

A Study on the Application of Housing Elements in Urban Cultural Heritage in Cultural Creation and Animation Scene Designs

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ABSTRACT

The inheritance and protection of urban cultural heritage faces the dilemma of narrow coverage and lack of change in form, and to solve this dilemma, we need to find a breakthrough in cultural creation and animation design, and carry out creative activities and popularisation among all people. The article proposes a feature extraction model that integrates multi-scale features and housing element information mining, and applies it to the feature extraction of housing elements in urban cultural heritage. A hybrid attention module is embedded in the ResNet-18 backbone network to enhance housing element features and suppress redundant information, and a CEB module and learnable parameters are combined to filter out the background information of the low-level features, so as to obtain finer architectural housing element features. The extracted housing elements are used as the basis for the design of creative products and animation scenes, and the feasibility of the programme is investigated through questionnaires. The overall evaluation mean value of the research respondents on the design of cultural and creative products for the housing was 7.64 points, and more than 95% of the evaluation respondents indicated that the housing elements were more suitable for the animation scene design. Relying on modern technology to extract housing elements from urban cultural heritage and realising the innovative application of cultural heritage in the form of cultural creation and animation provides a new path for the revitalisation and inheritance of urban cultural heritage.

Keywords: urban cultural heritage, housing elements, multi-scale features, mixed attention, animation scene design

1. Introduction

As socialism with Chinese characteristics enters a new era, China's economy has entered a new stage of transformation from high-speed growth to high-quality development. The urban economy has increasingly become the protagonist of the global economy, the development of cities has shifted from

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the "quantity" of abundance and breadth to the improvement of "quality", charm and vitality have become the demands and pursuits of contemporary people to meet people's aspirations for a better life, and culture has become a class of assets and resources in the process of urban transformation and development [1-3].

From the trend of cultural heritage from focusing on preservation to diversified revitalisation, culture is a powerful factor in promoting prosperity, security and sustainable development, and occupies an important position in urban development [4-5]. Taking the leading role of historical and cultural resources is not only a serious examination of the past, but also a good prospect for the future, which is the direction that modern urban renewal should follow [6-9]. It is not only necessary to make the preservation of historical monuments an individual feature of the society itself, but it is also necessary to successfully turn the monuments into an important factor for economic and cultural development, so that the participation of citizens in the practice of consumption can be evolved into a new impetus for the further upgrading and transformation of the city [10-13]. The housing elements of the city's cultural heritage are integrated into the design of cultural and creative products and animated scenes, enhancing the cultural value and attractiveness of the commodities through the integration of cultural elements, and highlighting the cultural connotation of its commercial products [14-16]. By fully excavating and displaying the city's historical and cultural resources, and with the support of rich cultural resources and unique natural landscapes, it creates commercial products with local characteristics and realises the innovative transformation and value enhancement of cultural resources [17-20].

This paper realises the feature extraction of housing elements in urban cultural heritage through the multi-scale feature and housing element information mining module fused with hybrid attention mechanism, and applies it to the design of cultural creativity and animation scenes. The design of cultural and creative products based on the housing elements of urban cultural heritage and the recreation of animation scenes by combining digital technology can give urban cultural heritage a new vitality. This paper analyses the classification, value and application trend of housing elements in urban cultural heritage, and discusses the design steps and expression methods of urban cultural heritage cultural and creative products. A multi-scale feature fusion module and a housing element information mining module are combined to construct a feature extraction model of housing elements, and its simulation verification is carried out. Based on the housing elements, a mobile phone case cultural and creative product example was designed, and a questionnaire was designed to analyse the design effect of the cultural and creative product. An animation scene design scheme was established by selecting the housing style of Ming and Qing powered buildings, which provides a new research direction for revitalising urban cultural heritage and enhancing the originality of Chinese animation industry.

2. Cultural and creative design for housing elements of urban cultural heritage

As a cultural heritage spanning thousands of years, urban cultural heritage buildings carry rich historical, cultural and artistic values, providing a unique perspective and rich materials for cultural and creative product design. From the carved beams and paintings of ancient architecture to the simple lines of modern architecture, the artistic elements of architectural housing have always been an important source of inspiration for designers. However, how to innovatively integrate architectural housing art elements into modern cultural and creative product design on the basis of respecting and inheriting traditions is a key issue that designers need to think about and solve.

2.1. Housing elements in the urban cultural heritage

2.1.1. Heritage value of urban heritage. As representative symbols of traditional culture, urban cultural heritage buildings are not only the material embodiment of diverse cultures, but also an

important carrier for recording the social development of the region, people's lifestyles and spiritual civilisation. However, with the advent of the industrial age, large-scale urban construction has resulted in many traditional architectural heritage buildings with cultural value being forcibly demolished or not repaired in a protective manner [21].

Therefore, for these cultural heritages to be noticed and to develop in the long term, they cannot remain in the dimension of "heritage", but need to be effectively "revitalized" and integrated into contemporary life, so that they can become cultural heritages that can be used, appreciated, experienced, understood and resonated with, and that are alive and vibrant. It is a cultural heritage that is full of vitality. As a popular product combining business and culture, cultural and creative products are not only an important part of the cultural tourism industry, but also an important medium for cultural dissemination. By studying the trend of cultural and creative product design and understanding the cultural needs of consumers, we can attract and guide more cultural consumers to understand the traditional urban cultural heritage while continuously developing innovative cultural and creative products. Therefore, the research and development of cultural and creative products need to integrate urban cultural heritage into them, and the research and development of cultural and creative products, brand design, manufacturing, marketing and sales around urban cultural heritage resources, so as to promote the renewal and development of urban cultural heritage.

2.1.2. Classification and application of housing elements. Traditional Chinese urban architectural elements contain almost all decorative disciplines, concentrating on the decorative content of traditional Chinese culture and ancient architectural design concepts. In traditional Chinese wooden buildings, the external contours follow the principles of symmetry and stability, and through the fusion of curves such as roofs, corner beams, and flying eaves, they form the independent aesthetic principle of Chinese urban architecture that is stable without losing its rhythm. The classification of architectural housing elements in urban cultural heritage is shown in Figure 1, which mainly includes various categories such as roofs, eaves, walls, columns, doors and windows.

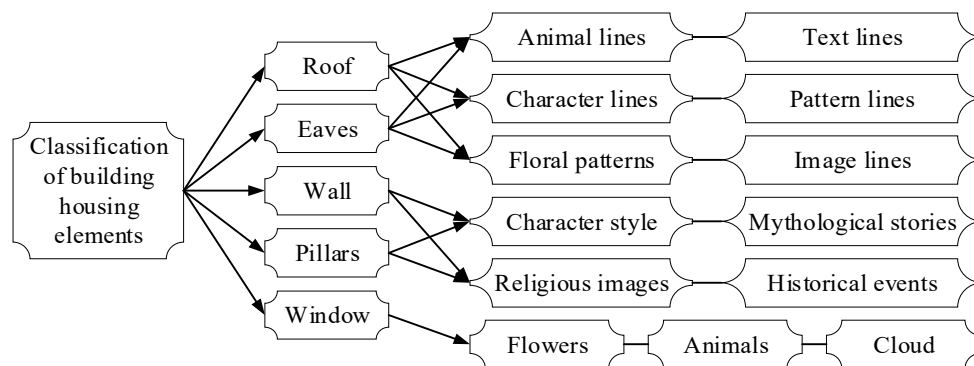


Fig. 1. Classification of building housing elements

The roof forms of the architectural housing elements of China's urban cultural heritage are not only rich and varied, but also distinctive, with each form reflecting a specific architectural function and aesthetic value. The application on the eaves is mainly reflected in the tiles and arches, and the tiles can be subdivided into three major categories: character patterns, pattern patterns, and image patterns. The walls of temples and palaces often have large murals depicting human figures, mythological stories, religious images or historical events, which visually reflect the humanistic characteristics of different periods. The decorations on the walls of ancestral halls and tombs were mainly reflected on the portrait stones, which contained mainly the daily life of human beings, historical changes, myths and legends, and so on. The openwork decorations on the window panes, such as flowers, plants, animals, auspicious clouds, etc., with their symmetrical and balanced layout, reflect the concept of harmony in traditional aesthetics.

2.2. Design Methods for Urban Heritage Cultural and Creative Products

2.2.1. Steps in Designing Cultural and Creative Products. Urban cultural heritage has a very high cultural and creative design value and development potential, for the different types of housing elements in the urban cultural heritage, in the research and development process, it is necessary to first select the appropriate product type and design direction to ensure the reasonableness of the subsequent progress. The general method of cultural and creative product design is to re-create the extracted cultural elements by combining various influencing factors [22]. The specific steps are as follows:

- 1) Cultural elements extraction. Mining the cultural connotation, from the external modelling gradually penetrate into its internal characteristics.
- 2) Creative design. Using contemporary technology to modernise traditional elements. The designer needs to carry out a conceptual assessment to judge the feasibility of the programme from the aspects of technology, cost and customer needs.
- 3) Programme implementation. The design product is divided into two forms: real and virtual products.
- 4) Product evaluation. Evaluate the designed product in terms of consumer demand, product utility and cultural connotation, so as to further transform the product to extend its life cycle and make it more competitive in the market.

2.2.2. Methods of presentation of housing elements. Relying on the diversity of housing element types in urban cultural buildings, the impact of different performance methods on enhancing the performance of housing elements in urban cultural buildings needs to be considered when carrying out the in-depth integration of housing elements and cultural and creative design. The classification of specific application performance is shown in Figure 2, including modelling transformation method, style application method and emotional design method. Through different methods to express the housing elements in urban cultural architecture, it helps to broaden the communication channels of urban cultural architecture.

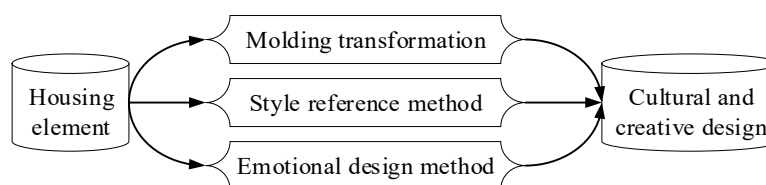


Fig. 2. Method of performance of housing elements

- 1) The modelling conversion method starts from human history, architectural style and period value, and conducts a comprehensive and in-depth combing of the extracted housing elements, and then refines the elements with the unique characteristics of urban culture and architecture, and uses them as the basis for designing cultural and creative products rich in regional characteristics.
- 2) The style citation method is an effective way to deeply explore the connotation of housing elements. Focusing on the style of housing, it explores the cultural heritage behind it, and combines style, culture and function skilfully.
- 3) Emotional design method is a design concept that can touch people's hearts. Emotional design is often easier to arouse people's empathy, so that people have an emotional connection when using the product.

3. Feature extraction and application of urban heritage housing elements

In China's traditional urban cultural heritage of ancient architecture, using the gatehouse and pagoda as the carrier, the traditional architectural housing elements present the regional and historical cultural connotations behind them. The use of modern design methods, combined with traditional Chinese culture and local characteristics to achieve the fusion of old and new, and the continuation of the vitality of the ancient architectural housing elements in the form of emerging cultural and creative products have become an important means to achieve effective protection of urban cultural heritage and promote regional economic development.

3.1. *Housing Element Feature Extraction Model Construction*

3.1.1. **Feature Extraction Model Framework.** The integration of housing elements and cultural and creative design in urban cultural architecture essentially needs to realise the effective extraction of housing elements, and the feature extraction of architectural housing elements is essentially a semantic segmentation task. The semantic segmentation network is generally a coding-decoding structure, and the coding part is the feature extraction network, and the feature extraction network selected in this paper is ResNet-28, and the residual structure of ResNet effectively alleviates the problem of gradient disappearance.

The housing element feature extraction model designed in this paper is shown in Fig. 3, and between encoding and decoding, a multi-scale feature extraction module with improved channel attention combined with improved spatial attention module is embedded. In the decoding part, this paper uses SE module and SPM module in parallel to obtain global context information from channel dimension and spatial dimension respectively [23]. At the same time, the feature extraction of architectural and housing elements in urban cultural heritage is achieved by connecting the underlying features extracted from the ResNet-18 network with the multiscale feature extraction structure and the housing element information mining module.

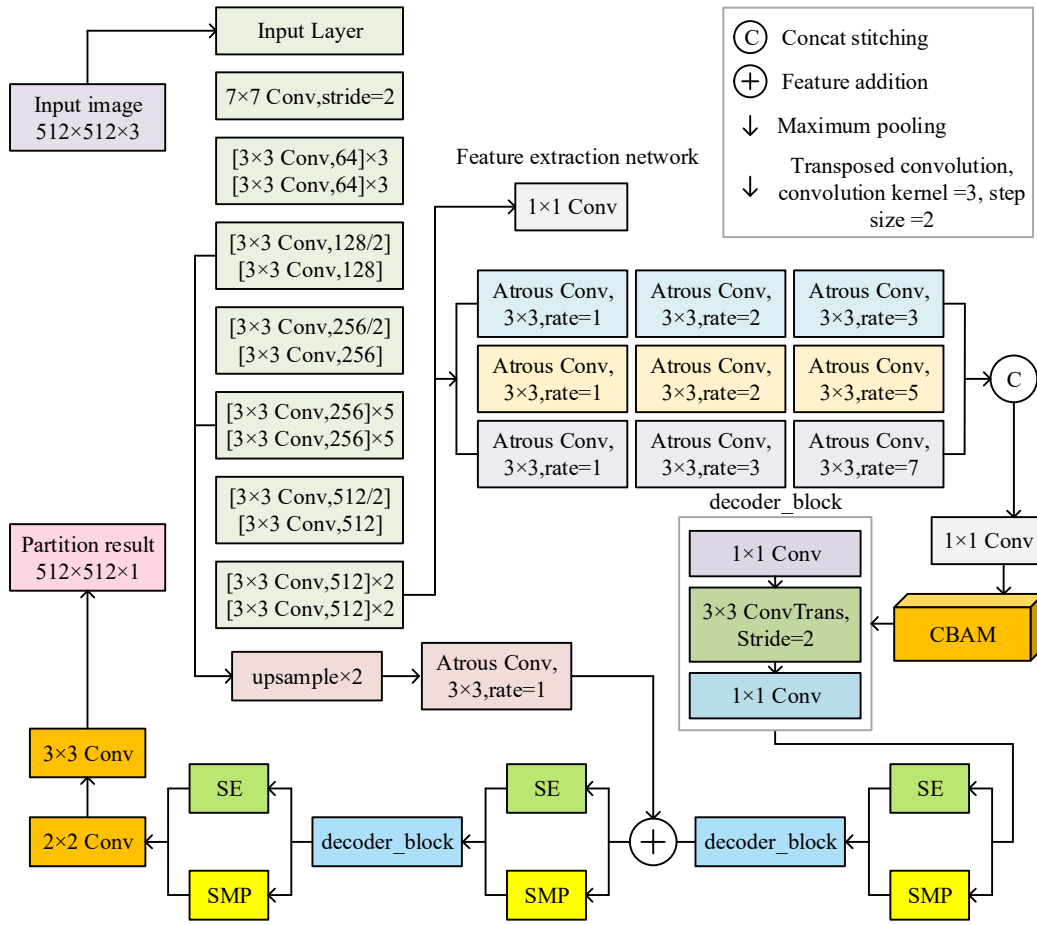


Fig. 3. Feature extraction model framework

In the decoding process, the resolution of the image is reconstructed using a transposed convolutional layer, which reduces the information redundancy and obtains a better feature mapping capability, and the transposed convolution better recovers the image resolution by back-propagating the learnable convolutional kernel. Meanwhile, a BN layer is used to constrain the data distribution to avoid gradient explosion and gradient vanishing, to speed up the network convergence, and ReLU is used as the activation function to speed up the training speed and increase the network sparsity.

3.1.2. Multi-scale feature fusion module:

1) Improvement of channel attention module. Each channel of the feature map can be regarded as a feature detector, and if the channels are given weights so that the important channels get more attention and the unimportant channels get less attention, then the feature extraction ability of the network can be improved and the limited arithmetic power can be utilised on the more important channels. In this regard, this paper designs an improved channel attention module in the housing element feature extraction recognition model, which is used to obtain a better channel attention graph [24].

Let the input feature map be F , the output channel attention map M_{CA} under this module can be expressed as:

$$M_{CA} = \sigma(f_1^{1 \times 1}(f_0^{3 \times 3} * \text{Avgpool}(F))) + f_1^{1 \times 1}(f_0^{3 \times 3} * \text{Maxpool}(F)) \quad (1)$$

where f denotes the convolution operation, σ denotes the Sigmoid activation function, the superscript of f represents the size of the convolution kernel, and the subscript represents the order of the convolution operation.

2) Improvement of spatial attention module. In the housing element feature extraction recognition task, the spatial attention mechanism can be combined to increase the weight of the key parts and improve the feature extraction ability of the network. In addition, the use of contextual information to go for understanding which locations should be attended to is also crucial for the spatial attention mechanism. One direction to solve this problem is to allow the network to have a larger sensory field. Therefore, in this paper, we design an improved spatial attention module in which inflated convolution is employed to effectively expand the perceptual field [25].

Expansion convolution increases the size of the convolution kernel by inserting voids, so as to obtain a larger region of information without increasing the computational effort. Let the expansion rate be d , when the convolution kernel size is k , then the actual convolution kernel size can be expressed as:

$$R = k + (k - 1)(d - 1) = kd - d + 1 \quad (2)$$

That is, it is equivalent to a standard convolution with convolution kernel R .

Let the input feature map of the improved spatial attention module be F , then the output spatial attention map M_{SA} of the module can be represented as:

$$M_{SA} = \sigma(f_3^{1 \times 1}(f_2^{3 \times 3}(f_1^{3 \times 3}(f_0^{1 \times 1}(F)))))) \quad (3)$$

where f denotes the convolution operation, σ denotes the sigmoid activation function, the superscript of f represents the size of the convolution kernel, and the subscript represents the order of the convolution operation. The two 1×1 convolutions are used for channel reduction, and the middle 3×3 inflated convolution is used to aggregate contextual information with a large receptive field.

Multiplying the input feature map with the channel attention map output from the improved spatial attention module yields the feature map with spatial weights F_{SA} the spatial attention weighted feature map F_{SA} output from the improved channel attention module can be represented as:

$$F_{SA} = M_{SA} \otimes F \quad (4)$$

where $\otimes$ represents element-by-element multiplication.

3) Multi-scale feature fusion. In order to obtain better feature extraction capability, this paper embeds a hybrid attention module in the backbone network, which is added after the shallow and deep features extracted in the CNN to achieve the enhancement of useful information and the suppression of redundant information in the input feature map. The improved channel attention module and the improved spatial attention module are connected in series to obtain new features that contain both important spatial information and important channel information in the feature map.

3.1.3. Housing element information mining. Due to the large amount of background interference around the urban cultural heritage buildings, the classical model is not clear enough to divide the foreground and background of the buildings, and it is difficult to accurately separate the housing elements of the buildings, which leads to the degradation of the feature extraction effect. Therefore, the following operations are carried out in this paper:

A Sigmoid operation is performed on the foreground (close to 1) and the background (close to 0) in the high-level prediction result, and the result of the Sigmoid is subtracted by 1 and multiplied with the up-sampled high-level feature F_k^p to obtain the background noise feature F_l^b . Then, the CEB module is introduced to enrich the sensory field and contextual information of the background noise feature. The background information in the low-level features is adaptively filtered out by the learnable parameter α to obtain robust and clear feature representations, and thus finer building segmentation maps are obtained.

Assuming the input of low-level feature F_l , high-level feature F_h , high-level prediction result P_h , and the output of fused feature F_{ngine} and finer segmentation result P_i , the computation of features and segmentation results at each level is as follows:

$$F_h^{ap} = \text{Upsample}(\text{Conv}_{7 \times 7}(F_h)) \quad (5)$$

$$P_h^{ap} = \text{Upsample}(\text{Sigmoid}(P_h)) \quad (6)$$

$$F_i^b = \text{CEB}((1 - P_h^{up}) \times F_i) \quad (7)$$

$$F_{rgfine} = \text{Relu}(\text{BN}(F_h^{up} - \alpha \times F_l^b)) \quad (8)$$

$$F_{rgfine} = \text{Relu}(\text{BN}(F_h^{up} - \alpha \times F_l^b)) \quad (9)$$

$$P_l = \text{Conv}_{3 \times 3}(F_{rgfine}) \quad (10)$$

In the formula, the corner marker up denotes the up-sampling operation, BN denotes the batch normalisation operation, and $Relu$ denotes the correction linear unit operation.

The information mining structure of architectural housing elements in urban cultural heritage is shown in Fig. 4, where Dilation denotes the expansion rate in the convolution operation, which is used to control the size of the feeling field of the convolution kernel.

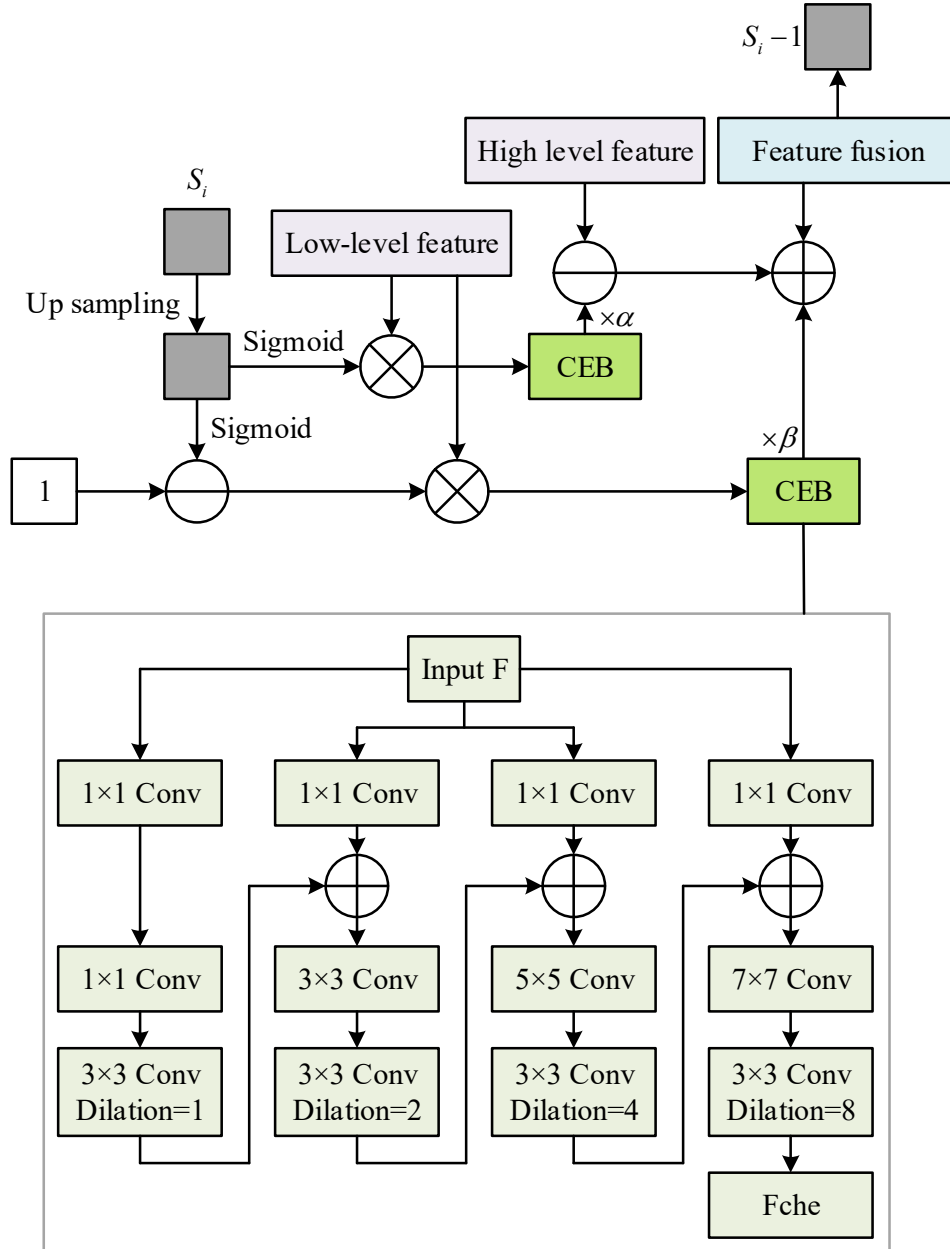


Fig. 4. Housing element information mining structure

In order to make the model more focused on the building housing element target, the CEB module uses multiple scale branches and applies null convolution, containing four null convolution layers with different sampling rates of 1, 2, 4 and 8 to obtain different sizes of sensory fields. These branches enable multi-scale feature fusion through the channel dimension. Through the CEB module, the model is able to acquire the feature representation capability for multi-scale contextual information perception.

Assuming input feature F , then output F_{ceb} , the output formulae for each branch $b1, b2, b3, b4$ can be expressed as respectively:

$$F_{b1} = \text{Conv}_{3 \times 3}^{d=1}(\text{Conv}_{1 \times 1}(\text{Conv}_{1 \times 1}(F))) \quad (11)$$

$$F_{b2} = \text{Conv}_{3 \times 3}^{d=2}((\text{Conv}_{1 \times 1}(F) + F_{b1})) \quad (12)$$

$$F_{b3} = \text{Conv}_{3 \times 3}^{d=4}(\text{Conv}_{5 \times 5}(\text{Conv}_{1 \times 1}(F) + F_{b2})) \quad (13)$$

$$F_{b4} = \text{Conv}_{3 \times 3}^{d=8}(\text{Conv}_{7 \times 7}(\text{Conv}_{1 \times 1}(F) + F_{b3})) \quad (14)$$

$$F_{ceb} = \text{Conv}_{1 \times 1}(\text{Concat}(F_{b1}, F_{b2}, F_{b3}, F_{b4})) \quad (15)$$

where d is the size of the expansion of the convolution kernel and *Concat* is the stitching together of multiple tensors.

3.2. Simulation validation of housing element feature extraction

The experiments in this paper were conducted in PyTorch under Ubuntu, and CUDA and cuDNN were used to assist in accelerating the computation. The model in this paper was optimally trained using stochastic gradient descent SGD method, and the initial learning rate, momentum, and weight decay coefficient were set to 0.001, 0.95, and 5×10^{-5} .

The images of urban cultural heritage buildings selected in this paper are all from the Internet, and the relevant buildings of urban cultural heritage under different eras are collected, and a dataset of 158 buildings with 1842 images of urban cultural heritage architectural styles (AS) is established.

3.2.1. Modelled loss variation curves. In order to make the image size convenient for calculating and finding the gradient, each large image is cropped to 256×256 size using sliding window cropping. The advantage of the partially overlapping cropping method is that it can make full use of the original image while enhancing the extraction of the boundary part of each small image. 2468 images are obtained after data enhancement operations such as flipping, rotating and mirroring. Among them, 2100 are used for model training, 268 for model validation, and 100 for model testing. The model of this paper is trained on the AS dataset for a total of 200 rounds, and the loss values of the model on the training and validation sets are recorded and smoothed in each round during the training process, and the loss values are used to judge whether the model reaches convergence. The loss value change curve is shown in Fig. 5.

During the model training process with 150 iterations, the model basically converges at the 115th round of training. As the model is trained, its loss value gradually decreases and tends to be stable, and the training loss value decreases from 0.1 to about 0.03 and then remains stable. Overall, firstly, both the training and validation curves decrease rapidly, and the rate of decrease starts to slow down from the 70th round to finally stabilise, indicating that the model training has reached convergence.

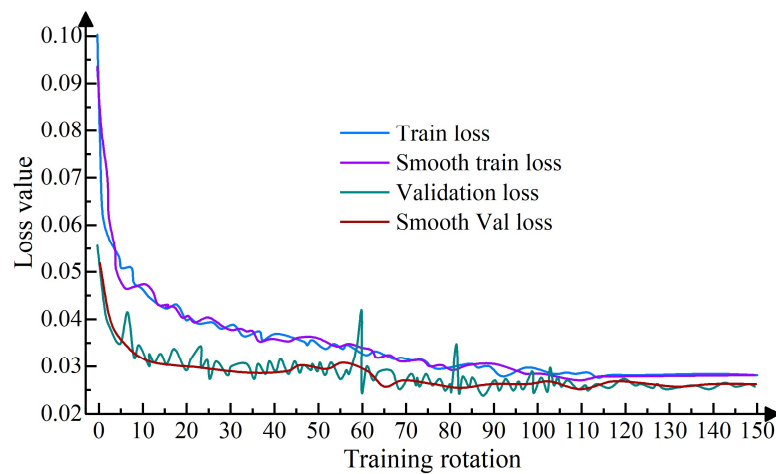


Fig. 5. The change curve of the loss value

In order to objectively evaluate the performance of this paper's model for feature extraction of architectural housing elements in urban cultural heritage, four indicators, Precision, Recall, F1-score, and IoU, are used in this chapter to evaluate the model accuracy. For performance comparison and validation of the model, the model proposed in this paper is compared with SegNet, UNet, and Deeplabv3+ in the experiments. At the same time, comparison experiments are conducted with SRINet, MA-FCN, a network dedicated to architectural element extraction. Table 1 shows the results of the accuracy comparison of each model on the dataset.

From the experimental data in the table, it can be seen that the feature extraction model in this paper, which combines multi-scale feature fusion and information mining of building and housing elements, performs better on the test set of AS dataset in terms of accuracy results, and has a greater improvement compared with other methods. The four evaluation indexes of Precision, Recall, F1 score and IoU on the test set reach 95.83%, 94.64%, 94.83% and 90.17% respectively, obtaining better results compared with other deep learning models. Compared with the MA-FCN model, the Precision and IoU of this paper's method are improved by 0.67% and 0.66%, while the Recall and F1-score are improved by 0.25% and 0.41%, respectively, over the SRINet model. The experimental data show that the feature extraction method of urban cultural heritage architectural housing elements proposed in this paper has higher extraction accuracy and can extract more subtle architectural housing elements to provide effective texture support for cultural and creative design.

Table 1. Accuracy comparison on AS dataset (%)

Model	Precision	Recall	F1-score	IoU
SegNet	92.75	91.06	93.21	85.46
UNet	93.06	91.58	93.06	87.72
Deeplabv3	93.58	93.27	93.75	88.38
SRINet	94.72	94.39	94.42	89.25
MA-FCN	95.06	94.15	94.38	89.51
Ours	95.83	94.64	94.83	90.17

3.2.2. Analysis of model comparison results. Chinese urban cultural heritage buildings have formed a unique architectural style during their development. In order to realise the digital pattern extraction of housing elements of urban cultural heritage buildings, and better apply them to cultural and creative design. In this paper, we constructed a dataset of Chinese urban cultural heritage buildings with the help of deep learning technology to identify the styles of housing elements of urban cultural heritage buildings by feature extraction.

The AS dataset is divided into 10 categories of architectural housing roof styles, including Tang Song single-eaved hipped roof, Tang Song single-eaved hipped roof, Tang Song single-eaved overhanging roof, Tang Song heavy-eaved hipped roof, Ming and Qing dynasty heavy-eaved hipped roof, Ming and Qing dynasty single-eaved quadrangular roof, Ming and Qing dynasty single-eaved hipped roof, Ming and Qing dynasty single-eaved hard roof, Ming and Qing dynasty three-storey heavy-eaved hipped roof, and Ming and Qing dynasty heavy-eaved hipped roof, which are denoted by U1~U10, respectively.

Figure 6 shows the confusion matrix for identifying different housing roof styles. The Tang-Song single-eaved overhanging roof building, the Tang-Song single-eaved hipped roof building and the Tang-Song single-eaved hipped roof building are easily confused with each other, and the accuracy of their feature extraction recognition is only 75% at the lowest. The recognition rate of heavy-eaved roofs such as Ming and Qing heavy-eaved hipped roofs, Ming and Qing heavy-eaved hipped roofs, and Tang and Song heavy-eaved hipped roofs is higher, and its recognition accuracy reaches more than 95%. And for the same roof style in different periods, the model can distinguish them well, such as the Ming and Qing Dynasty heavy eaves hipped roof buildings and the Tang and Song heavy eaves hipped roof buildings, the Ming and Qing Dynasty single eaves hipped roof buildings and the Tang and Song single eaves hipped roof buildings, and so on. In this paper, the model improves the feature capture ability of housing elements of different cultural heritage buildings through the multi-scale feature fusion module, and combines with the large margin metric to guide the network to learn the key features, so the style feature recognition of housing elements of cultural heritage buildings is more effective.

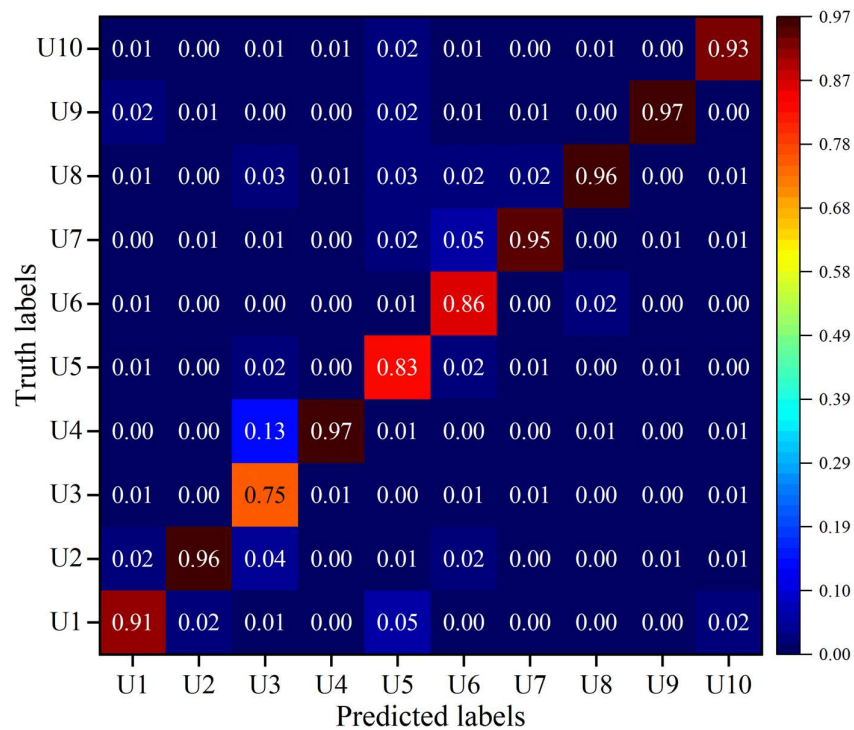


Fig. 6. Roof style identification confusion matrix

3.3. Application of cultural and creative products for urban cultural heritage

3.3.1. Cultural and creative design programme for housing elements. Culture is the soul of a city and the window to show the city's charm. It is of great significance to integrate the unique representative genes of cultural heritage into the design of cultural and creative products to enhance the intrinsic value of the products. Based on the style of urban cultural heritage architectural housing elements extracted from the model in the previous section, the design scheme of cultural and creative products of urban cultural heritage architectural housing elements is constructed. The specific idea is shown in

Figure 7, which mainly includes determining the brand name, determining the product category, determining the product colour tone, extracting the required elements, and then realizing the design of the cultural and creative products of urban cultural heritage architecture and housing elements.

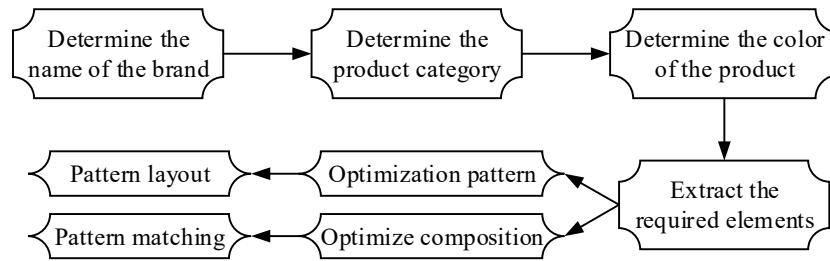


Fig. 7. The idea of housing element creation plan

In this design, the basic graphics of plant flowers and curly-leaf grass are selected from a large number of housing element patterns, and then geometric quadrilateral matching combinations are found in similar decorations to form new cultural and creative styling elements. The basic flowers, pillars, leafy grass, animals, etc. are simplified to fit the current trend of flat style, forming a new cultural and creative basic styling symbols. The colour configuration of the cultural and creative basic symbols is extracted from the colour scheme of the external wall of the housing elements through the colour processing software, and the colour scheme is processed with low saturation, and then the unique colour of the decorative construction of the window flower is added as a supplementary colour on its basis, so as to obtain the basic colour scheme of the basic symbols. This combines the unique colour scheme of the housing elements themselves with an innovative treatment that reinforces the impression of the architectural colours of the city's cultural heritage. In terms of composition and pattern arrangement, bipartite and quadripartite sequences are used for artistic reprocessing through arranging treatment. Compositional techniques such as thematic composition, tiling composition, diagonal composition, and centre of gravity composition are used to express the characteristics, creativity and value of the product.

3.3.2. Evaluation of the design effect of cultural and creative products. Based on the housing elements in the urban cultural heritage and the design scheme of cultural and creative products given in the previous section, a mobile phone case product was designed, and for the design effect of this mobile phone case this paper adopts a questionnaire to obtain the audience's evaluation of its shape, material, colour and logo. A total of 10 experimental subjects were selected to fill in the questionnaire, and its rating standard is $[-2,2]$, which means very dissatisfied, dissatisfied, average, satisfied and very satisfied respectively. In addition, a 10-point system was adopted for the overall evaluation of the design effect of cultural and creative products, and the average value was taken as the final evaluation of the experimental subjects after ten evaluations. The questionnaires filled in by the experimental subjects were statistically evaluated, and the evaluation of the design effect of cultural and creative products with housing elements in urban cultural heritage is shown in Figure 8.

From the statistics of each evaluation result, it can be seen that the average value of the overall evaluation of the experimental subjects on the cultural and creative products of mobile phone cases designed based on the housing elements of urban cultural heritage is 7.64 points, which is in the range of general to satisfactory. It can be considered that the experimental subjects are relatively satisfied with the evaluation of the effect of housing elements of urban cultural heritage in the design of cultural and creative products. In the remaining four sub-evaluation systems, the evaluation mean values of styling design, material use, colour control and commercial logo are 0.448, 0.262, 0.275 and 0.229 respectively, which are all between 0 and 1 points, and are also between the general and satisfactory grades. Among them, the experimental subjects had the relatively highest satisfaction with the styling

design and the relatively lowest satisfaction with the commercial logo. This is due to the fact that the feature extraction recognition model integrating multi-scale features and housing element information mining can effectively identify the style of housing elements of urban cultural heritage, and the design of cultural and creative products based on this style can restore the original shape of urban cultural heritage more, but the optimisation of the logo needs to be improved.

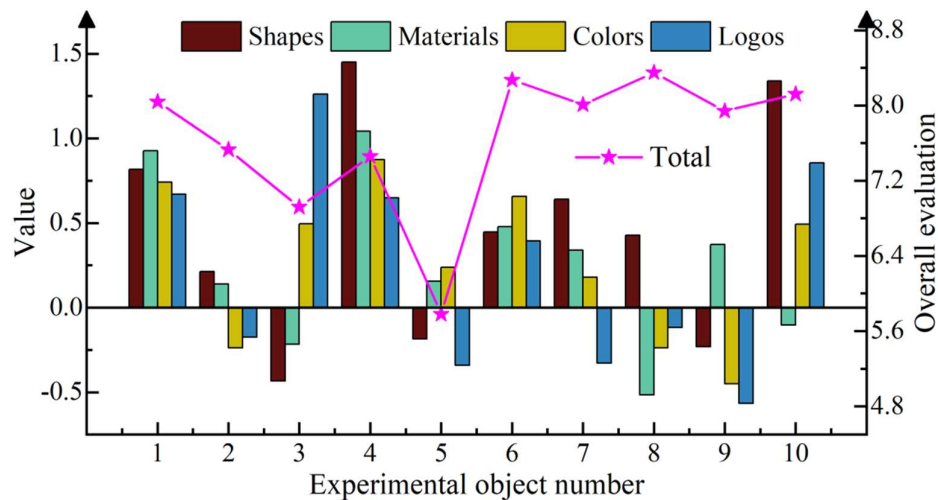


Fig. 8. The design effect of the product is evaluated

4. Animated scene design for urban heritage housing elements

The architectural and housing elements of China's urban cultural heritage have a long history, diverse forms and rich connotations, which provide rich creative materials for animation design, and play an important role in enriching the cultural connotation of animation works and improving the quality of animation works, among which the traditional architectural and housing elements of China have a close relationship with animation scene design. It is important to extract the architectural and housing elements of urban cultural heritage and integrate them into animation scene design, explore the way of using traditional architectural and housing elements in animation scene design, and point out the direction for the development of China's animation industry while promoting the national culture.

4.1. Representation of housing elements in animated scene design

4.1.1. Representation of housing elements. The application of urban cultural heritage architectural housing elements in animation scene design is conducive to the enhancement of the vitality of animation works, and is conducive to the enhancement of the cultural self-confidence of modern animation originality. From the perspective of the components of urban cultural heritage architectural housing elements and their visual aesthetics and cultural connotations, the application of urban cultural heritage architectural housing elements in animation scene design is mainly manifested in the following aspects:

1) Script creation. As the basis of animation art creation, the script has an important guiding significance and decisive role in the application of urban cultural heritage architecture and housing elements. The animation scene design is based on the background of the time, national characteristics, regional culture and other factors of the script story. The application of urban cultural heritage architectural housing elements in animation scene design must be in line with the background of the era in which the animation script story takes place, and the use of appropriate architectural housing elements can make the animation scene designed and created conform to the basic logic.

2) Scene setting. Based on the animation script to determine the overall style and expression of the animation scene, and then select the architectural housing elements consistent with the background of the script story, and its appearance, decorative details, the overall colour tone, etc. for refining and artistic processing. Animation scene design is not imaginary, more from real life, drawing on real life with aesthetic character, historical and cultural connotations of the architectural housing elements, the whole animation work can have a very good foil and rendering effect.

3) Colour creation. The effective grasp and application of traditional architectural colour elements in animation scene design can effectively reflect the national self-confidence, self-esteem and other national personality traits. Animation scene colour creation, not only can give the audience a strong visual impact, but also can be constructed full of artistic beauty, fun and cultural connotation, rich emotion of the animation art scene.

4.1.2. Modes of application of the housing element. Animation scene design creates a specific atmosphere and mood according to the development of the plot, and can accurately express the designated emotions. The drawing of the scene can play a role in accentuating the character traits, mental outlook and occupation of the characters, which can effectively let the audience feel the identity of the characters. In the scene portrayal, the thematic connotation of the work can also be deepened. When the housing elements of urban cultural heritage are applied to the animation scene design, the specific application mode is shown in Figure 9, which mainly emphasises the sense of realism, decoration and re-creation of the housing elements in the animation scene design.

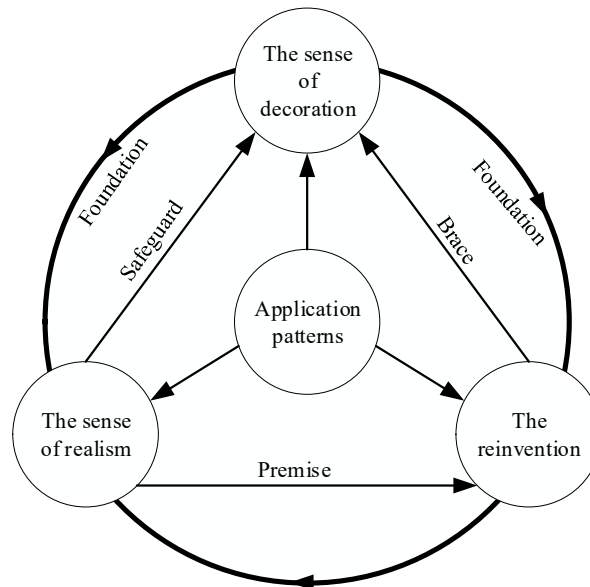


Fig. 9. Application patterns of housing elements

In the animation scene design that incorporates the elements of urban cultural heritage architecture and housing, the sense of realism, sense of decoration and re-creation should be flexibly utilized according to different performance requirements in order to achieve the best visual effect. The sense of realism is the reproduction of the real life, the sense of decoration is the refinement of the real life, and the re-creation is the sublimation of the real life. The sense of realism is the foundation of the sense of decoration and recreation, and the sense of decoration is the guarantee and premise of the sense of realism and recreation. The design of architectural housing modeling can show the time and space background of the story and the cultural background, the traditional architectural housing elements for the expression of decorative sense, can make the animation scene design more national characteristics, more national and cultural. The deconstruction and reorganization of traditional

architectural housing elements in animation scene design is to form the artistic effect of “conveying the spirit by shape” and “conveying the feelings by situation” in the animation scene.

4.2. Animated Scenography Programme Design and Evaluation

4.2.1. Design options for animated scenes Based on the Ming and Qing architectural housing elements in the urban cultural heritage extracted from the model in the previous paper, combined with the expression and application mode of architectural housing elements in animation scene design, this paper establishes an animation scene design scheme as shown in Fig. 10, which mainly consists of three parts, namely, script creation, main scene setting, and scene colour setting, each of which needs to carry out the animation scene design based on the elements of Ming and Qing architectural housing. Design.

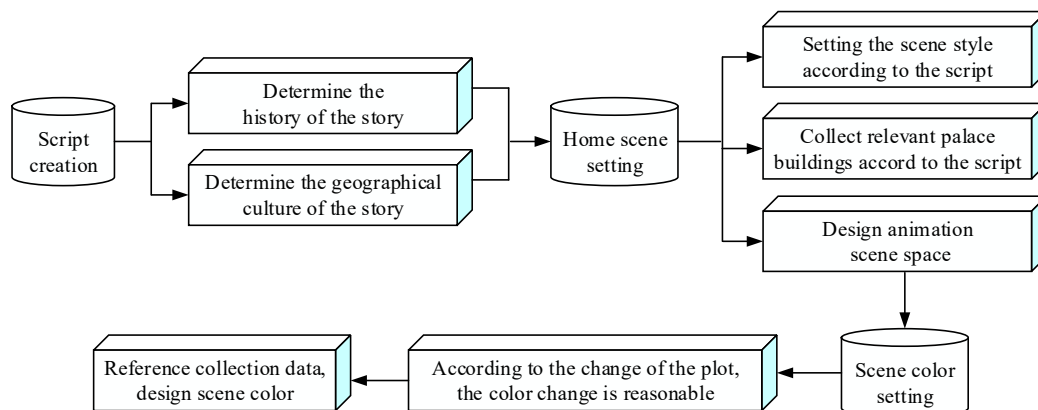


Fig. 10. The scheme of Animation scene design

In the process of script creation, it is necessary to match the scenes according to the historical period and regional culture in which the story takes place. Drawing on the elements and cultural symbols of the palaces of the Ming and Qing dynasties, the national spirit and regional culture are shown in the scene design, so that the animated film can be sublimated.

The architectural shape is the most important part of the animation scene, and the animation scene designers refine and process the appearance, decorative patterns, colours and local decorations of the Ming and Qing palaces, and exaggerate and distort them according to the plot. In the film, that shows the inner charm of classical architecture, but also maintains a high degree of consistency with the picture style of the whole animated film.

The animation scene artist extracts the material obtained from the model through the characteristics of the housing elements, and then according to the colour requirements of the animation scene, considering the association between the colour and the whole animation film and animation scene, combining with the strong colour culture of the Ming and Qing dynasty palace architecture, and expressing the relevant thematic content of the scene through the processing of artistic methods.

4.2.2. Evaluation of animated scene design In order to illustrate the effect of animated scene design based on housing elements in urban cultural heritage, this paper analyses the effect of animated scene design obtained from the previous design scheme through a questionnaire. The questionnaire is mainly designed from four aspects: colour, composition, shape and other aspects, and the questionnaire adopts a Likert 7-level scale for data quantification, with 1~7 points representing seven levels of very inappropriate~very appropriate, i.e., L1~L7. This survey mainly uploads the results of the animated scene design to the Internet, and sets up a scoring option for the survey in the message

area as a way of obtaining the evaluation results. Figure 11 shows the evaluation results of the animation scene design.

On the whole, a total of 4,727 people participated in the evaluation of the animation scene design, and the total number of people with L4 grade or above reached 94.5%, and the relatively highest evaluation of the people for the adaptability of the composition reached 4,664 people, accounting for 98.67% of the total number of people. The compositional design of the Ming and Qing dynasty palace architecture housing elements in the animation scene guides the audience as well as promotes the development of the plot. The content expressed in the picture can be known according to the architectural body in the visual centre of the animation scene, which presents a more prominent effect, fits the emotions expressed in the plot, and renders the brilliant atmosphere of the Ming and Qing palaces. The number of evaluations of colour and shape is relatively high, reaching 97.86% and 97.08% of the total respectively. Relying on the colour performance of the architectural housing elements of the city's cultural heritage to highlight the style of the animation work, the ever-changing colour effects, applied to different buildings, each effect presents a different style. The colour design can show the charm of the animation work and explain the background information of the story. The architectural modeling is designed through figurative, exaggerated, heteromorphic, anthropomorphic, special materials, contrast contrast and other techniques to carry out the ever-changing animation scene design, highlighting the style of animation works. Relatively speaking, the number of other artistic expression forms is relatively small at 84.39%. The production method and aesthetic effect of each artistic expression form are different, in this regard, when carrying out different expression effect test, use different artistic expression forms to design the architectural effect, compare and analyse the characteristics to meet the creation of different styles.

To sum up, it is highly feasible to apply the architectural housing elements of urban cultural heritage in the design of animation scenes. The application of colours can highlight the main building in the animation scenes, highlight the style of the animation works, render the atmosphere of the works, and promote the plot to move forward. The application of colour can highlight the main building in the animation scene, highlight the style of the animation work, render the atmosphere of the work, and push the plot forward. The application of composition can create the aesthetic sense of the picture, and provide a suitable stage for the characters to perform according to the script and the effect of the picture in the animation scene design.

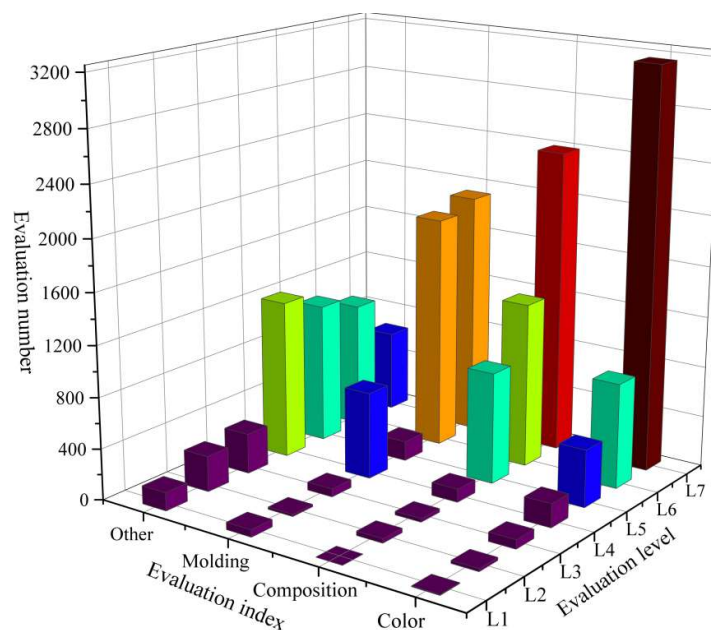


Fig. 11. Evaluation of animation scene design

5. Conclusion

In this paper, the features of housing architectural elements in urban cultural heritage are extracted by combining multi-scale feature fusion and housing element information mining, and applied to the design of cultural and creative products and animation scenes. The overall rating of the mobile phone case designed based on housing elements is 7.64, which can effectively enhance consumers' familiarity with the housing elements of urban cultural heritage and provide a new path to promote the revitalisation and inheritance of urban cultural heritage. In addition, when the extracted architectural housing elements were applied to the design of animation scenes, more than 95% of the audience indicated that the scenes were more compatible with the architectural style. This further demonstrates the feasibility of digital transmission of urban cultural heritage through animation and film, and provides new creative inspiration for the originality of China's animation industry.

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