and the output value as:

$$CB^{re}{=}\frac{K^{im}\left(y^e{+}y^r\right)}{fg^i}{+}qr{+}\frac{xcv}{vrt} \tag{3.9}$$

The nearest neighbor domain function xy group is selected to establish the fuzzy degree distribution set for color visual feature detection in building interior space, and from the perspective of intermediate layer feature reuse, the building interior space color visual feature boundary feature quantity is obtained as:

$$\begin{gathered} SDR{=}\tfrac{xy}{CB^{re}}, \\ T_i\left(g_i\right){=}\tfrac{2\pi\left(go^i+gu^i\right)}{SDR} \end{gathered} \tag{3.10}$$

where go^i and gu^i are the resolution and information entropy of color visual feature extraction for architectural interior space, respectively. The evolutionary deep learning algorithm is used to improve the convergence level of color feature extraction in architectural interior space, and the implementation process is shown in Figure 3.1.

3.3. C-DCGAN-based color design scheme generation model for architectural space. The paper uses C-DCGAN to construct a product color scheme generation model, and the design flow of the model is shown in Figure 3.2.

According to the principle of mutual adversarial game between generator and discriminator of generative adversarial network, when they reach the equilibrium, the generator-generated samples should be like the real

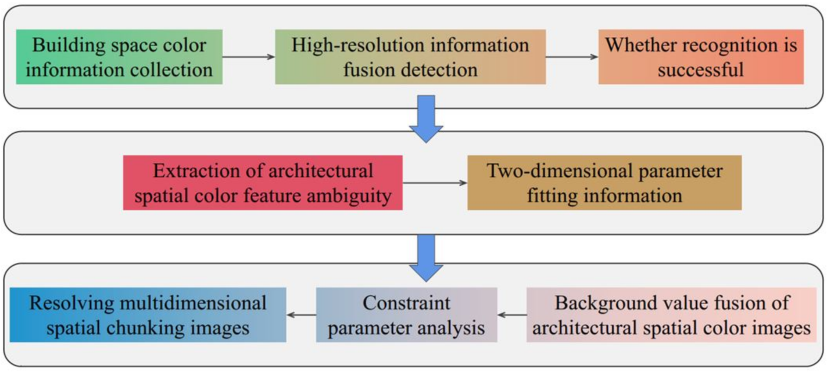

Fig. 3.1: Feature extraction implementation based on evolutionary deep learning

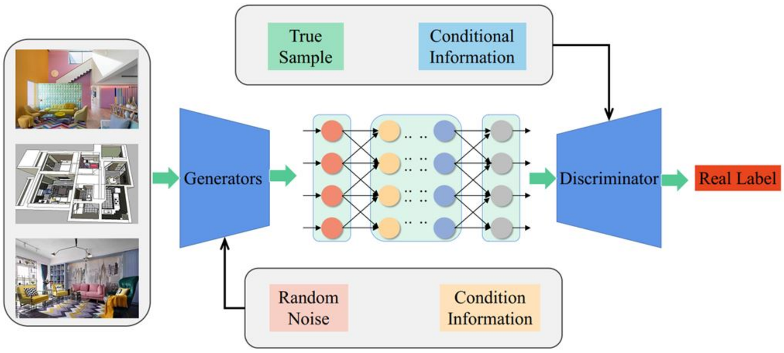

Fig. 3.2: Model Structure

samples, while the discriminator D cannot distinguish the real samples from the generator-generated samples. C-DCGAN training and optimization. The loss loss function of the system can be expressed as:

$$\min_{G} V(G) = E_{z\sim p(z)}[\log D(G(z|y))] \tag{3.11}$$

The discriminator in this article needs to use algorithms to judge the samples, mainly to determine the similarity of the sample data, compare the generated samples with the real samples, and use this as a basis to test the effectiveness of the generated samples. Its loss function can be expressed as:

$$\max_{D} V(D) = E_{x\sim p_{\text{data}(x)}}[\log D(x|y)] + E_{z\sim p(z)}[\log(1 - D(G(z|y)))] \tag{3.12}$$

For the entire system network, its loss function can be expressed as:

$$\min_{G} \max_{D} V(D,G) = E_{x\sim p_{\text{data }(x)}}[\log D(x|y)] + E_{z\sim p(z)}[\log(1 - D(G(z|y)))] \tag{3.13}$$

In the above equation, x represents the collected real samples, and z represents the noise input into the system. To improve the training effect of the model in this paper, it is necessary to optimize the parameters of the model.

4. Experiments and results.

Table 4.1: Training sample details

Test serial number	Pixel intensity/dB	Visual fusion difference	Feature recognition/%
1	19.682	5.552	75.500
2	20.761	5.856	68.833
3	19.428	5.480	69.666
4	21.142	5.964	71.166
5	18.920	5.337	72.166
6	19.174	5.409	68.333
7	18.222	5.140	74.000
8	18.730	5.283	72.000
9	19.365	5.462	64.166
10	18.158	5.122	69.666
11	17.650	4.979	71.500
12	17.269	4.871	69.666
13	17.841	5.032	62.666
14	16.507	4.656	60.833
15	20.571	5.803	74.000
16	20.381	5.749	67.333
17	19.809	5.588	67.500
18	21.142	5.964	70.000

4.1. Experiment setup. Python 3.7 programming language and Tensorflow 1.15 deep learning framework were used to build the network. All experiments were completed on a single NVIDIA GeForce GTX 1080Ti graphics card for training. The PPO network was trained using the Actor-Critic shared network structure, in which the first four fully connected layers had dimensions of 4096, 4096, 2048, 1024, and each layer was connected to a linear rectification function, and the final outputs the post-connected SoftMax layer probability value with dimension 12, and Critic outputs the state value with dimension 1. In order to prevent the gradient explosion or gradient disappearance phenomenon during the training process, the image needs to be pre-processed before input to the network. The image size is set to (224, 224) and the pixel value range is set to (0, 1). Except for the reward model, the intelligent body network needs to be trained from scratch. The training uses multi-threaded operation, taking 6 threads for experience acquisition respectively, each thread samples 4 groups of photos for sampling modification at the same time, the maximum number of steps used in each episode round is 50, when more than 50 steps or meet the termination condition $V(s) < 0$, the environment is reset and the smart body re-trains the sampling operation, a total of 300000 rounds of episodes are trained. The optimizer is selected as Adam optimizer, the minimum batch of network sampling is 64, the initial learning rate is set to 1×10-4, the decay is 0.97 times every 3000 steps, and the minimum learning rate is set to 1×10-8. The clipping clip for the estimated dominance function is 0.2, and the discount factor is set to 0.96. The experimental data were obtained from the internal data of a domestic interior design research institute in China, With the approval of the official website, data collection is carried out on the network through crawlers, and the data is classified and stored in a database, containing 20 data samples, and the data details are shown in Table 4.1.

4.2. Experimental results. To verify the effectiveness of this method, a comparison test was conducted on the data set. To conduct a comprehensive experiment, some deep learning baseline methods are added for quantitative comparison.

Figure 4.1 shows the comparison of L2 average errors on the dataset, Figure 4.2 shows the comparison of SSIM on the dataset, and Figure 4.3 shows the comparison of PSNR on the dataset. From these figures, it can be seen that the model proposed in this paper has good performance in spatial color feature extraction.

The Figure 4.1, Figure 4.2 and Figure 4.3 compare the present method with all leading pairwise training methods, bolded numbers represent the best results, and NA indicates test data where the relevant metrics are not given in the reference paper. Since not all experiments in the article were performed under the same conditions. As shown in Figure 3, Figure 4 and Figure 5, the mean L2 error evaluation criterion indoor

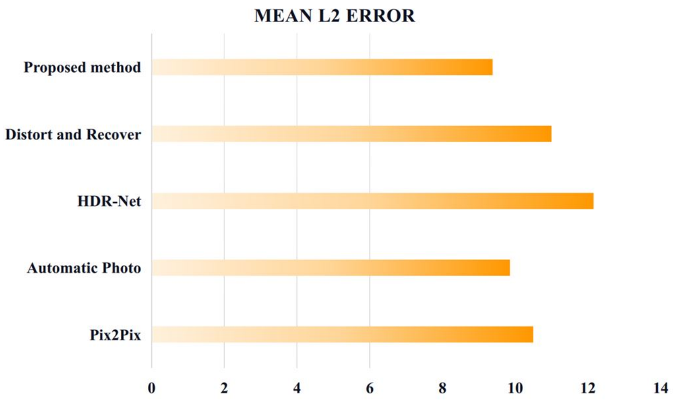

Fig. 4.1: Comparison of mean L2 error on the dataset

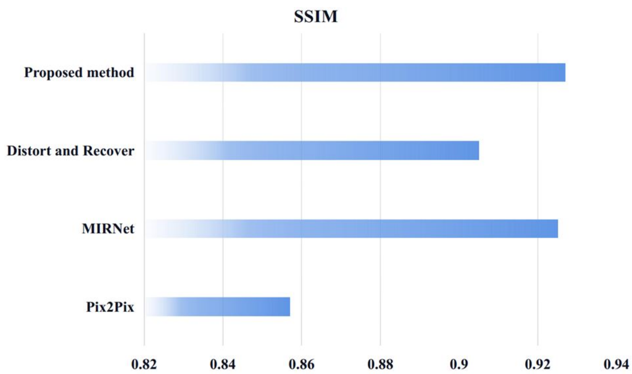

Fig. 4.2: Comparison of SSIM on the dataset

spatial color and the SSIM evaluation criterion on RGB indoor spatial color both outperform other algorithms, indicating that this algorithm can better balance the chromaticity, saturation, and sharpness of the image. Although the metric PSNR does not reach the highest in RGB indoor spatial color, it is still in an acceptable range and the image quality generally meets the requirements of image color enhancement.

To verify the effect of depth perception features and aesthetic models on the indoor spatial color enhancement method, ablation experiments were conducted Indoor spatial color experiments were conducted using a combination of different feature rewards to retain the enhancement effect of Rdist, Rdist+Rp, Rdist+Raes, Rdist+Rp+Raes on the dataset Indoor spatial color ablation experiments are shown in Table 4.2 shown Indoor spatial color from the experiments, it can be concluded that the depth feature is better than the point-to-point pixel distance and the aesthetic feature indoor spatial color in determining the similarity of indoor spatial color. At the same time, Rdist+Rp+Raes is better than other methods in the evaluation index of structural similarity, which indicates that the depth feature as well as the aesthetic feature help the model to judge the quality of indoor spatial color, and also indicates that the integration of depth perception features and aesthetic model can enhance the color enhancement effect of indoor space color and improve the visual quality of indoor space color indoor space color.

To further validate the effectiveness of the model proposed in this paper, the ability of the model to extract architectural spatial colors was compared with references [1], [2], [6], and [10]. Expert evaluation methods were used to evaluate the effectiveness, and the experimental results are shown in Table 4.3. The RoCROC curve for extracting architectural spatial features is shown in Figure 4.4.

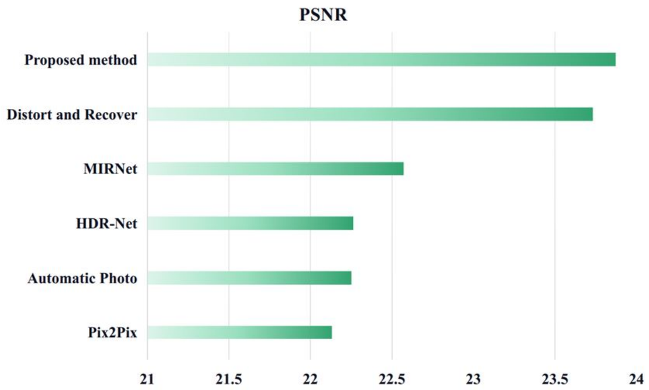

Fig. 4.3: Comparison of PSNR on the dataset

Table 4.2: Comparison of SSIM indicators of different color enhancement methods

Method	SSIM
Rdist	0.899
Rdist+Rp	0.922
Rdist+Raes	0.917
Rdist+Rp+Raes	0.925

Table 4.3: Comparison Results of Building Space Feature Extraction Capability

Method	Evaluation of feature extraction capability
The method of this article	93.52
Method of Reference [1]	82.32
Method of Reference [2]	79.64
Method of Reference [3]	68.35
Method of Reference [10]	81.65

From Table 4.3 and figure 4.4, it can be seen that the proposed deep learning model-based feature extraction method for building space and color connections in interior design has better color extraction capabilities compared to existing research.

5. Conclusion. The application of color in interior environmental art design needs to follow the principle of color moderation and the aesthetic law of color matching, so that the colors can be harmoniously matched to create a harmonious and beautiful interior space environment. In the specific application, we should take the theme of indoor environment space as the core, analyze the visual psychology, grasp the symbolic meaning of color, and pay attention to the spatial expression on this basis to ensure that the color conveys aesthetic mood and enhances cultural connotation in the indoor environment.

In order to improve the color quality of interior space, this paper proposes an evolutionary deep learning-based method for extracting color features of architectural interior space and determines its edge sequence based on the extracted interior space color parameters and uses an evolutionary deep learning algorithm to control the convergence of the feature parameters to complete the extraction of color features of architectural interior space. The results show that the method in this paper can extract features effectively and with high accuracy. In the future, we plan to develop a method for extracting the characteristics of architectural space and color connections in interior design based on big data architecture.

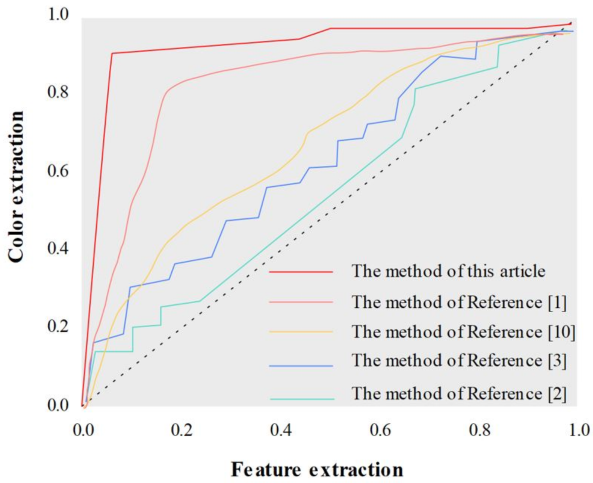

Fig. 4.4: RoCROC curve for extracting architectural spatial features

The model in this article is trained through a database, but the training data is limited. Therefore, more data is needed for training in the future, and the model in this article needs to be extended to color feature recognition outside of building spaces, which is also a future research direction.

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