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Article

Study on the Path of Visual Symbol Extraction and Design Transformation of Traditional Culture in Western Guangdong by Integrating Computer Vision Technology under the Background of Digital Intelligence

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Abstract: In this paper, an adaptive convolutional neural network (ACNN) model is proposed to accurately recognize traditional cultural images of western Guangdong in a complex environment. The DDPM pattern symbol reconstruction technique is used to realize the translation and analysis of the Lijin pattern, and the color clustering method is introduced to effectively mine the shapes and colors in the cultural materials and transform them into design elements. Through the factor analysis method, it is clear which design materials are prioritized and used for product design practice. The study shows that the image recognition accuracy of the ACNN model is 83.2%. A total of six aspects of traditional cultural visual symbols of western Guangdong represented by Nuo dance, paper-cutting, lion dance, floating color, jumping flower hut and architecture are translated, and five representative main colors and 17 types of symmetrical patterns are obtained. The comprehensive evaluation value of charm, artistry and locality of the architectural aspect is 4.27, which is most suitable to be applied in the design of seal products.

Keywords: traditional culture of western Guangdong; reconstruction technique; color clustering; image recognition; factor analysis

1. Introduction

With the development of the times and the improvement of people's aesthetic level, modern designers are increasingly focusing on the integration of modern design concepts and cultural symbols, aiming to provide a good space for the exchange and collision of ideas, to show its unique aesthetic sense, to enhance its cultural heritage, and to achieve a flexible, interactive and appropriate design effect. As valuable cultural resources, regional cultural symbols play an indispensable role in visual communication [1]. Regional culture is a variety of cultural phenomena formed in a certain region and perceived and recognized by people, and regional culture not only carries the artistic and cultural value of the nation, but also has the cultural capital of revitalization value [2]. The visual form of regional cultural symbols is highly artistic and decorative, often integrating the aesthetic qualities of the public. The visual vocabulary, compositional arrangement and color matching of traditional symbols in different cultural backgrounds reflect their respective regional characteristics [3,4]. Through the visual way, it vividly reflects the values, spiritual pursuit, aesthetic orientation and so on of the people living in the region, and becomes a unique way of cultural expression [5–7]. Regional cultural symbols not only present

distinctive visual characteristics, but also contain rich cultural connotations, and become an important carrier of cultural inheritance and communication [8]. The excavation and innovation of regional cultural symbols will inject a powerful cultural force into modern visual design.

Guangdong, a rich and diversified land, has nurtured the unique Lingnan culture. The traditional cultural symbols in this land, such as traditional handicrafts like broad-colored paintings, Cantonese embroidery, marquee carvings, and Cantonese furniture, as well as folk art performances such as waking lions and Cantonese Opera, are both the accumulation of history and the important expression of contemporary life [9]. Therefore, extracting visual elements with cultural connotations from Guangdong traditional culture and skillfully integrating them into modern design language not only enhances the cultural connotations of the design, but also constructs more influential and infectious visual symbols.

The application of regional culture in the design discipline is very extensive, and multi-dimensional research has been carried out in the fields of landscape design, packaging design, and cultural and creative product design. In the field of landscape design, Dai, Y. found that the exploration of the application of regional culture in landscape design has never stopped, and the combination of the essence of regional culture and urban landscape architecture can effectively expand urban culture, thus promoting the healthy development of the city [10]. Kempenaar, A. et al. showed that landscape design can enhance its cultural taste and cultural connotation by integrating cultural features, extracting cultural elements based on the inheritance of traditional national cultures, and combining them with modern landscapes can create a unique charm [11]. In the field of packaging design, Shen, Q. studied the packaging design of local specialties based on the visual language of regional culture, which can satisfy the unique personality and aesthetic needs of consumers in order to increase the desire of consumers to buy, and both promote the dissemination of local culture and promote the development of local economy [12]. Zhou, C. Aiming at the packaging design of agricultural products with serious homogenization, the use of regional cultural characteristic elements and modern green design concepts for the packaging of agricultural products can help to reshape the brand and value construction of agricultural products [13]. In the field of cultural and creative product design. Zhang, L. et al. elaborated on the application of regional culture in cultural and creative product design, put forward the principle of extracting effective regional cultural symbols, and accordingly developed a reasonable strategy for regional cultural and creative product design, which provides an effective path for the dissemination of regional culture and the sale of cultural and creative products [14]. Wu, R. et al. emphasize that culture is the source of design and design is the carrier of culture, and the combination of regional culture and cultural and creative products not only makes the regional characteristics of culture be inherited and respected, but also gives cultural value and artistic connotation to cultural and creative products. These studies introduce the modernized visual translation design of current regional culture and also verify and discuss the importance of regional culture [15].

In this process of translating regional culture to modern visual symbols, a large number of scholars have researched the extraction methods of visual symbols in regional culture. Hu, Y. et al. designed a method for extracting the visual elements of traditional culture based on fuzzy hierarchical analysis and entropy computation, which combined with the image processing tools can efficiently extract key shape elements with high information entropy [16]. Zhu, B. B. et al. studied the retrieval system of visual cultural symbols and proposed a saliency region segmentation algorithm based on k-mean clustering to establish an intelligent image retrieval method for shape feature recognition, which achieved better retrieval performance [17]. Zhang, X. constructed a traditional cultural symbol recognition system based on the TensorFlow framework, which not only significantly improved the recognition efficiency of visual cultural symbols, but also increased the recognition accuracy compared to the manual recognition process [18]. Yang, L. et al. developed a model for generating traditional cultural symbols combined with combining generative adversarial networks, and the generated visual images can both represent the culture to a great extent and enable people to have a high level of cultural identity, which has some practical value [19]. The traditional culture visual symbol extraction method gradually transitions from inefficient manual processing to highly efficient digital generation, which reflects the progress of science and the improvement of productivity in the context of digital intelligence, so it is of great significance to further study the extraction and transformation of traditional culture visual symbols based on machine vision technology.

Based on the traditional cultural visual symbols, providing materials for modern design and combining tradition and fashion is an urgent problem to be solved nowadays. Before inputting the Yuexi culture images into the model, a series of preprocessing operations are carried out on the images so as to improve the accuracy and robustness of the recognition. An adaptive mechanism is introduced on the basis of traditional CNN, and an adaptive convolutional neural network (ACNN) model is proposed to realize image recognition in complex environments. Then the DDPM pattern symbol reconstruction technique is used, which incorporates the color clustering technique to effectively guide the color and structure of the reconstructed pattern, so as to obtain the complete Cantonese and Western cultural

materials. On the basis of accurately extracting and reconstructing the regional cultural symbols of western Guangdong, the factor analysis method was used to define and select the most applicable cultural elements for product design for the practice of architectural series seal design.

2. Design Path for Translation of Cultural Visual Symbols

2.1 Selection of cultural visual symbols

The purpose of extracting visual symbols is to extract visual symbols from the culture that can be transformed. As there are many visual symbols of western Yue culture, when selecting symbols, the designer should first determine the audience for the design, so as to determine the purpose of the design and the theme of the design, etc., and select typical symbols that can meet the conditions and differentiate themselves from other cultures, and that can highlight the recognition of western Yue culture and have a unique representative significance according to the different design audiences and purposes.

2.2. Ways of Translating Cultural Visual Symbols

2.2.1. Deconstruction and Reconstruction

Deconstructing and reconstructing the translation method can use ready-made photos and images as symbols, and use the collage art technique to design a combination of physical symbols that exist objectively in Yuexi culture, such as architecture, clothing, food, utensils and other ready-made visual symbols of Yuexi culture, so as to visually convey the information contained in the photos and images to the audience. This collage of ready-made objects allows real things to be reassembled in fragments and placed in a completely new environment, where the imagery in the original environment is reconstructed with new meanings. This design technique is not just a simple reproduction or imitation, but requires the creator's subjective creation, through the control of the overall composition, color and details, the use of artistic expression of the visual symbols of the western culture of Guangdong to narrate the presentation of the visual characteristics of intuition, diversity and creativity, but also to make the expression of the design content more understandable.

2.2.2. Deformation and Creation

From a purely mathematical and geometric point of view to analyze the basic composition of geometric pattern elements and the generation rules of the elements, and convert the generation rules into mathematical formulas that can be automatically generated through parameters by means of fixed parameters and formula derivation, so as to provide a general generation algorithm for a class of geometric patterns. The main ways include the symmetric group theory parameter method and so on.

Metamorphosis and creation is a translation method with strong visual impact and attraction through the metamorphosis of the visual symbols of Yuexi culture and reorganization and arrangement based on the design purpose. It is not a simple reproduction of cultural symbols, but focuses more on the refining of cultural connotations and the deformation and creation based on cultural archetypes.

2.3. Regeneration Paths for Translation of Visual Symbols

Design has three levels, namely “instinctive, behavioral and reflective”. Instinctive level design is related to people's first impression, focusing on shape, color, material and so on. Behavioral layer design is concerned with function and implementation, focusing on the comprehensibility of the design. The reflective layer of design is closely related to the message and culture behind the design, which can trigger the audience's empathy. The regeneration path of visual symbol translation can be extended to the three levels of “form, context and meaning” as shown in Figure 1.

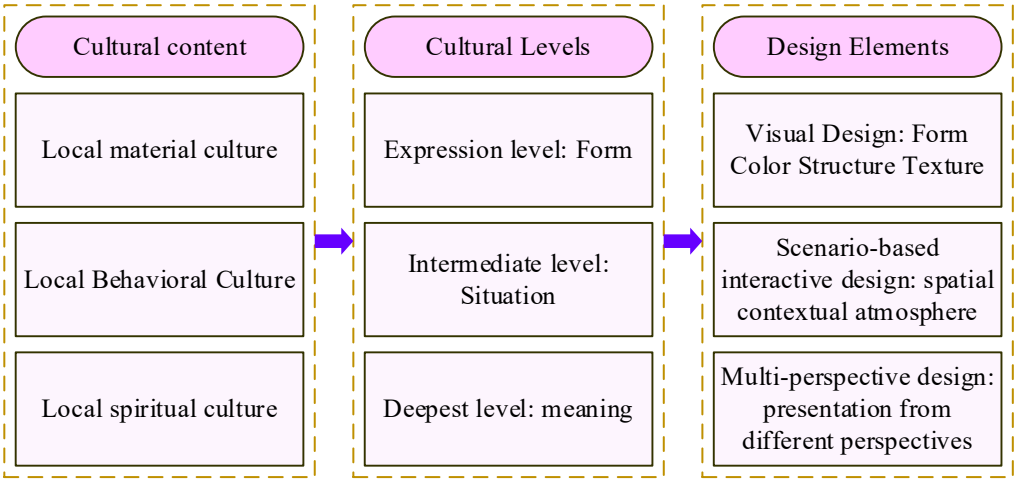

Figure 1. The transformation of visual elements.

3. Theories related to pattern recognition and reconstruction techniques

3.1. Image Pre-Processing Process

Adaptive convolutional neural network is a deep learning model for image recognition tasks in complex environments. Different from traditional convolutional neural networks, adaptive convolutional neural network introduces a series of self-adaptive mechanisms, which enable the network to autonomously adjust its structure and parameters according to the characteristics of the input image and the needs of the recognition task, so as to improve the accuracy and robustness of recognition.

In order to improve the accuracy and efficiency of image recognition, a series of preprocessing operations need to be performed on the image before feeding it into the ACNN model. The following preprocessing process is used in this study:

(1) Image Normalization: Normalizes the image pixel values from a range of $[0,255]$ to a range of $[0,1]$, so that differences in brightness and contrast between different images are eliminated. The normalization formula is:

$$x_{norm} = \frac{x}{255} \tag{1}$$

where, x is the original pixel value and x_{norm} is the normalized pixel value.

(2) Image Centering: The normalized image pixel values are subtracted from the mean value of the dataset so that the image is centered at 0. Centering can accelerate the convergence speed of the model and improve the training efficiency. The centering formula is:

$$x_{cent} = x_{norm} - \mu \tag{2}$$

where, μ is the mean value of the dataset and x_{cent} is the centered pixel value.

(3) Image enhancement: new training samples are generated by randomly performing operations such as panning, rotating, flipping, cropping, etc. on images. Image enhancement can expand the training set, improve the generalization ability of the model, and alleviate the overfitting problem.

(4) Image standardization: Divide the centered image pixel values by the standard deviation of the dataset to make the pixel value distribution of the image smoother. Standardization can accelerate the convergence speed of the model and improve the training efficiency. The standardization formula is:

$$x_{std} = \frac{x_{cont}}{\sigma} \tag{3}$$

where, σ is the standard deviation of the dataset and x_{std} is the normalized pixel value.

Through the above preprocessing process, the original CIFAR-10 image data is converted to the

normalized, centered and normalized format, while the training set is expanded by image enhancement. These preprocessing operations can significantly improve the training efficiency and generalization performance of the ACNN model, and lay a good data foundation for the subsequent experiments.

The ACNN model adopts the classical convolutional neural network structure, which consists of multiple convolutional and pooling layers stacked alternately. Specifically, the input image first passes through an adaptive convolutional layer to extract low-level visual features. Then, it passes through an adaptive pooling layer to downsample the feature map and reduce the size of the feature map. Next, the feature map is again passed through several adaptive convolutional and pooling layers to extract more abstract and high-level feature representations. Finally, the features are mapped to the output space through fully connected layers to obtain the category labels of the image. In the ACNN model, each adaptive layer can autonomously adjust its parameters and structure according to the complexity of the input image and the environmental interference. This adaptive mechanism enables the model to dynamically adapt to different task requirements and data distributions, improving the accuracy and robustness of image recognition.

3.2. Research on Pattern Symbol Reconstruction Techniques

Denoising Diffusion Probabilistic Models (DDPM) is the cornerstone of all diffusion models and involves two key phases: the forward diffusion process and the reverse denoising process. In the forward diffusion process, the model starts with a clear original image and gradually adds noise until the image becomes completely random noise. This process is usually realized by going through multiple steps, each of which introduces a certain amount of noise into the image. As the process proceeds, the structure and content of the image is gradually lost and eventually transformed into a purely noisy state. We take the real image data x_0 as a starting point and gradually add Gaussian noise in a forward process, resulting in a series of progressively diffused images x_1, x_2, and so on up to x_T. In this way, we obtain a gradual transformation from an initial image x_0 to a sequence of images containing noise. Where T is the total number of noise addition steps.

In the forward process, the initial data $x_0 \sim q(x_0)$ is assumed, and then each step of the forward process is to add Gaussian noise with specific values of mean and standard deviation to the data x_{t-1} of the previous process. Namely:

$$q(x_t \mid x_{t-1}) = N\left(x_t; \sqrt{1-\beta_t}x_{t-1}, \beta_t l\right) \tag{4}$$

where N represents the Gaussian distribution, x_t is the data denoised to the moment t, $\beta_t I$ is the covariance matrix, and β_t is between 0 and 1. This variance increases gradually with the number of steps, so when the number of forward process steps is large enough, it will eventually turn the original data into a random pure noise. Since the image state at each time step in the forward process depends only on the state of the previous time step, and the generation of the current state is independent of the previous state given the previous state, the forward process of the diffusion model can be viewed as a Markov process:

$$q(x_{1:T} \mid x_0) = \prod_{t=1}^{T} q(x_t \mid x_{t-1}) \tag{5}$$

Thus x_t can be represented by x_{t-1}:

$$x_t = \sqrt{1-\beta_t} \times x_{t-1} + \sqrt{\beta_t} \times \varepsilon_t, \varepsilon_t \sim N(0, I) \tag{6}$$

Then, by Markov property, it can be further obtained:

$$q(x_t \mid x_0) = N\left(x_t; \sqrt{\bar{\alpha}_t} \cdot x_0, (1-\bar{\alpha}_t) \cdot I\right) \tag{7}$$

Among them:

$$\alpha_t = 1-\beta_t, \bar{\alpha}_t = \prod_{i=0}^{t} \alpha_t \tag{8}$$

In the forward process, the noisified data for each step can be generated sequentially as long as sample data x_0 and noise schedule $\beta_1, \beta_2 \ldots \beta_T$ are given.

The reverse process is a series of noise reduction steps that gradually removes noise from the image through network learning until a noise-free image is restored.

In the inverse process of DDPM, assuming that each step t can accurately obtain the conditional probability distribution $q\left(x_{t-1} \mid x_t\right)$, the generation can be realized by continuously sampling for $q\left(x_0\right)$ through the reverse iteration. However, since $q\left(x_{t-1} \mid x_t\right)$ depends on the data distribution of all samples, directly solving for $q\left(x_0\right)$ is not achievable. Therefore, the construction of a neural network parameterized by θ is taken to approximate its distribution. It is assumed that $p_\theta\left(x_{t-1} \mid x_t\right)$ is the probability distribution of the inverse process and obeys a Gaussian distribution with its mean μ_θ and variance $\sum\theta$ using x_t and t as input parameters, i.e:

$$p_\theta\left(x_{t-1} \mid x_t\right) := \mathsf{N}\left(x_{t-1}; \mu_\theta\left(x_t, t\right), \sum_\theta\left(x_t, t\right)\right) \tag{9}$$

Applying Bayes' formula, we can compute the posterior conditional probability based on the process value xt at moment t and the initial value $x0$ as in (10):

$$q\left(x_{t-1} \mid x_t, x_0\right) = q\left(x_t \mid x_{t-1}, x_0\right) \frac{q\left(x_{t-1} \mid x_0\right)}{q\left(x_t \mid x_0\right)} \tag{10}$$

and can be obtained from the Gaussian distribution property:

$$q\left(x_{t-1} \mid x_t, x_0\right) = \mathsf{N}\left(x_{t-1}; \tilde{\mu}_t\left(x_t, x_0\right), \tilde{\beta}_t I\right) \tag{11}$$

Among them:

$$\tilde{\mu}_t\left(x_t, x_0\right) := \frac{\sqrt{\bar{\alpha}_{t-1}}\beta_t}{1-\bar{\alpha}_t} x_0 + \frac{\sqrt{\bar{\alpha}_t}\left(1-\bar{\alpha}_{t-1}\right)}{1-\bar{\alpha}_t} x_t \tag{12}$$

$$\tilde{\beta}_t := \frac{1-\bar{\alpha}_{t-1}}{1-\bar{\alpha}_t}\beta_t \tag{13}$$

It can be seen that the variance β_t is an unlearnable variable related only to the noise scale series. And the mean is a function of x_0 and x_t. Ultimately, it can be estimated by means of a neural network that reduces x_t to x_0:

$$x_{t-1} = \frac{1}{\sqrt{\alpha_t}} x_t - \frac{\sqrt{1-\alpha_t}}{\sqrt{\alpha_t}} \varepsilon_\theta\left(x_t, t\right) + \sigma_t \tag{14}$$

Simply put, the diffusion model works by fundamentally corrupting the training data by learning to keep adding Gaussian noise and then reversing this noise process to recover the data. After training, the diffusion model can be used to feed randomly sampled noise into the model and learn the denoising

process to generate data.

3.3. Color Clustering

K-means clustering algorithm is one of the most basic and commonly used clustering algorithms, which searches for a kind of division scheme of K cluster by iterative way, so that the clustering result corresponds to the minimization of the cost function. In this paper, the clustering algorithm of K-means is used to search and cluster the Lai brocade patterns converted to CIELab space, and then realize the pattern segmentation. The specific algorithm steps are designed as follows:

Step 1: Perform a color analysis on the input Lai Kam image, create a color occupancy map, and based on the size of this histogram occupancy, select a specified K color clustering category, and use these points as the initial clustering centers $\{C_1, C_2, \ldots, C_k\}$.

Step 2: For each pixel x_i, calculate the distance from the pixel to the K clustering centers, and classify the pixel to that clustering center nearest to it. Where the minimization distance formula is:

$$E = \sum_{i=1}^{K} \sum_{x \in C_i} \|C_i - x\|2 \tag{15}$$

where, K denotes K clustering centers, C_i is the i th clustering center and x is the pixel of C_i clusters.

Step 3: After all the pixels are divided, the mean value of each category is calculated and it is used as the cluster center:

$$CI = \frac{1}{m} \sum_{x \in C_i} x \tag{16}$$

where: m is the number of categories to which C_i belongs.

Step 4: Repeat steps 2 and 3 until the clustering center of the image no longer changes.

It can be seen that the pattern tattoos extracted based on color clustering segmentation have complete outlines and clear edges, which are friendly for subsequent use as input for generating model color structures.

4. Extraction and Redesign of Visual Symbols of Traditional Culture in Western Guangdong Province

4.1. Image Recognition Techniques for Cultural Symbols

Based on convolutional neural network (CNN), an image recognition technology that can automatically identify and classify functions is proposed for the big data of the current cultural status map of western Guangdong. On this basis, combined with geographic information system (GIS) technology, the elements in different categories are comprehensively analyzed and processed, and a corresponding model is established to realize the digital management of western Guangdong cultural symbols. At present, this method utilizes the database of western Guangdong cultural symbols to extract the symbolic features of western Guangdong culture traditions, such as picture texture, morphological structure, traditional activities, topography and geomorphology. It also provides certain material and quantitative support for the construction of Chinese traditional cultural symbols database and subsequent research work Simply put, the research results based on convolutional neural network image recognition technology can identify any picture and output the corresponding geographic province information of western Guangdong. For example, it is possible to quickly identify whether a picture is Fujian Tulou or Guangdong Tulou. The confusion matrix of image recognition accuracy is shown in Fig. 2, and the average recognition accuracy of this model is 83.2%.

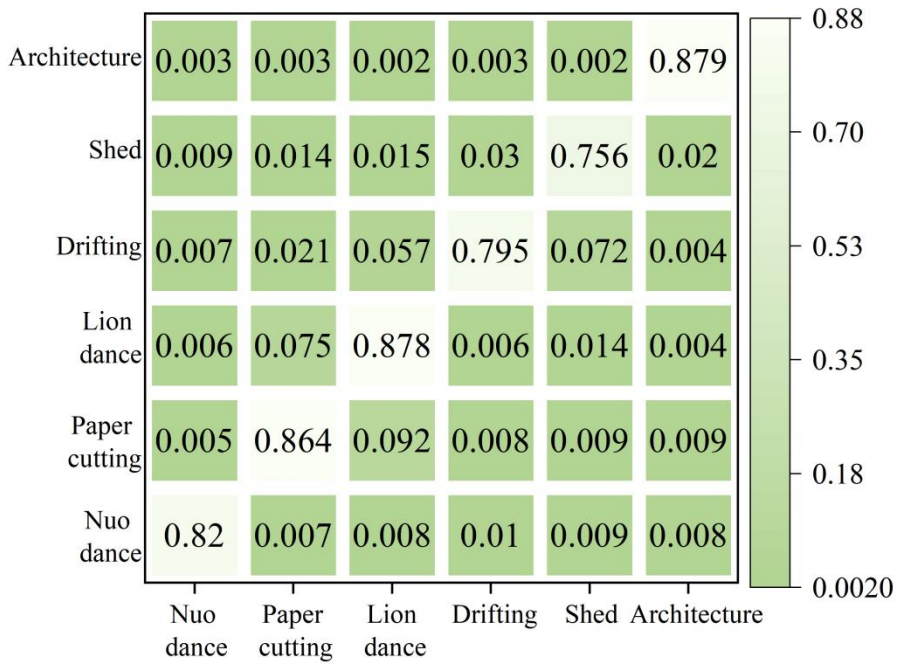

Figure 2. Image recognition matching.

4.2. Establishment of Symbol Materials of Western Guangdong Culture

As shown in Table 1, the research year of cultural symbols in western Guangdong is a festival with extremely rich connotations, which integrates various elements such as sacrificial shrines, Lantern Festival, witchcraft, Taoism, and local god beliefs. The local people have endowed the annual event with richer expression and connotation, making it evolve into a cultural festival with a strong sense of identity and pride where social entertainment coexists. The local culture of western Guangdong such as architecture and folk cultural resources (including clay sculptures, floating colors, sedan chairs, lion dances, puppets, unicorn dances, flower jumping, paper-cutting, etc.). For example, the most representative "Wu Dance", commonly known as "ghost play" or "dancing grimace", is a kind of mask dance and sacrificial ritual to pray for blessings and welcome auspiciousness, and is known as "the living fossil of Chinese dance art". According to its cultural characteristics, unique cultural symbols can be extracted, such as its simple and rough, solemn, and primitive dance movements condensed into artistic and expressive patterns. The color spectrum of the mask is used to refine the five colors of red, blue, purple, yellow, and black as the color system of the packaging. As a unique Lingnan and Western Guangdong culture, the humanistic spirit of annual activities is mainly reflected in three aspects: (1) the function of folk belief transfer: "Huazhou goes to Huawuben and worships witches", after hundreds of years of changes, the atmosphere of sacrifice and superstition has gradually weakened, and now it carries more of the function of praying for blessings and wishes. (2) The function of expressing local feelings: the beliefs and rituals in annual activities not only reflect the function of clan identity, but also reflect the function of expanding inter-village and interpersonal relationships. (3) Cultural, sports and entertainment display function: "The purpose of planning a festival is ostensibly to sacrifice to the gods, but in fact it is to celebrate a festival for oneself." The meaning of cultural symbols "has shifted from focusing on the communication between heaven and man and the vertical connection of clans (i.e., the connection with ancestors) to the equal emphasis on vertical connection and horizontal connection (the connection of the real social circle)", and these spirits also need to be translated into product design through regional cultural symbols.

Table 1. The western cultural symbol is analyzed.

Order	Cantonese western culture representative	Feature	Refined cultural symbols

1	Nuo dance	Pray for happiness; Dancing in the face; Sacrificial Canon; Simple, bold, simple	Mask modelling; Dancing and dancing as a case; The Angle of the Angle; Red, blue, purple, yellow and black
2	Paper cutting	Paper products; The pattern is vivid; clear	Paper cutting pattern; hollowing
3	Lion dance	The lion's head drew spiral lines, horns and colors. South lion dance; The head tail is supported by the pole and the dance, The movement is strong and rugged	The lion's head (unlike the north lion); Festive colors; choreography
4	Drifting	The performance of vivid characters is a myth, history and drama. Mobile stage; Characters and animals of different shapes; Fly up	Scene drawing is a typical pattern; Broad embroidery pattern, gorgeous color; Use legends and stories to classify food packages and name them
5	Shed	In ancient costumes, wearing strange faces, holding axe, knife, hoe, etc., and singing along the gongs	Mask modelling; The dance action diagram; A scene view; Colorful color; To define the theme of the package with the theme of the script
6	Architecture	Perfect decorative stone carving, coufolds, inscribed, pan ears, etc., carved beams, dragon ridge flying eaves, artists, paintings, sculptures and construction three kinds of art	Pan ear shape; Decorative pattern; Thick color; Molding combination

4.3. Color Extraction of Cultural Symbols in Western Guangdong Architecture

When the human visual organ observes an object, the sensation of color occupies an absolute place in the first impression. According to Frank H. Mank's "Pyramid of Color Experience" model, in addition to "physiological responses to color stimuli" and "collective unconscious", "intentional symbolic relations" become the third level of universality of color experience, that is, color is used to refer to non-color ideas. Among the various methods of digital image recognition, image segmentation using the K-means clustering algorithm achieves this efficiently. When the main color of the image is successfully extracted, a corresponding color card can be formed for design reference. The color translation refers to the object and meaningful acquisition, not by personal feelings of association, but social customs, such as the red represents the revolution, the pagoda signifies the neighborhood. K-Means algorithm for image segmentation will calculate the average value of pixels in each cluster, according to the average value can get the main color RGB distribution of the image, and then get the proportion of the main color in the total pixels of the image, and then can draw the corresponding color card of the image. The main color of the image can be obtained from the RGB distribution of the main color of the image, and the proportion of each main color in the total pixels of the image can be obtained. By accessing the OpenCV library in Python platform, the K-means algorithm is used to identify the color of the image, and the corresponding clustering results are shown in Figure 3. The five representative main colors of the cultural symbol are obtained. That is, the RGB of the five main colors are (44, 53, 41), (240, 250, 254), (142, 140, 122), (88, 96, 72), and (170, 192, 204).

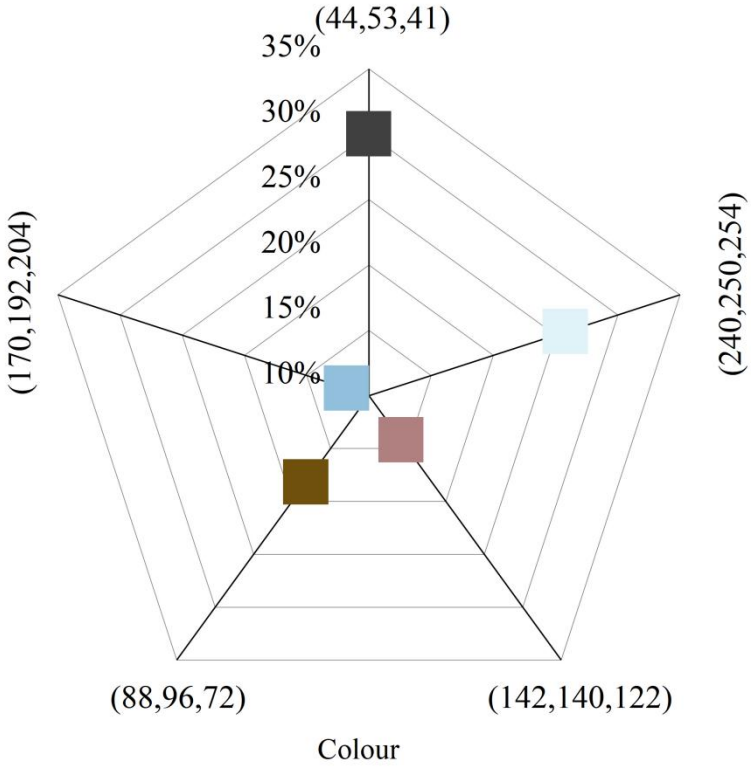

Figure 3. Image main color extraction results.

4.4. Screening of design and cultural elements

The ultimate goal of collecting western Guangdong cultural materials is to deconstruct and reconstruct the design elements. Since there is a huge amount of cultural materials in western Guangdong, and not all of them are suitable as design materials, it is necessary to further sort out and select the most representative cultural materials in western Guangdong. In this section, we use factor analysis and questionnaire to analyze and select the most suitable elements to represent the regional culture of western Guangdong through qualitative and quantitative research methods.

4.4.1. Vocabulary Factor Analysis of Design Factors

Firstly, KMO test and Bartlett's spherical test were conducted on the valid questionnaires using SPSS, and the results of which, KMO value = 0.674 (>0.6) and Bartlett's value = 178.859, reached significance with a degree of freedom of 56.32, which indicates that there are common factors among the correlation matrices of the design factors, which can be used to conduct factor analysis. The three common factors were selected as the evaluation factors of Yuexi culture, and the three dimensions of culture were comprehensively judged from the three dimensions, and the meanings of the three evaluation factors are shown in Table 2.

Factor analysis was conducted on the vocabulary of design factors, and a total of three common factors were extracted according to the common criterion of characteristic root greater than 1: charisma, artistry and locality. In order to verify the validity of the factor analysis, intrinsic reliability analysis was used to test the summarized common factors, and the reliability of each item and its Cronbach coefficient were all above 0.6, and the results of this study should be credible.

Table 2. The design of the inelement word is analyzed.

Extraction factor	Design factor	Factor load	Eigenvalue	Reliability
Charm	Connotation	0.74	2.98	0.785
	Attraction	0.72		
	Publicity	0.66		

	Stability	0.42		
	Infectivity	0.83		
	Moral	0.87		
Artistry	Colour	0.96	1.75	0.756
	Form	0.93		
Regionality	Uniqueness	0.42	1.96	0.685
	Degree of correlation	0.95		
	Identification	0.97		
KMO = 0.674	Bartlett = 178.859	Df = 56.32	Sig. = 0.001	

The purpose of the survey was to analyze consumers' awareness of cultural materials and to identify which design materials should be prioritized in design. The Likert scale method was also used, and the participants evaluated the importance of the above 10 cultural materials according to the degree of agreement with the description of the variables, with 1 score indicating "very good", 2 points indicating "poor", 3 points indicating "average", 4 points indicating "good", and 5 points indicating "very good". The evaluation indicators are charm, artistry, and regionality.

A total of 30 questionnaires were issued, of which 23 were valid. After the statistics, we get the scores and rankings of charm, artistry and locality as shown in Table 3. 6 kinds of cultural materials are ranked according to the average scores in the order of architecture, paper-cutting, jumping flower hut, floating color, Nuo dance, lion dance. From the results of the data, it can be seen that people on the coquettish stone carvings, couplets, plaques, pot ears, etc., the overall ranking is higher.

Table 3. Questionnaire results.

Cultural material	Charisma	Artistry	Regionality	Synthesize	Ranking
Nuo dance	4.34	3.98	4.31	4.21	5
Paper cutting	3.68	3.63	3.95	3.75	2
Architecture	4.42	4.22	4.16	4.27	1
Lion dance	3.78	3.74	3.68	3.73	6
Shed	4.08	4.15	3.51	3.91	3
Drifting	4.18	4.23	3.47	3.96	4

4.4.2. Cultural and Creative Product Design Practice

China's Yinna has a long history of development, but there is no definite conclusion as to when it originated. It is possible to determine the fool. In the Spring and Autumn and Warring States period, the production and use of seal has been very mature. With the replacement of the change of dynasties, the details of the workmanship of the seal are also different, collect representative of each period of the seal take, the development of the history of the seal for the first time to understand. With the current revival of the national trend, many museums, libraries, themed post offices, art galleries, cultural and creative stores, bookstores, etc. are providing compulsion service, and it is quite aesthetic and interesting. Basically, all the seal meanings can be privately customized patterns, used as a collection of bookmarks, name badges, calligraphy badges, etc. Through the comparative analysis of six seal shapes, it is found that the shape and design of the seal: the seal is gradually developing in the direction of fun and portability.

This research to consumers of Yuexi culture seal collection of motivation and the styling appearance preference of Tibetan book taking as a problem set treasure range, using random sampling of consumers questionnaire survey, issued 50 questionnaires, 43 valid questionnaires. The male and female ratio of the survey respondents is balanced, and the research results are shown in table 4.

Survey respondents tend to warm colors in the choice of colors, like bright and vivid colors accounted for 35.6%. May take into account the portability or jade and other materials fragile reasons, 70.8% of consumers tend to wooden seals.

The survey on the purchase intention of seal products reflects the consumers' demand for seal products, and the functions included in most of the cultural products are listed in the questionnaire to

assist the respondents in choosing. 83.3% of the respondents are willing to buy seals with commemorative significance, and people's consumption intention of Yuexi cultural products is mainly for travel commemoration when they travel to a different place. 71.4% of the dumping households hope that the seal fails to convey the cultural characteristics as well as can be interesting, indicating that consumers value the pleasure that cultural and creative products bring to their mind and relieve stress. In recent years, creative and interesting cultural and creative products are popular among consumers. In addition, there are a few people who will consider ornamental, technological and practicality when purchasing.

Table 4. Stamp product purchase meaning statistics.

Options	Proportion	Options	Proportion	Options	Proportion
Cold color system	2.92%	Organic glass	14.3%	Transfer culture	71.4%
Brightly colored	35.6%	Metal	5.71%	Commemorates	83.3%
Black and white	11.2%	Lithoplasm	8.64%	Practicability	28.6%
Warm color system	50.0%	Wood	70.8%	Be interesting	71.4%
Other	0.28%	Other	0.55%	High-tech content	17.22%

4.4.3. Design Options and Analysis

The architectural elements of Western Guangdong cultural symbols are organically integrated with the products, which can not only be stamped by readers. It can also be used as decorations and ornaments to provide consumers with a different consumer experience. Based on the above research and analysis of the book collection, the design objectives are determined, the sketches are drawn, and the rationality of the product form and function is scrutinized. Its initial form is like a building block toy, which needs to be assembled by hand, mortise and tenon building blocks, and the ancient building is restored. As shown in Figure 4, when using the bottom stamp, the acrylic mandarin orange is placed on the building block, which gives emotional value to the product, so that people can have a special cultural emotional association with the Jinan cultural connotation presented by the product symbol in the process of appreciation, purchase, appreciation, collection, gift, etc., which is the recognition of the culture of western Guangdong and the emotional embodiment of the value of the product symbol.

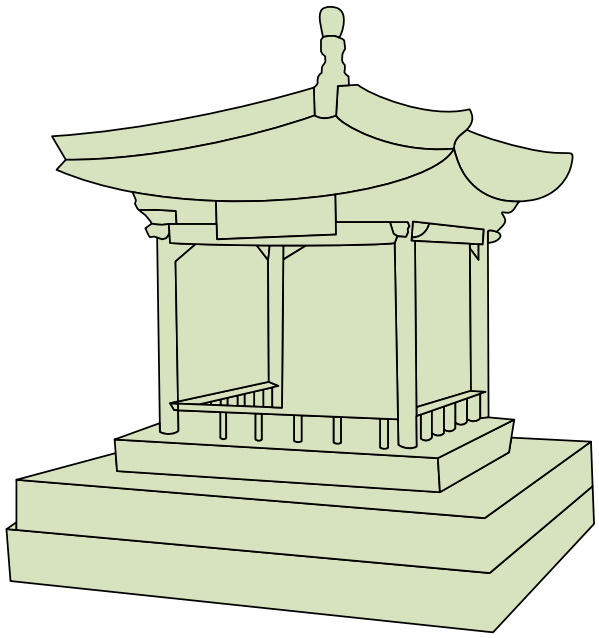

Figure 4. A sketch of the Chinese culture seal.

5. Conclusion

This project uses image recognition technology, deconstruction and reconstruction theory, and K-means clustering algorithm to extract and reconstruct the forms and connotations of the visual symbols of traditional culture in western Guangdong, and applies them to the practice of designing cultural and creative products in libraries. The research results show that the image recognition of adaptive convolutional neural network model has high robustness and accuracy. In total, visual symbols of traditional culture of western Guangdong in terms of Nuo dance, paper-cutting, lion dance, floating color, jumping flower trellis and architecture were parsed with vivid patterns. The corresponding color clustering is performed with K-means algorithm, and five representative main colors are obtained. In terms of the reconstruction of traditional geometric symbols, they are found to be characterized by axial symmetry, point symmetry as well as rotational symmetry. Using factor analysis, it can be seen that architecture is most suitable for designing product applications, therefore, this paper organically combines the architectural elements of the cultural symbols of western Guangdong with the product to design a series of seals of the Seal Library Architecture.

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