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Computer-Aided Design AND APPLICATIONS

Design and CAD Integration of Guangxi Cultural Creative Products Based on Multi-Modal Data

Meihuan Chen[1] and Yan Cai[2]

[1,2] School of Visual Arts Design, Guangzhou Academy of Fine Arts, Guangzhou 510000, China, [1]meihuan_chen1606@163.com, [2]caiyan_311@163.com

Corresponding author: Meihuan Chen, meihuan_chen1606@163.com

Abstract. Guangxi's cultural creativity is not only a world-renowned intangible cultural heritage but also an important carrier of national culture and social culture. The traditional Guangxi cultural creative mainly inherits the tradition, lacks the innovation and development of cultural elements, and can not meet the ever-changing consumer demand. Therefore, this paper combines CAD technology and multi-modal data to build a creative product design model of Guangxi culture. It can effectively extract cultural feature factors of Guangxi's cultural creativity through CNN and RNN. In addition, the internal migration algorithm and PSO algorithm are used to optimize the innovative product design. The experimental results show that compared with the traditional model, the proposed model has a lower error rate of feature factor extraction and can provide reliable data information for designers in the process of application. In addition, this model greatly improves the design efficiency of innovative production capacity and allows flexible use of Guangxi elements. Eight kinds of Guangxi cultural creative, innovative product design show that the combination of CAD and multi-modal data can provide designers with more design space and improve the quality of the use of design elements so as to meet the personalized needs of consumers.

Keywords: Multimodal Data; Guangxi cultural creative; Cultural Creativity; Cultural Product Design; CAD
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1 INTRODUCTION

As one of the intangible cultural heritages of China, Guangxi cultural creative enjoys a good reputation both at home and abroad for its exquisite skills and unique artistic style. It not only carries a long history and cultural connotation but also shows the scenery of Lingnan in the four seasons, like spring, and the living conditions of people in different times through rich colors, delicate stitching, and exquisite patterns, forming the unique artistic charm and cultural value of Guangxi's cultural creative. However, the traditional Guangxi cultural creative design process is cumbersome and time-consuming, which makes it difficult to adapt to the modern market's demand for rapid iteration

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of cultural and creative products. Traditional Guangxi cultural creative design needs to consume a lot of labor costs and time costs, and can not follow the pace of changes in the market. At the same time, due to the lack of inheritors of Guangxi cultural creative and the high complexity of skill inheritance, many Guangxi cultural creative skills are faced with the risk of being lost. In a certain period of time, fewer types of products are produced, mainly in the form of traditional products, and there is a lack of innovative products that combine with modern aesthetics and lifestyle. As a result, Guangxi Cultural Creative's competitiveness in the market is insufficient. The awakening of social and national cultural confidence and the development of computer technology provides a new way for the inheritance and development of Guangembroidery culture, in which creative cultural products play a vital role in the inheritance and development of Guangembroidery culture [1]. Culturally creative products: Through innovative design, the Guangxi cultural creative elements and modern aesthetic and design concepts are combined to create a unique charm for new products. These products not only retain the essence of Guangxi cultural creativity but also integrate modern fashion elements; the Guangxi cultural creative is presented to the public in a more colorful form, and the attraction and communication power of intangible cultural heritage is enhanced. Through cultural innovation, product design not only enriches the expression form of intangible cultural heritage but also injects new vitality and elements into Guangxi's cultural creativity and promotes the integration and development of Guangxi's cultural creativity and modern society.

The images of clothing styles are not only provided and annotated by fashion design experts but also invite embroidery art experts to participate, ensuring that embroidery patterns, color matching, and craftsmanship details are accurately captured and classified. In order to further identify and combine traditional embroidery culture with clothing style recognition, some scholars have not only established a standard clothing style library but also specifically introduced embroidery cultural elements as an important recognition dimension. In terms of image representation, in addition to using line segments composed of edge feature points to depict clothing contours, image segmentation techniques are also used to extract embroidery areas separately [2]. Even when facing complex images in real-wearing environments, the recognition rate can remain stable at over 92%, fully demonstrating the effectiveness and practicality of this method in integrating traditional embroidery culture with modern clothing style recognition. Analyze the complexity, density, colour distribution, and traditional pattern features (such as dragon and phoenix, peony, cloud and water patterns, etc.) of embroidery patterns. Based on these features, more complex clothing style matching rules have been established, which not only cover the recognition of modern fashion styles but also pay special attention to the classification and recognition of traditional embroidery cultural styles. Subsequently, a detailed analysis was conducted on the embroidery patterns in the clothing area, comparing their features with the pre-built embroidery cultural style matching rules in order to accurately determine the overall style of the clothing and the embroidery cultural characteristics it contains. These rules can capture the fusion of embroidery elements in clothing, distinguish the cultural characteristics of embroidery in different regions and historical backgrounds, and make the matching and recognition standards automatically generated by the system more comprehensive and accurate [3]. When inputting an image of a person wearing clothing with embroidery elements, the system first locates the person through skin color detection and then further identifies and segments the clothing area. In the feature extraction stage, not only the basic shape, colour matching, and material texture of the clothing were considered, but also the uniqueness of embroidery patterns was deeply studied. These embroidery features not only enrich the representation dimensions of clothing styles but also provide richer information sources for subsequent feature extraction and matching rule establishment [4]. A multidimensional feature vector containing embroidery cultural characteristics has been constructed, including needlework techniques (flat embroidery, lock embroidery, seed embroidery, etc.), colour transitions, and pattern layouts. The experimental results show that for standard clothing images containing embroidery elements, the recognition rate of clothing style is significantly improved, reaching over 95% [5].

Since its inception, clothing CAD technology has undergone continuous innovation and rapid development. Nowadays, intelligent clothing design combined with traditional embroidery culture has become a new trend and research hotspot in the industry. Some scholars fully utilize the structural

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characteristics of clothing and combine the unique charm of embroidery culture to divide clothing styles into multiple component combinations containing embroidery elements. This system deconstructs clothing into multiple independent and interrelated components, each of which not only serves as a basic unit of design but also incorporates embroidery cultural elements, making the design process more flexible and culturally rich [6]. The existing software is still insufficient in integrating traditional cultural elements such as embroidery, which, to some extent, limits the full expression of cultural creativity in the clothing production process and has become a bottleneck for industry development. Detailed analysis of the overall design process and core functions of the intelligent styling design system, especially the intelligent processing and optimization of embroidery elements. On this basis, a system architecture that meets modern design requirements and contains profound cultural heritage was designed to ensure that the system can efficiently and accurately support the innovative application of embroidery culture in clothing style design. Researchers focus on introducing an innovative, intelligent clothing-style CAD system design framework based on the integration of components and embroidery culture. Special emphasis is placed on the design and application of embroidery patterns, such as the collar, cuffs, and body of the garment [7]. This includes the selection, layout, colour matching, and needlework expression of the patterns, aiming to promote the deep integration of embroidery culture and modern clothing design through modularization. We conducted an in-depth analysis of the current development status of clothing CAD software both domestically and internationally and pointed out that despite continuous technological advancements [8]. These components not only cover the basic structural parts of traditional clothing. Driven by algorithms, the system can automatically analyze user preferences, fashion trends, and embroidery cultural characteristics, providing personalized design suggestions and inspiration for designers, thereby greatly improving the efficiency and creativity of clothing style design.

At present, many Guangxiu cultural creative products simply copy the patterns or elements of Guangxiu to the products in the design process, on the one hand, they do not combine consumer needs and preferences to clear market positioning, and choose more attractive Guangxiu elements; On the other hand, the designer did not dig deeply into the cultural connotation of Guangxi cultural creative, and the design lacked uniqueness, diversity and innovation, and the market competitiveness was insufficient. In order to improve the quality of Guangxiu cultural creative product design [9], This paper combines multi-modal data and CAD technology to realize the design of Guangxi cultural creative products. Multimodal data refers to data that contains multiple different modes or types of data that may be related and collectively express a complex real-world scenario or situation. The culture of Guangxi cultural creative contains a variety of feature factors, and multi-modal data can realize the extraction, selection and optimization of multi-dimensional, multi-directional and diversified feature factors, so as to provide better data information for product design.

2 RELATED WORK

Embroidery, as a treasure of traditional Chinese culture, adds infinite possibilities to jacquard design with its exquisite needlework and rich patterns. In the graphic design of jacquard fabrics, incorporating embroidery cultural elements not only requires precise editing of pattern contours to match the desired shape but also clever use of weaving markers and embroidery techniques to control long-term floating and maintain the perfect and flawless boundaries of the pattern. Li et al. [10] carefully selected the type of woven markers and combined embroidery techniques and patterns to ensure that floating can be controlled when applied in the selected area, avoiding leaving markers at boundaries that do not require floating and maintaining the harmony and unity of the overall design. Especially for different varieties of jacquard fabrics (such as double weave, super warp, super weft, and single weave), some studies have conducted in-depth analyses of the required bundling fabric control strategies. In the field of computer-aided jacquard graphic design, further exploration has been conducted on how to optimize the weaving and embroidery combination effects of jacquard patterns through a series of automated steps combined with embroidery culture. Like corner pixels,

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it automatically selects the best "Selective Direction Color Contour Options", "Layer Merge Options", and "Transparent Color Options" to tailor a perfect embroidery and jacquard design scheme for single-layer fabric patterns. In order to further improve the design effect, Liu et al. [11] developed specialized algorithms that can intelligently identify key areas in patterns. Innovatively introduced the "Omnidirectional Color Contour Options" and "Selective Directional Color Contour Selection", aiming to achieve finer embroidery and weaving marking layouts to achieve a perfect combination of graphic and background boundaries. During this process, the algorithm ensures precise application of weaving marks only in necessary locations while using embroidery techniques to fill non-essential edges and corners, avoiding unnecessary floating and maintaining clear design boundaries and precise shapes.

As the treasure of Chinese opera art, Qin Opera culture carries thousands of years of profound historical accumulation and is known as the ancestor of Chinese opera. With the rapid development of modern science and technology and the vigorous development of new media, the protection and inheritance of traditional Qin Opera costumes are facing unprecedented challenges and opportunities. Liu et al. [12] deeply analyzed the unique style and complex structure of Qin Opera costumes, focusing not only on the tailoring and modelling of costumes but also on the essence of embroidery art contained therein. Through the careful analysis of the colour application of Qin Opera costumes, a set of bright and symbolic colour systems is extracted. At the same time, the patterns on the clothing were carefully classified and summarized, especially those elements that contain profound cultural significance and exquisite embroidery skills. They are not only decorations but also the inheritance and expression of culture. Through 3D modeling and rendering technology, each restored garment can be displayed on a full range of high-fidelity digital displays, allowing the audience to appreciate every detail of Qin Opera costumes from a close distance and from multiple perspectives and feel the unique charm of embroidery art. Its unique clothing culture, especially the close integration with embroidery art, showcases the exquisite craftsmanship and aesthetic pursuit of traditional Chinese culture. It is worth mentioning that in the process of virtual restoration and innovative design, this article pays special attention to the integration and innovation of embroidery culture. The application of this technology not only realized the precise virtual restoration of 12 sets of traditional Qin Opera costumes, making these precious cultural heritage shine in the digital world but also carried out digital protection and the innovative design of Qin Opera series costumes on this basis. In order to further explore the protection and innovation of Qin Opera costume culture, Pannierselvam and Prakash [13] innovatively introduced 3D virtual visualization technology. Through digital means, the traditional embroidery patterns are deconstructed and reorganized, and modern aesthetic trends and technical means are combined to create Qin Opera costumes that retain traditional charm and have a sense of the times. This innovation not only enriched the expression form of Qin Opera costumes but also injected new vitality into the inheritance and development of embroidery culture.

With the improvement of people's living standards and the transformation of aesthetic concepts, the market demand for innovative products of Guangxi Culture is becoming increasingly diversified. Traditional embroidery, such as decorative paintings and clothing, is still sought after by collectors and cultural enthusiasts, while modern embroidery, such as screens and porcelain paintings, is more popular among young consumers. At present, there are many well-known Cantonese embroidery brands and handicraft workshops in the market. These brands and studios have demonstrated strong competitiveness in product quality, design innovation, sales channels, and other aspects, providing strong support for the development of Guangxiu Culture's innovative products. At the same time, Tan et al. [14] found that traditional Cantonese embroidery cultural products can no longer meet the personalized and modern needs of consumers. Therefore, some designers have modernized traditional patterns through modern technology. In the project "Revitalizing Fashion - Research and Transformation of Traditional Patterns in Cantonese Embroidery", Associate Professor Ding Min and her student team from Guangzhou Academy of Fine Arts extracted visual symbols from traditional patterns in Cantonese embroidery and applied them to modern product design. For example, the packaging they designed for "Bird Language Tea Fragrance: A Tea Cup that Can be Enjoyed at Any Time" features elements of Guangxiu Golden Bird, Oriole, and Peony, which not only preserve

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Guangxiu's exquisite patterns but also give the product new cultural connotations and aesthetic value. Some designers cleverly combine traditional techniques with modern materials, and modern Cantonese embroidery products are no longer limited to traditional materials such as silk but are beginning to try to combine with materials such as porcelain and cotton. For example, the combination of Jingdezhen porcelain painting and Cantonese embroidery not only showcases the exquisite craftsmanship of Cantonese embroidery but also enhances the artistic value of porcelain. This cross-border integration has enabled Guangxiu to find new application spaces in modern home decoration. In order to attract more young consumers, Guangxiu Culture's innovative product design has also incorporated many trendy elements. Products such as Guangxiu Xiaoxiao Music, Guangxiu Tea Bags, Guangxiu Nail Stickers, etc. are not only practical but also full of fun, allowing young people to feel the charm of Guangxiu in their daily lives. In the design of Guangxi Cultural Creative Products, the integration of technology and design is becoming increasingly close. By using modern technologies such as digital design and 3D printing, the details and beauty of Guangxiu patterns can be presented more accurately, improving the production efficiency and quality of products. Wang et al. [15] used digital design software to draw and modify patterns. This software provides rich tools and precise control functions, enabling designers to create more flexible embroidery patterns to meet modern aesthetic needs. At the same time, 3D printing technology is also applied to the production of Guangxiu products, especially those that require complex structures and fine details. Through 3D printing, precise models or parts can be made and then subjected to subsequent embroidery processing, thereby improving the overall quality and production efficiency of the product. In the future development, science and technology will provide a broader space for the inheritance and development of Cantonese embroidery culture.

3 GUANGXI CULTURAL CREATIVE PRODUCT DESIGN MODEL BASED ON MULTI-MODAL DATA

3.1 Factors in Guangxi Cultural Creative

The Guangxi cultural creative contains pattern factors, color factors, and semantic factors, among which pattern factor is the theme pattern of Guangxi cultural creative, including figures, mountains and rivers, landscapes, flowers, birds, beasts, dragons, and phoenix-phoenix, melons and fruits, characters, utensils and so on. The colour factor is divided into two categories: fine colour and light colour. The fine colour is mainly in full colour, and the light colour is mainly in three colours, and the colour depends on the embroidery variety. The semantic factor refers to the semantic description words of Guangembroidery culture in different development stages, which can reflect the multi-dimensional characteristics of Guangembroidery culture. Figure 1 shows the statistical results of the Guangembroider pattern factor classification. As can be seen from the picture, Guangxi cultural creative mainly uses flowers, birds, and plants as the main pattern elements of the works, among which birds are mainly finches, peacocks, and red-belted chickens. These birds not only have bright feathers and beautiful shapes but also have beautiful meanings. Similarly, in the flower category, the bright colors of red cotton and moral noble lotus, peony, mainly fruit and vegetable, meaning health and longevity, inspirational lychee, plants, meaning gentleman bamboo, etc., are the main pattern elements of Guangxiu.

Figure 2 shows the statistical results of colour factors. It can be seen from the results that the colours of Guangxi cultural creatives are mainly traditional colours, the overall tone is darker, mostly blue-green tones, and more colourful. But there is still a corresponding light colour system, the colour is relatively rich and bright.

Since Guangxi cultural creative has a long history of development, and Guangxi cultural creative at different stages is closely related to the social development at that time, there are many semantic factors that cannot be sorted through simple statistics, so semantic factors will be extracted directly through the neural network model, as shown in Figure 3.

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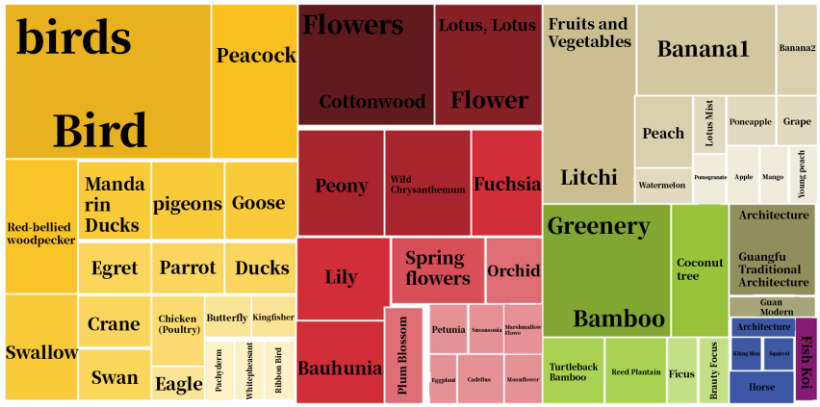

Figure 1: Statistical results of Guangxi cultural creative pattern factor classification.

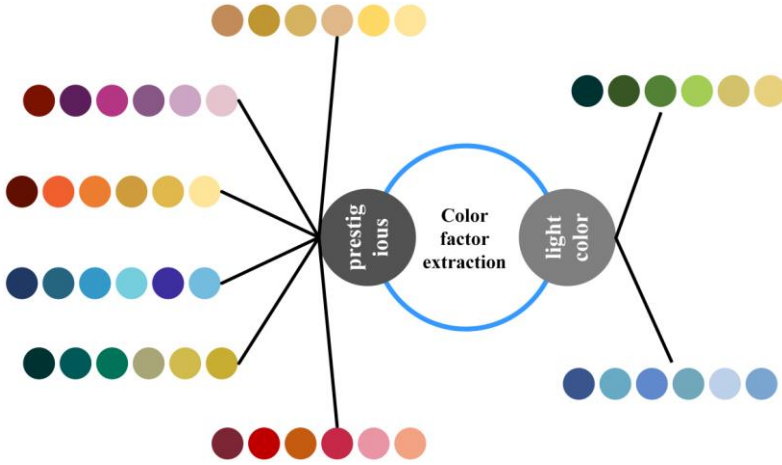

Figure 2: Statistical results of color factors.

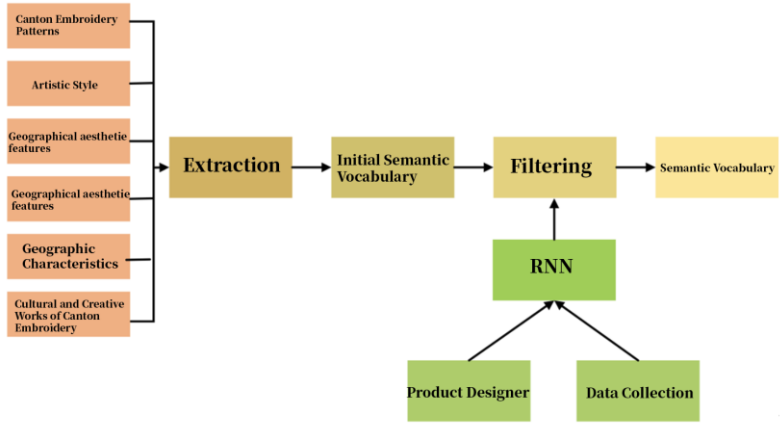

Figure 3: Semantic factor feature extraction process.

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3.2 Factor Feature Extraction Model Based on Neural Network

Considering the diversity of cultural feature factors, this paper uses CNN to extract image features and combines RNN to analyze text intention. As a neural network with a depth structure specially used to process data with a similar grid structure, CNN has a strong performance in image data processing. CNN can perceive and extract features from local areas of Guangxi's cultural creative images through the filter in the convolution layer. This local perception enables CNN to effectively capture local patterns and structures in Guangxi's cultural creative images. These local features are the key to the image analysis of Guangxi's cultural creativity. All neurons in the same convolutional layer share the same set of filter parameters, and the parameter-sharing mechanism greatly reduces the number of parameters in the network, reduces the risk of overfitting, and improves the generalization ability of the model. For Guangxiu images, because they usually contain a large number of repeated textures and patterns, parameter sharing can extract these features more efficiently. Based on the parameter sharing feature, the translation transformation generated by CNN in the process of processing the Guangxi cultural creative image with a complex background and multiple pattern layouts has invariance. Compared with the traditional feature extraction methods, CNN Guangxi cultural creative feature extraction is more efficient and flexible, and it can automatically learn feature representation from Guangxi cultural creative images without manually designing a feature extractor.

Let the input Guangxi cultural creative image be I, the convolution kernel is H And the size is $n*n$, then the final output feature graph is shown in formula (1):

$$y_j(j \in p*q) = f(\sum\nolimits_{i \in m*m} I_i * H_i + c) \tag{1}$$

In the formula, the bias quantity is expressed as c The final output graph size is expressed as $p*q$.

Suppose that the sequence number is $l-1$ The number of sequences in the layer is j The output feature graph is expressed as a_j^{l-1} After passing through the pooling layer, as shown in formula (2) :

$$a_j^l = f(down(a_j^{l-1}) + c_j^l \tag{2}$$

The amount of bias in the formula is expressed as c_j^l the pooling function $down()$.

The CNN activation function is shown in formula (3):

$$relu(x) = \max(0, x) \tag{3}$$

The loss function is shown in formula (4) :

$$loss(Y, \hat{Y}) = \frac{1}{N}\sum_{i=1}^{N}(\hat{y_i} - y_i)^2 \tag{4}$$

The semantic factor is not only the description language of Guangxi cultural creative, but also the emotional expression of designers and consumers of Guangxi cultural creative, which has a certain sequence and timing, and RNN has unique advantages in processing sequence data. RNNS are able to handle long-term dependencies in sequence data, which is particularly important for text analysis because the intent of text often depends not only on the current word or phrase but also on the entire sentence or longer context. Compared to traditional machine learning algorithms, RNNS are able to capture timing information in text, which is crucial for understanding the overall meaning and intent of a sentence. RNN can flexibly process input text of different lengths without the need for complex feature engineering or data preprocessing as some traditional methods do. The RNN model can be easily extended to handle multilingual text or cross-domain text intent analysis tasks. By adding additional language processing layers or adjusting model parameters, RNNS can adapt to different language and cultural backgrounds and can adapt to Guangxiu culture in different development periods.

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Locate in the t Time node input corresponding value is x_t, the corresponding value status of the previous time point C_{t-1} When transmitted to the present moment, the historical data and the current data participate in the calculation, so as to obtain the output of the current time node y_t Sum state C_t At the same time will C_t Transfer to the next time node and participate in the calculation of the next time node. The calculation formula (5) is:

$$C_t=f\ a_t x_t + b_t c_{t-1} + d_t \tag{5}$$

The calculation formula (6) is:

$$y_t=f\ u_t x_t + v_t c_{t-1} + w_t \tag{6}$$

3.3 Design Optimization of Guangxi Cultural Creative Products Based on Transfer Theory

In the design of Guangxiu cultural innovation products, the main idea of transfer learning can be cleverly applied to this process, that is, the culture, traditional skills, and marked data or knowledge structure that have been learned and deeply understood in Guangxiu cultural innovation products can be effectively transferred to the design field of Guangxiu cultural innovation products.

Shorten the time of feature extraction and classification, and improve efficiency. In addition, in order to effectively alleviate the distribution difference between source domain and target domain data in transfer learning, this paper proposes to introduce an adaptive layer into the network architecture as a key strategy. The design of the adaptive layer is based on the principle of domain adaptation, aiming to realize the flexible transformation and alignment of features by building a bridge connecting the feature space of two domains. This layer can intelligently adjust the characteristics of the source domain to make it close to the distribution characteristics of the target domain, so as to enhance the generalization ability and performance effect of the model in the target domain. Through this innovative design, this paper is committed to maintaining the essence of Guangxi's cultural creativity while ensuring that innovative product design can seamlessly integrate into and meet modern aesthetic and market needs. The maximum mean difference distance of its value is calculated as shown in (7) :

$$DM_{\max}(E_g,E_b)=\left\|\frac{1}{E_g}\sum\nolimits_{e_g\in E_g}\phi(e_g)-\frac{1}{E_b}\sum\nolimits_{e_b\in E_b}\phi(e_b)\right\| \tag{7}$$

Where the mapping between an original space and a Hilbert space is described as a function ϕ The source data set and the target data set are denoted as E_g and E_b, the corresponding data is e_g, e_b.

In order to achieve the maximum computation and the optimal migration effect, the above problems can be optimized through the deep adaptation network. Its optimization objectives are shown in (8) :

$$\min_{\Theta}\frac{1}{i_c}\sum\nolimits_{m=1}^{i_c}Q(\theta(y_m^c),z_m^c)+\varphi\sum\nolimits_{l=l_1}^{l_2}e_h^2(E_g^l,E_b^l) \tag{8}$$

Where the learning goal value is denoted as Θ, l_1,l_2 Describes the sequence number of adaptation layers, and the penalty coefficient is denoted as φ, the loss function Q. According to the actual needs of this paper and fully considering other factors, the domain adaptation method is finally selected and the best selection scheme is obtained through experiments.

The final fusion calculation of special and general features is shown in (9):

$$K_{st}(\alpha)=\left[\varepsilon K_s^{(1)}(\alpha),\ldots,\varepsilon K_s^{(12)}(\alpha),\gamma K_t(\alpha)\right] \tag{9}$$

among $\varepsilon>0,\gamma\geq 0$, general and special characteristics are described as $K_s(\alpha)$ and $K_t(\alpha)$.

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In order to improve the market competitiveness of Guangxiu cultural innovation product design and meet the needs of different levels of consumers, this paper adopts a particle swarm optimization algorithm (PSO) design scheme optimization algorithm. The algorithm originates from the hunting behaviour of birds in nature, is rooted in the broad theory of swarm intelligence, and has a strong performance of global optimization strategy. By simulating the cooperative and competitive behaviour of individuals in a bird swarm (or particle swarm) in the solution space, the search and solution of complex multidimensional space functions and dynamic optimization targets are realized. Particle swarm optimization (PSO) not only shows excellent solving ability for multi-dimensional complex problems but also stands out in many optimization problems with its fast convergence speed and good robustness. These advantages make particle swarm optimization a powerful tool for solving various optimization problems in engineering, economy, science and other fields.

Let the L -dimensional space be the search space, The number of particles in a population is K , can pass $X_j = (x_{j1}, x_{j2}, ..., x_{jl})$ To represent the number of sequences in the population j The position of the particle in space, and the optimal solution of the particle position is the global optimal individual, expressed as $P_j = (p_{j1}, p_{j2}, ..., p_{jl})$ The position velocity vector of the particle is expressed as $V_j = (v_{j1}, v_{j2}, ..., v_{jl})$. Formulas (10) and (11) show the position and velocity of each particle in the population after iterative changes:

$$v_{jl}(t+1) = g \cdot v_{jl}(t) + z_1 \cdot rd() \cdot (p_{jl}(t) - x_{jl}(t)) + z_2 \cdot rd() \cdot (p_y(t) - x_{jl}(t)) \tag{10}$$

$$x_{jl}(t+1) = x_{jl}(t) + v_{jl}(t+1) \tag{11}$$

The inertia factor in the formula is expressed as g , The acceleration factor is expressed as z_1, z_2 And it's a normal number, $rd()$ Represents random values and $rd() \in [0,1]$ The current iteration algebra is expressed as. Because the velocity and initial position of the particle swarm is generated randomly, the iteration of the particle swarm will stop when the position and velocity of the particle swarm meet the termination condition through the iteration of the above formula.

As shown in formula (12) is the calculation formula of inertia weight in formula (10) :

$$g = \begin{cases} g_{\max} - \dfrac{(g_{\max} - g_{\min})(s - s_{ave})}{s_{\max} - s_{ave}}, s \geq s_{ave} \\ g_{\max}, s < s_{ave} \end{cases} \tag{12}$$

Where the particle adaptation value is expressed as s , the average particle adaptation value is expressed as s_{ave} , the maximum fit value in the particle swarm is expressed as $s_{\max}$.

4 EXPERIMENTAL RESULTS

In order to better test the performance of this model, this paper first tested its feature factor extraction performance. Since Guangxi cultural creative pattern factors have been statistically analyzed above, colour factors and semantic factors of Guangxi cultural creativity were further extracted in this experiment, and the results are shown in Figure 4. The results in the figure show that in terms of colour factor extraction, the model in this paper realizes secondary extraction of colour factors according to market and consumer demand, and the extracted colours are more in line with the current market and aesthetic trend. In terms of semantic factors, the model effectively extracts the corresponding feature factors from six dimensions and completes the classification.

In order to further verify the feature factor extraction performance of the proposed model, this paper selected another three feature factor extraction models to compare the error rate of feature factor extraction, namely the KNN model, SVM model and HOG model. The results in Figure 5 show that among the four models, the HOG model has the highest error rate, while the paper model has the

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lowest error rate, and the error rate of the paper model is significantly lower than that of the other three models.

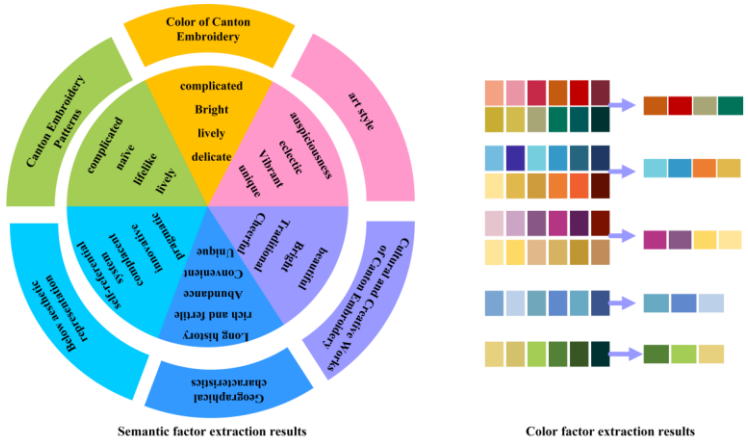

Figure 4: Feature extraction results of cultural colour factor and semantic factor in Guangxi cultural creative.

This shows that the model in this paper can effectively classify pattern elements, colours and semantics in Guangxi cultural creative with high accuracy, and complete feature extraction on this basis to provide reliable and accurate basic data for the application of the model.

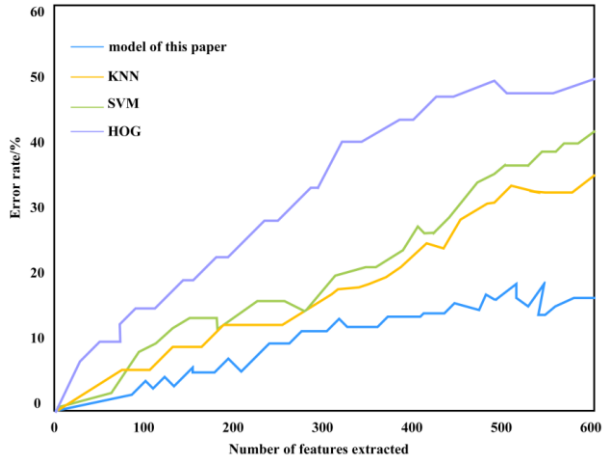

Figure 5: Comparison results of error rates of four feature factor extraction models.

In the application experiment, this model will design Guangxiu cultural innovation products according to the feature factor extraction results, and analyze the design time and application of Guangxiu cultural innovation products. Figure 6 shows the innovative products of Guangxiu culture to be evaluated, including hoodies, jewellery, jewellery boxes, thermos cups, bags, silk scarves, etc. Most of them are products that consumers can use daily. The design of innovative products is mainly to add Guangxiu cultural elements on the basis of the original functions of daily necessities. In order to highlight the Guangxiu culture, some of the products directly use the elements, and the other part of the product elements are re-used by the designer through CAD design.

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Figure 6: Design of eight kinds of cultural innovation products in Guangxi cultural creative.

Figure 7 shows the comparison result of the design time of eight kinds of Guangembroidery cultural innovation products and the average design time of traditional Guangembroidery products. The results in the figure show that compared with the average design time of traditional Guangxi cultural creative products of the same product, the design time of Guangxi cultural creative cultural innovation products combined with multi-modal data and CAD technology is significantly shorter, and the design efficiency has been greatly improved, that is, it can complete more product designs in a shorter time and provide consumers with more product design choices. To meet the needs of the market to a greater extent.

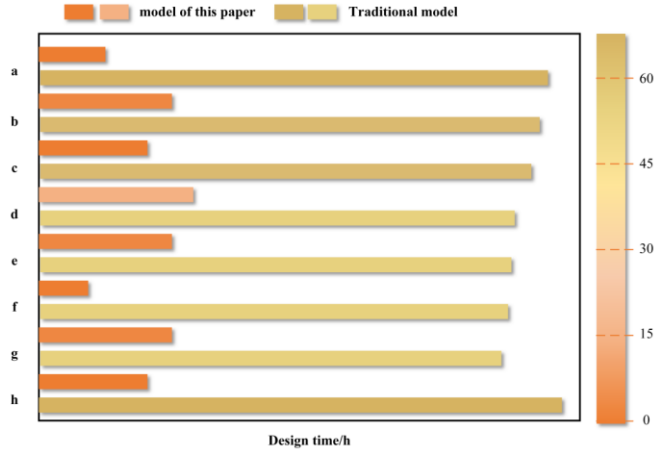

Figure 7: Comparison of design time between traditional Guangxi cultural creative products and innovative products.

Based on the results of design time and efficiency, this paper further analyzes the design elements of eight kinds of Guangxiu cultural innovation products, and the results are shown in Table 1. The results in the table show that Guangxiu elements are used in the design of the eight middle school Guangxiu cultural innovation products, among which e-h directly uses the patterns of "red cotton", "peacock" and "lychee" in Guangxiu, and the colours are mainly Guangxiu colours. The overall design is based on traditional design, and certain innovations are made in aspects of vision, function,

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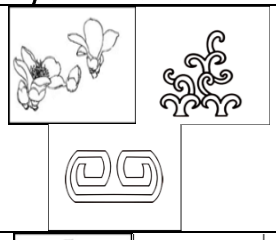
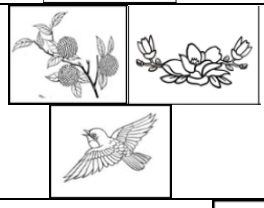
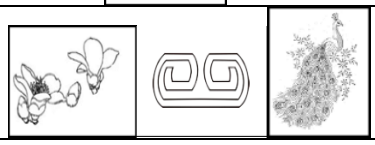
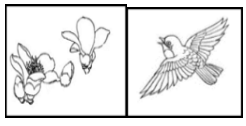
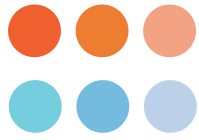
material and shape. Introduce more in line with modern aesthetic design elements. Product a-d is based on the traditional patterns of Guangxi cultural creativity to carry out certain design and morphological changes so that it is more adaptable to the functionality of the product itself. In terms of colour, on the basis of maintaining the characteristics of Guangxi cultural creative colour factors, it will add colours in line with the current aesthetic, so that the colour level of the product is richer, and the design sense of the pattern is enhanced. This kind of product design is more inclined to the development and innovation of the product, and the flexible use of Guangxiu cultural elements gives it more freshness. To sum up, CAD technology combined with multi-modal data can extract and select corresponding feature factors and data information for designers according to the needs and preferences of consumers and markets, and improve the design efficiency and quality of designers.

D	*Guangxi cultural creative pattern factor*	*Guangxi cultural creative colour factor*	*Guangxi cultural creative semantic factor*
			Complex, bright, compact, eclectic, auspicious, innovative
			Delicate, lifelike, innocent, traditional
			Complex, compact, innovative, pragmatic, auspicious, unique, beautiful
			Vibrant, unique, bright and innovative
			Traditional, delicate, lifelike and pragmatic
			Bright, delicate, lively, bright
			Lively, vibrant, innovative and cheerful

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		Traditional, unique, delicate, full of vitality

Table 1: Analysis results of design elements of eight kinds of Guangxiu cultural innovation products.

5 CONCLUSIONS

Traditional Guangxi cultural creative product design is affected by many factors such as the designer's technical level, experience, market conditions and so on, it is difficult to complete the design of a variety of products in a short time. At the same time, traditional Guangxi cultural creative products are mainly based on traditional styles, lack corresponding innovation, and can not meet the diversified and personalized needs of consumers. Therefore, this paper combined CAD technology and multi-modal data to build the Guangxiu cultural innovation product design model, that is, CNN and RNN were used to extract different cultural data features, and the PSO algorithm and migration algorithm were introduced to optimize the design of innovative products. The experimental results show that this model can efficiently and flexibly complete the classification and extraction of cultural feature factors, and significantly reduce the extraction error rate. At the same time, it can effectively extract the characteristic factors in line with the current aesthetic according to the needs of the market and consumers, and help designers shorten the design time. In addition, the combination of CAD technology and multi-modal data provides designers with more space for element innovation, which can improve the flexibility of element application, improve design efficiency and design quality. However, because the innovative products of Guangxiu culture still need to be decided and designed by designers, in the absence of market comparison, there will be results that the innovative design does not meet the needs and expectations of consumers. This requires the introduction of a recommendation system in the model in the subsequent research to provide designers with elements and data that are more in line with the market according to consumer preferences.

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Meihuan Chen, https://orcid.org0009-0009-6157-4802
Yan Cai, https://orcid.org/0009-0007-5226-5712

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