

Article

The Revitalization Design of Regional Ethnic Cultural Capital in a Sustainable Perspective: The Case of Traditional Chinese Garment Yunjian

Han Chen ¹, Han Xu ¹, Yudian Zhang ² and Leilei Jia ^{1,*} 

¹ School of Design, Jiangnan University, Wuxi 214122, China; chenhanisaac@163.com (H.C.); xh502443490@foxmail.com (H.X.)

² School of Fashion Design and Engineering, Zhejiang Sci-Tech University, Hangzhou 310018, China; zoey0712@126.com

* Correspondence: jialeilei@jiangnan.edu.cn

Abstract: The formation of the globalization pattern of regional ethnic culture brings new opportunities for the sustainable development of cultural capital. In order to solve the problem of mismatch between the high development demand of regional ethnic costumes and their traditional design methods, this study proposes an innovative design method for regional ethnic traditional costumes, taking the Yunjian, a cloud-shaped sash-like shoulder garment as an example. Firstly, we deeply explored the historical and cultural connotation of the Yunjian through fieldwork and literature research. Then we sorted out and refined its elements, colors and structural features. We classified the patterns according to the composition forms and clarified the path of pattern creation based on fractal theory. We combined the representative elements of Yunjian with the fractal algorithm and proposed the design model of Yunjian fractal pattern. Finally we verified the feasibility of the proposed design method through design practice. The results show that the Yunjian garment created by the method of this paper can better reflect the characteristics of fashion art and ethnic culture.

Keywords: sustainability; digital design; regional ethnic culture; cultural capital; revitalization; Yunjian; traditional garment



Citation: Chen, H.; Xu, H.; Zhang, Y.; Jia, L. The Revitalization Design of Regional Ethnic Cultural Capital in a Sustainable Perspective: The Case of Traditional Chinese Garment Yunjian. *Sustainability* **2022**, *14*, 8090. <https://doi.org/10.3390/su14138090>

Academic Editors:
Hafeezullah Memon, Xiaoke Jin,
Tian Wei and Chengyan Zhu

Received: 20 April 2022

Accepted: 28 June 2022

Published: 1 July 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Ethnic traditional costumes are not only intangible cultural heritage carrying the spirit and centripetal force of national culture, but also cultural capital and wealth containing great revitalization value [1]. With the formation of the globalization of regional ethnic culture, Chinese regional fashion has become part of the global popular style [2]. The Yunjian is a unique costume item placed on the shoulder in ancient China, which has a rich art form and profound cultural heritage, and has a prominent position and high research value in the Han Chinese costume culture. The culture of traditional Yunjian garments is constantly being explored and moving towards the world fashion stage. This market-oriented fashion phenomenon has transformed the regional ethnic “cultural heritage” into “cultural capital” that can be transferred, and brought opportunities for sustainable development to the regional ethnic traditional culture, which was facing a crisis of discontinuity. The worldwide popularity of Chinese traditional costume styles has put forward higher demands on the design and development methods. With the development of artistic aesthetics and value experience, the emerging culture of ethnic fashion has changed the clothing consumption behavior of modern people. More scientific and efficient innovative design methods that take into account ethnic characteristics and modern fashion need to be researched and developed.

The rapid development of science and technology can give new possibilities to artistic expression. Research on the innovative design of costumes is not uncommon, but most

of the studies focus on material and functional innovations. Few researchers have introduced computer algorithms into the innovative design of ethnic costumes with remarkable results. Nowadays, fractal algorithms have received a lot of attention from researchers. Mathematician Mandelbrot was the first to use the term fractal to describe a figure or phenomenon with similar properties. Fractal patterns contain self-similarity between the whole and the parts, with the possibility of infinite iteration and repetition. Currently, there is a lot of literature applying fractal theory to modern design. A Laubsted explored the mathematical logic behind fractal geometry and fractal art [3]. JZ Zhang et al. used fractal geometric methods to analyze traditional furniture shapes and decorative arts, and concluded a design method applicable to furniture shapes in practice [4]. JC Driscoll used fractal dimension and Vollendorf method to create unique fractal compositions and tried to apply them in architectural design development [5]. However, fewer research results have applied fractal theory to the design of regional ethnic traditional costumes with fractal art features and concluded a proven systematic approach. The Yunjian costumes created by ancient Chinese ancestors are not lacking in fractal art features, but have not been formed into a scientific and systematic pattern design system based on fractal theory. This study proposes an innovative method for Yunjian costumes based on the Newtonian function model, aiming to expand a new way of inheritance, innovation and application of national costumes.

2. Research Background

Yunjian is draped over the front and back of the shoulder. In Chinese, the meaning of “Yunjian” is “a colorful cloud on the shoulder”, because people wear it as beautiful as a colorful cloud. Yunjian was developed during the Five Dynasties and Ten Kingdoms period (907–979 AD). At that time, it had no decorative meaning. It was mainly used to protect the collar and prevent the hair from staining the clothes. During the Qing dynasty, the decorative meaning of the Yunjian was greater than its practical function, and it became an indispensable decorative garment for women as part of their wedding ceremony. The Yunjian was rich in color, beautifully crafted, and had a very distinctive structure and design. In this section, we will introduce and analyze the pattern themes, color rules and structural features of the Yunjian.

2.1. Pattern Theme

Most of the patterns in traditional Chinese folk costumes come from life and are influenced by the background of the times, people’s beliefs and local customs [6]. The common pattern images in Yunjian can be broadly divided into plant, animal, character, artifact and text categories. The common plant themes are pomegranates, grapes, pumpkins, loquats, and so on. The Chinese pronunciation of “many seeds” is the same as “many sons”, so the Chinese people give pomegranate an auspicious meaning of many sons and many blessings. People also like the round shape and golden skin of pumpkins, which they believe symbolizes completeness and wealth. The long, curved and tough vines of the pumpkin symbolize longevity and family prosperity. In addition to the melon and fruit patterns, the lotus flower, which symbolizes harmony between husband and wife, and the peony flower, which symbolizes wealth and elegance, are also common motifs in the Yunjian. Animal motifs include bats, butterflies, Chinese unicorn, cranes, dragons and phoenixes. The Chinese pronunciation of “bat” is the same as “happiness”, so bat patterns are loved by Chinese people as a symbol of happiness. The Chinese unicorn is a mythological animal in China. In mythology, the appearance of the Chinese unicorn usually means that good things are about to happen. As a symbol of hope and good luck, the Chinese unicorn pattern is often found in the clothing of Chinese nobility. Ruyi, coral, pearl, vase, ivory and other objects are also common subjects for auspicious patterns. Word patterns are usually derived from the deformation of words with auspicious meanings and good wishes, such as Shou (longevity) word patterns, Wan (ten thousand) word patterns and Xi (joyful) word patterns. Character patterns are mainly chosen from the subjects of

maids, babies, couples and so on. These characters usually form lively scenes of life, such as farming, marriage, boat trips, flower viewing, children playing, etc. The common patterns in the five main themes and their line drawing extracts are shown in Figure 1.

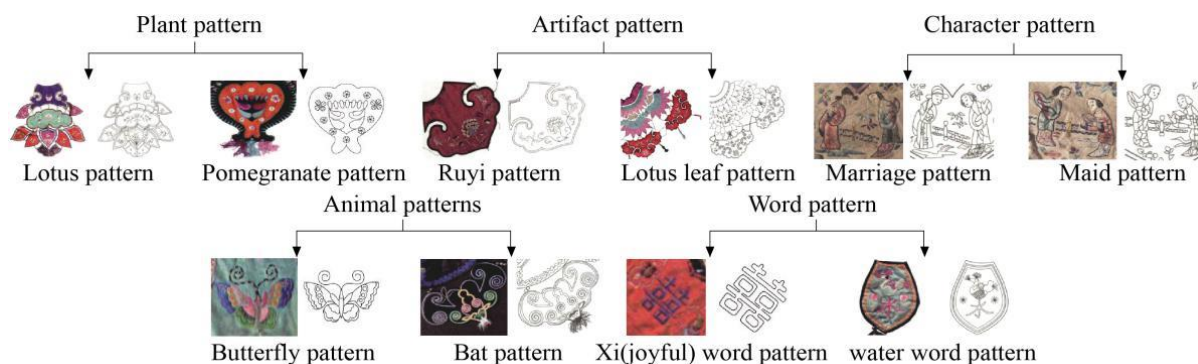


Figure 1. Representative Yunjian pattern themes and line drawings.

2.2. Color Rules

The color scheme of the Yunjian garment follows the two traditional color rules of “Homochromatic system” and “Contrast color system” in ancient costumes. Yunjian costumes commonly use five colors (white, cyan, black, red, yellow) as the main colors for large areas, while using related average colors for auxiliary embellishment. The same color series of Yunjian focuses on the harmony and unity of colors. Contrasting colors are used to adjust the color according to brightness, purity and area size to achieve a lively visual effect. There has been related literature that classifies Yunjian colors into three categories according to the rules of color usage, which are primary colors, auxiliary colors and decorative colors. Primary colors of Yunjian mainly refers to the fabric base color. Auxiliary colors refer to the embroidery, applique and other process colors to meet the overall or local modeling needs of the garment. Auxiliary colors usually have no obvious effect on the visual effect of Yunjian colors. The decorative colors mainly refer to the complicated, small block of gorgeous colors in the Yunjian costume.

2.3. Structural Features

Although the Yunjian is used as a costume accessory most of the time, it is worn in the visual center of the body. Therefore, it plays an important role in the overall structure of the costume. The modeling of Yunjian has unique artistic charm and regularity, its structure can be divided into hierarchical structure and external structure [7].

The hierarchical structure of the Yunjian can be divided into four categories: the single-piece structure, the multi-layer structure, the connected structure and the mixed structure. Different structure of Yunjian gives people completely different style feeling. The earliest Yunjians were basically symmetrical single-piece structures that were simple, lightweight, and suitable for children to wear. Modern children’s bibs are developed from this. The multi-layer structure are single pieces of shaped Yunjians laminated together, this kind of design is ordered and looks richer. The connected structure Yunjian is light, it consists of the overall shape breaking down and cutting off the excess padding parts to form the skeleton, and then putting it together in an orderly manner. The connected structure Yunjian is more complex, it not only requires fine single piece, but also pays more attention to the overall arrangement effect. The mixed structured Yunjian combines all of the above forms and is more elegant and refined.

The appearance structure of the Yunjian can be divided into two types: centrifugal structure and centripetal structure. The centrifugal structure is centered on the neckline and spreads out in a straight line to lead the sight outward. The centripetal structure is a contraction from the periphery to the center, and the visual center is more focused. When

the Yunjian is worn on the body, its shape outline can be divided into crescent-shaped, semi-circular and T-shaped, as shown in Figure 2.

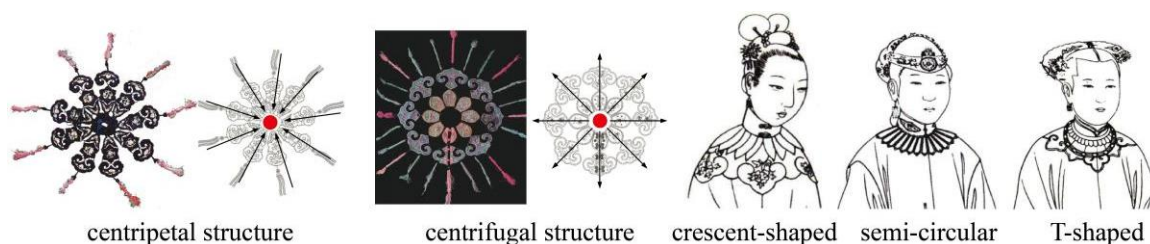


Figure 2. Cloud shoulder structure and shape.

Analyzed from the overall visual effect, the Yunjian has rich formal aesthetic characteristics. The modeling of the Yunjian reflects an orderly aesthetic, with a sense of symmetry and balance between the individual pieces. The same single-piece shape and form are used repeatedly, while the decorative elements are varied to give it a sense of rhythm.

3. Research Methods

3.1. Elemental Derivation Methods

This study focuses on the derivative design of pattern elements through the morphological displacement method. The morphological displacement method can summarize the derivation process of the elements into a regular design language [8]. The basic elements of the Yunjian pattern are moved in a directional way by the morphological displacement method, and the size of the elements and the logic of the displacement trajectory can be changed during the movement. We take the classical element of the Yunjian pattern, Ru Yi pattern, as an example, and show 8 predefined rules of morphological displacement derivation in Figure 3. The combined use of different rules and their derivation results are shown in Figure 4.

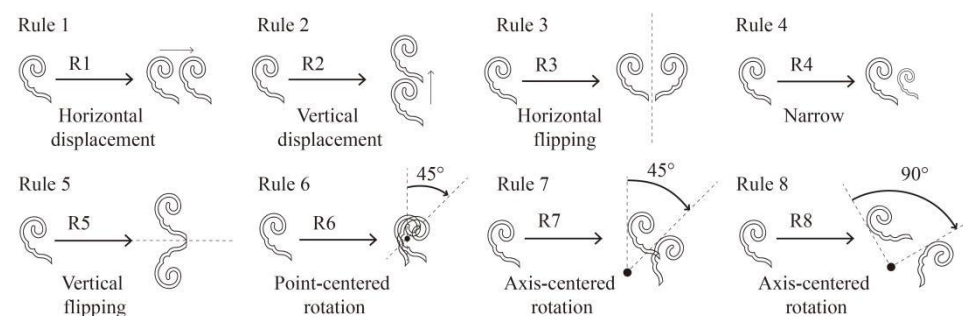


Figure 3. Elemental derivation rules.

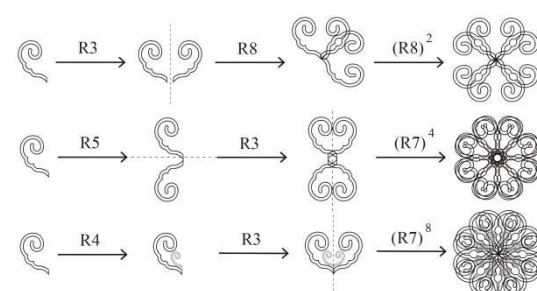


Figure 4. Example of the application of derivative rules.

3.2. Color Extraction Method

3.2.1. K-Means Clustering Algorithm

Color design is one of the most direct ways to convey the aesthetics of a garment [9]. Clustering algorithms can merge and extract colors from existing patterns based on a preset range of color fields. k-means is an iterative solving algorithm for cluster analysis [10]. It uses a circular positioning technique to translate different intervals to improve the quality of interval delineation. The algorithm selects K objects as initial clustering centers. The algorithm assigns each object to the closest cluster center and calculates the distance between each object and the center. When all objects are assigned, the cluster centers are recalculated based on the existing objects in the class. Applying the k-means clustering algorithm to Yunjian pattern color extraction and making color cards can analyze the color distribution more accurately and quantitatively [11,12].

3.2.2. Color Analysis Method Based on HSB Model and L*a*b* Model

Compared with the common RGB and CMYK color models, L*a*b* is a description model with a wider range of colors [13]. Considering that Yunjian garment focuses more on subjective color imagery feeling in artistic expression, we introduced HSB model, which is closer to human sensory intuition based on L*a*b* color model. In this research, the two color models L*a*b* and HSB are combined to analyze color. We extracted the RGB values of the colors in Adobe photoshop, and obtained the L*a*b* color axes by converting the RGB values through the XYZ intermediate parameters. The specific calculation is shown in Equations (1) and (2).

Converts RGB values to XYZ values:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 0.412 & 0.357 & 0.180 \\ 0.212 & 0.715 & 0.072 \\ 0.019 & 0.119 & 0.950 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \quad (1)$$

Conversion of XYZ values to L*a*b* values.

$$\begin{aligned} L &= 116f\left(\frac{Y}{Y_n}\right) - 16 \\ a &= 500\left[f\left(\frac{X}{X_n}\right) - f\left(\frac{Y}{Y_n}\right)\right] \\ b &= 200\left[f\left(\frac{Y}{Y_n}\right) - f\left(\frac{Z}{Z_n}\right)\right] \end{aligned} \quad (2)$$

$X_n = 95.047$, $Y_n = 100.000$, $Z_n = 108.883$. The a and b values of the L*a*b* model parameters are used as the horizontal and vertical coordinates to plot the color distribution scatter diagram. In addition, we extracted the HSB values of the colors through Adobe photoshop and made a histogram for statistical analysis [14]. L*a*b* color distribution scatter diagram and HSB histogram can show the color usage rules of the Yunjian garment more intuitively.

3.3. Pattern Design Method

The overall structure of the Yunjian garment is symmetrical, and the combination of each single piece has regularity and repetition. Such a symmetrical structure makes most of the Yunjian patterns have the fractal characteristics of self-similarity and repetition iteration. Based on this feature, this study uses the fractal art principle of escape time algorithm to innovate the design of Yunjian pattern. The escape time algorithm is a computer graphics generation algorithm based on iterative function f_n . Assuming that f is a variational iterative function, $f_0(x) = x$, $f_1(x) = f(x)$, $f_2(x) = f(f(x))$, $f_{n+1}(x) = f(f_n(x))$, $n = 0, 1, 2, \dots$. The computer establishes a coordinate system in the graphical determination region, brings the pixel coordinates in the region into the iteration function in turn, and judges whether the pixel coordinates converge under the given iteration function. Because of the different

number of iterations for different convergence point divergence points, we can get the pattern with rich structure and conform to the preset parameter fractal characteristics. Based on the symmetrical and divergent skeletal structure of the Yunjian pattern, we chose the Newton iterative fractal prototype that fits this feature. The structure of the Newton iterative fractal prototype can be expressed by the formula as shown in Equation (3).

$$Z_{n+1} = Z_n - \frac{F(Z_n)}{F'(Z_n)}, (n = 1, 2, \dots) \quad (3)$$

$F(z)$ is a complex function, $z = x + yi$, x, y are variables, and i is an imaginary number. In the specific calculation, generally $F(z) = z^p - 1$, and p is a positive integer greater than 2, so the iterative formula can be rewritten as Equation (4).

$$Z_{n+1} = \frac{(p-1)Z_n^p + 1}{pZ_n^{p-1}}, (n = 1, 2, \dots) \quad (4)$$

We can change the p -value in Equation (4) according to the specific design requirements to obtain different evolutionary results based on Newton's iterative fractal prototype to be used as the key design material for the Yunjian garment pattern.

3.4. Evaluation Methodology

This study uses a rank sum algorithm to determine the weights of each indicator in the evaluation system. We invited an expert panel of senior related practitioners to score the importance of the evaluation indicators [15]. Before calculating the weights, we conducted consistency tests on the expert opinions, as shown in Equations (5)–(7).

$$\chi^2 = m(n-1)w \quad (5)$$

$$w = S / \left[(12)^{-1} m^2 (n^3 - n) \right] \quad (6)$$

$$S = \sum R_j^2 - (\sum R_j)^2 / n \quad (7)$$

χ^2 is the statistic, R_j is the rank sum of the j th indicator, m is the number of experts, and n is the number of indicators. By substituting Equations (6) and (7) into Equation (5), we can check whether the experts' opinions are consistent by calculating and comparing.

The specific calculation of the evaluation index weights is shown in Equation (8).

$$a_j = 2[m(1+n) - R_j] / [mn(1+n)] \quad (8)$$

After determining the evaluation indexes, evaluation item weights and evaluation scales, we adopt a questionnaire survey conducted both online and offline to conduct a comprehensive evaluation of the design practice results [16].

4. Design Practice

4.1. Yunjian Pattern Derivation

We extracted several common elements from the Yunjians and combined them into a new pattern. Then we apply the morphological displacement method to mirror and rotate the elements to generate a new pattern with prototypical features. The pattern can be used as a new basic element unit. We have completed several representative Yunjian element units by this method, as shown in Figure 5. These element units will be further used in the subsequent design.

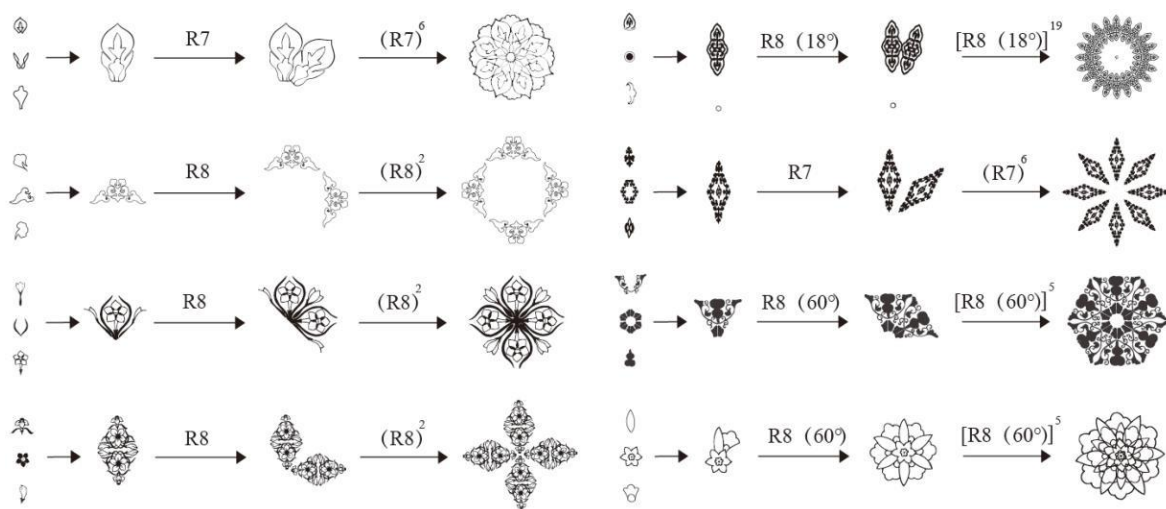


Figure 5. Basic pattern unit generation process.


























4.2. Yunjian Color Design

In this research, five color intervals were created using the K-means clustering algorithm, and the clustered colors were batch normalized and averaged by the color distance value ΔE . The image cluster partition of the 5 groups of images is set to consist of all colors within $\Delta E \leq 5$ pixels. To achieve the desired effect, we obtain the color share of the Yunjian pattern by presetting the color separation value with the distance value and multiple clustering calculations. Then we clarify the color collection area and size by image cluster partitioning, as shown in Table 1. HSB represents hue, saturation, brightness and RGB represents the colors of red, green and blue channels [17]. The RGB color extraction results of each group of Yunjian patterns are shown in Table 2.

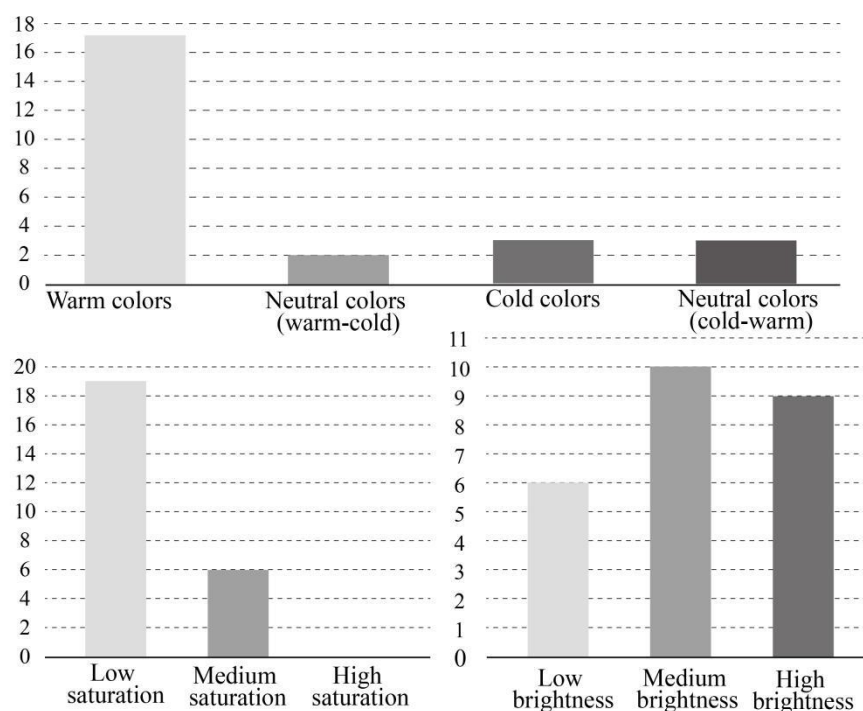
Table 1. Yunjian color extraction.

Main Color	Pattern	Image Cluster Partitioning	Color Ratio (%)
White series			 25.7 24.6 20.7 15.5 13.5
Cyan series			 23.9 22.4 21.3 20.0 12.4
Black series			 81.5 5.3 5.1 4.7 3.4
Red series			 31.2 22.2 19.4 17.3 9.9
Yellow series			 33.1 22.8 18.4 17.9 7.8

Table 2. HSB values and RGB values of colors.

White Series					
RGB	194/177/169	227/216/208	44/41/46	77/79/77	145/124/123
HSB	19/13/76	25/8/89	276/11/18	120/3/31	3/15/57
Cyan series					
RGB	116/138/132	150/177/165	47/36/40	156/123/117	102/85/89
HSB	164/16/54	153/15/69	338/13/28	9/25/61	346/17/40
Black series					
RGB	12/7/8	165/142/121	122/129/128	87/106/73	172/96/121
HSB	348/42/5	29/27/65	171/5/51	95/31/42	340/44/67
Red series					
RGB	191/176/166	208/75/70	181/88/87	180/128/127	94/92/93
HSB	24/13/75	2/66/82	1/52/71	1/29/71	330/2/37
Yellow series					
RGB	234/185/138	178/139/112	60/43/62	113/90/83	209/86/77
HSB	29/41/92	25/37/70	294/31/24	14/27/44	4/63/82

From Figure 6, it can be seen that most of the extracted colors are warm colors, and a small amount of colors are distributed in the neutral and cold color regions. In terms of saturation, most of the colors are low-saturation colors, a small number of medium-saturation colors, and no high-saturation colors appear. In terms of brightness, the color distribution is relatively uniform, and there are few low brightness colors.

**Figure 6.** Number of different hues, saturation and lightness in the color extraction results.

According to Equation (2), we plotted the scatter diagram of color distribution of five color families with the a value as the horizontal coordinate and the b value as the vertical coordinate, as shown in Figure 7.

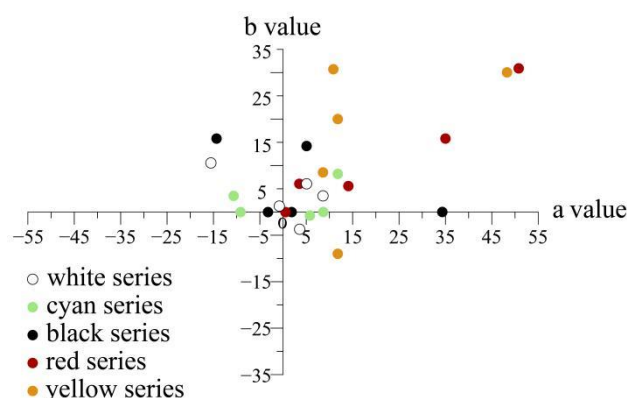


Figure 7. Distribution of color dots for the five color series.

The L-axis represents brightness, with values from 0 to 100 indicating brightness from black to white. The a-axis represents the relative colors of red and green, and the b-axis represents the relative colors of yellow and blue.

As can be seen from Figure 7, the distances between the dots of the white and cyan series are relatively close to each other and are concentrated around the origin L value. The dots of the black series are not far from the origin, but their positions are scattered and their colors differ in hue. The dots of the red series are all located in the first quadrant and distributed in a diagonal line, but the distance between the dots is farther. The yellow series is similar to the red series, the a-value gap between each of their dots is small and the b-value is relatively scattered. In general, the dots of the five color series are basically distributed in the first quadrant and concentrated near the L value of the origin, with a small number of dots scattered in more distant locations.

The histogram statistics of the HSB color model and the scatter plot of the L*a*b* model both confirm that the Yunjian garments usually choose warm colors, low saturation colors, and evenly distributed color brightness.

4.3. Yunjian Fractal Pattern Designcolor Design

According to Equation (4), when $p = 4, 6, 8, 20$, we can obtain the Newton iterative fractal diagram when the “arms” of the fractal are equal to the corresponding values, as shown in Figure 8. We can know that the value of the real part of the exponent p is proportional to the number of “arms” of the Newtonian fractal, and the area of the central intersection circle increases gradually as the value of p increases. We rewrite the Exponent (Re) index in the primary Newton fractal in the Ultra Fractal software platform in version 6.04 to make the model match the pattern structure according to the design characteristics of the Yunjian. When the exponent is 4, 6, 8, and 20, different models and their mapping patterns are obtained. This research lists four series of Yunjian fractal pattern processes produced by different exponent real parts.

When we set the Exponent (Re) index to 4, we get two new models with completely different forms and effects by adding Inverse mapping, Glass Hemisphere mapping and Triangle Inequality Average external mapping respectively. On top of that, we can further superimpose new mappings or formulas to pursue more complex and exquisite pattern effects. After selecting the mapping, we add a color factor with the Yunjian style in the Adjustment Gradient window in the model and change the opacity to achieve the desired effect. Similarly, when the Exponent (Re) index is 6 or 8 or 20, the corresponding fractal pattern can be obtained by the same procedure. It can be seen that the final fractal patterns obtained are extremely different due to the different settings of indices. We made 8 fractal patterns according to the model. These patterns conform to the basic composition form of the Yunjian pattern with infinitely subdivided fractal features and brilliant colors, which can reflect the exquisite and complicated style features of the Yunjian to a certain extent.

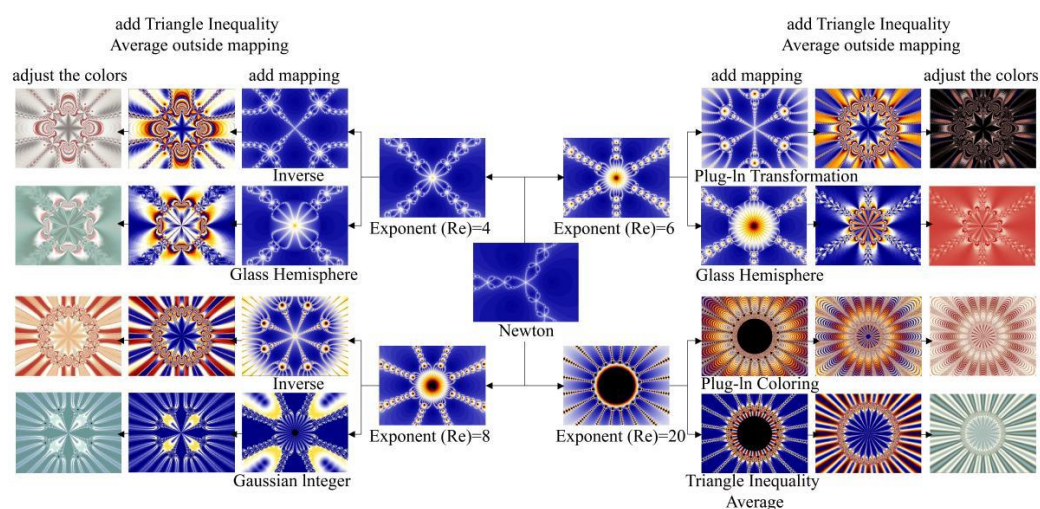


Figure 8. Yunjian fractal pattern design process.

4.4. Yunjian Clothing Design

In order to make the fractal pattern not lose the original characteristics of the Yunjian, we integrated the representative element unit of the Yunjian into the fractal pattern and made the design processing of mirroring or rotating according to the structural characteristics of the fractal pattern. We subjectively processed the elemental units to make them blend naturally, and finally finished the fractal pattern. We combined the typical outer outline structure of the Yunjian with the fractal pattern and removed the outer pattern to obtain 8 tiling style figure of the fractal Yunjian. The production process is shown in Figure 9.

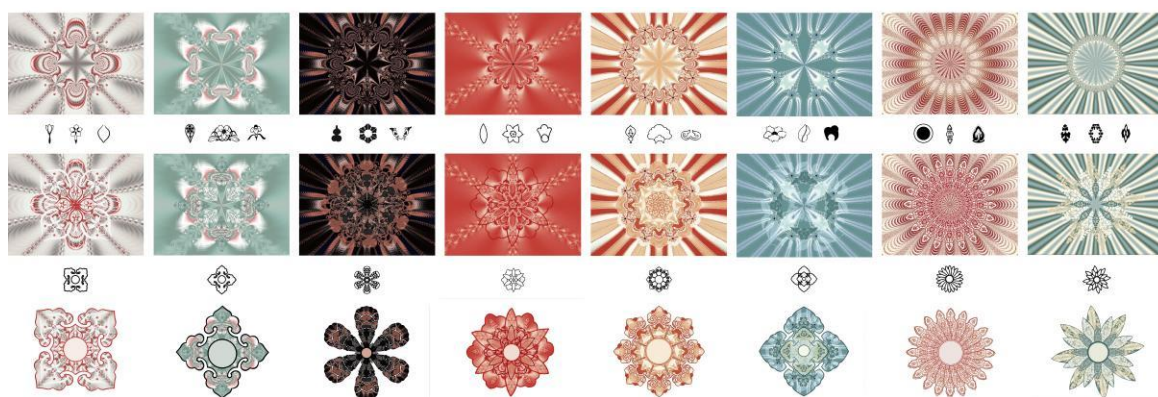


Figure 9. Cloud shoulder shape design process.

This research focuses on 8 styles of Yunjians, combined with modern clothing to complete a series of Yunjian clothing design, as shown in Figure 10. The series of garments are simple in design, and the overall style is casual and comfortable. In the color selection of the series, we retained the traditional color custom of using the same color scheme as the overall clothing, and only added a small amount of contrasting colors in the details to enrich the color layers. The styles of this collection are mostly skirts, mixing Yunjians with modern casual style blazers, loose shirts and halter skirts brings us a new fashion feeling. And the Yunjian became the highlight of the whole set.



Figure 10. Series of Yunjian clothing design development.

4.5. Yunjian Clothing Design Evaluation

This research determined the presentation effect evaluation index U according to the characteristics of the Yunjian garment, $U = (u_1, u_2, u_3, u_4) = (\text{shape, structure, pattern, color, aesthetics})$. A five-level scale criterion was used, $V = (v_1, v_2, v_3, v_4, v_5) = (\text{very bad, bad, mediocre, good, very good})$. A team of expert judges, consisting of eight relevant senior practitioners, ranked the importance of the five indicators for recovery effects, and the results obtained are shown in Table 3.

Table 3. Evaluation index importance ranking.

Rank	Shape	Structure	Pattern	Color	Aesthetics
P ₁	1	2	4	3	5
P ₂	2	1	3	4	5
P ₃	1	2	3	4	5
P ₄	2	1	4	5	3
P ₅	1	2	4	3	5
P ₆	1	2	3	4	5
P ₇	1	4	2	3	5
P ₈	2	1	5	4	3
Rank Sum (R _j)	11	15	28	30	36

Assuming that the 8 judges did not agree on the importance of the 6 recovery effect indicators, we calculated $X^2 = 22.300$, took the significance level $\alpha = 0.01$, and the degree of freedom $df = 4$, checked the table to get $X_{0.01}^2(4) = 13.277$. Since $X^2 = 22.300 > 13.277$, we can assume that the 8 judges' opinions are significantly consistent.

The weights of each indicator were calculated from Equation (8) as: $a_1 = 0.3083$, $a_2 = 0.2750$, $a_3 = 0.1667$, $a_4 = 0.1500$, $a_5 = 0.1000$, yielding the weight of each indicator $A = (0.3083, 0.2750, 0.1667, 0.1500, 0.1000)$.

After identifying the evaluation items, evaluation scales and evaluation item weights, we took online and offline questionnaires at the same time. We set the survey target as university students aged 18 to 25 who have knowledge of Yunjian clothing, and we collected a total of 146 questionnaires, of which 139 were valid, resulting in a valid rate as 95.2%. The data of our survey questionnaires are shown in Table 4.

Table 4. Statistics of questionnaire results.

Evaluation Indicators	Very Bad	Bad	Mediocre	Good	Very Good
Shape	0.00	0.01	0.12	0.38	0.49
Structure	0.00	0.03	0.16	0.28	0.53
Pattern	0.02	0.12	0.05	0.10	0.71
Color	0.00	0.03	0.10	0.18	0.69
Aesthetics	0.01	0.08	0.09	0.28	0.54

We can get the matrices from this table:

$$R = \begin{bmatrix} 0.00 & 0.01 & 0.12 & 0.38 & 0.49 \\ 0.00 & 0.03 & 0.16 & 0.28 & 0.53 \\ 0.02 & 0.12 & 0.05 & 0.10 & 0.71 \\ 0.00 & 0.03 & 0.10 & 0.18 & 0.69 \\ 0.01 & 0.08 & 0.09 & 0.28 & 0.54 \end{bmatrix}$$

Using equation $B = A \cdot R$ for the calculation:

$$B = \begin{bmatrix} 0.3083 & 0.2750 & 0.1667 & 0.1500 & 0.1000 \end{bmatrix} \cdot \begin{bmatrix} 0.00 & 0.01 & 0.12 & 0.38 & 0.49 \\ 0.00 & 0.03 & 0.16 & 0.28 & 0.53 \\ 0.02 & 0.12 & 0.05 & 0.10 & 0.71 \\ 0.00 & 0.03 & 0.10 & 0.18 & 0.69 \\ 0.01 & 0.08 & 0.09 & 0.28 & 0.54 \end{bmatrix}$$

$$= \begin{bmatrix} 0.0043 & 0.0438 & 0.1133 & 0.2658 & 0.5727 \end{bmatrix}$$

The comprehensive evaluation results show that 11% of the evaluators think the design effect of the Yunjian garment is “mediocre”, 26% of the evaluators think the design effect is “good”, and 57% of the evaluators think the design effect is “very good”. According to the principle of maximum affiliation, the effect of this series of Yunjian apparel design was evaluated as “very good”. Therefore, the Yunjian fractal pattern design model proposed in this study can be better used and practiced in clothing products.

5. Conclusions

Yunjian garment is an important intangible cultural heritage of the Han Chinese, with artistic expression and profound cultural connotation of oriental intentions. Under the globalization of regional ethnic culture, the Yunjian has also become a sustainable cultural capital with great revitalization value. By analyzing the motifs, color principles and structural rules of the Yunjian, this study proposes a digital innovation design method for regional ethnic costumes based on the Newtonian fractal model and carries out design practice. The comprehensive evaluation results show that the Yunjian costume designed by the design method proposed in this study has a good combination of ethnic cultural core and modern fashion communication characteristics. Taking the Yunjian garment as an example, this study tries to explore the capital revitalization method of regional ethnic fashion culture based on digital design method, aiming to provide theoretical and practical reference for the sustainable design of regional characteristic fashion culture.

Author Contributions: Conceptualization, H.C. and L.J.; Data curation, H.X. and Y.Z.; Formal analysis, H.X.; Investigation, H.X.; Methodology, H.C. and L.J.; Resources, H.C. and Y.Z.; Supervision, L.J. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the Jiangsu Province Social Science Foundation Youth Project (grant number 22YSC001), Jiangsu Province Culture and Tourism Research General Project (grant number 22YB30), Jiangsu Province Universities Philosophy and Social Science General Project (grant number 2021SJA0866). The authors acknowledge the above financial support.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The garment photos for this article were obtained from the Jiangnan University Folk Costume Heritage Museum. The authors appreciate the support.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Delgado, M.J.B.L.; Albuquerque, M. The contribution of regional costume in fashion. *Procedia Manuf.* **2015**, *3*, 6380–6387. [\[CrossRef\]](#)
2. Thompson, C.J.; Haytko, D.L. Speaking of fashion: Consumers' uses of fashion discourses and the appropriation of countervailing cultural meanings. *J. Consum. Res.* **1997**, *1*, 15–42. [\[CrossRef\]](#)
3. Rian, I.M. Fractal-based algorithmic design of Chinese ice-ray lattices. *Front. Archit. Res.* **2022**, *11*, 324–339. [\[CrossRef\]](#)
4. Zhang, J.Z.; Xu, J.; Bai, W.D. Furniture design and fractal geometry-the fractal art in traditional furniture. *Adv. Mater. Res.* **2014**, *933*, 655–661. [\[CrossRef\]](#)
5. Driscoll, J.C. Fractal patterns as fitness criteria in genetic algorithms applied as a design tool in architecture. *Nexus Netw. J.* **2021**, *23*, 21–37. [\[CrossRef\]](#)
6. Gong, Y.X.; Qiao, C.Q.; Zhong, B.C.; Zhong, J.R.; Gong, D.C. Analysis and characterization of materials used in heritage theatrical figurines. *Herit. Sci.* **2020**, *8*, 13. [\[CrossRef\]](#)
7. Jin, X.; Yin, S.; Liu, N.N.; Li, X.D.; Zhao, G.; Ge, S.M. Color image encryption in non-RGB color spaces. *Multimed. Tools Appl.* **2018**, *77*, 15851–15873. [\[CrossRef\]](#)
8. Liu, L.; Zhao, Z.M. Morphological image processing in the speckle metrology. *Imaging Sci. J.* **2011**, *59*, 303–310. [\[CrossRef\]](#)
9. Ding, M.; Dong, W. Product color emotional design considering color layout. *Color Res. Appl.* **2019**, *44*, 285–295.
10. Liu, J.L.; He, R.; Tian, W.; Xia, S.F.; Zhu, C.Y. An overview of color system development and its application in Dai brocade design. *J. Silk* **2021**, *58*, 117–125.
11. Wang, S.H.; Li, X.M.; Jin, X.K.; Tian, W.; Zhu, C.Y. Design and application of jacquard fabric patterns based on the geomorphologic color features. *J. Silk* **2022**, *59*, 101–110.
12. Jin, X.K.; Zhang, S.C.; Li, Q.Z.; Du, L.; Zhu, C.Y. Development of color difference formula and its application in fabric color evaluation. *J. Silk* **2013**, *50*, 33–38.
13. Miao, P.Y.; Fang, Z.Q.; Sun, T.; Jin, X.K.; Zhu, C.Y.; Tian, W. Primary color extraction method for brocade. *J. Text. Res.* **2021**, *42*, 120–125.
14. Huang, S.M. A study of hue identification in the hue circle of the HSB color space. *Percept. Motor Skills* **2005**, *100*, 1143–1154. [\[CrossRef\]](#) [\[PubMed\]](#)
15. Zhu, L. Research and application of AHP-fuzzy comprehensive evaluation model. *Evol. Intell.* **2020**, *13*, 1–7. [\[CrossRef\]](#)
16. Chen, H.; Shen, L.; Wang, M.M.; Tang, Y. Man-algorithm Cooperation Intelligent Design of Clothing Products in Multi Links. *FIBRES TEXTILES East. Eur.* **2022**, *30*, 59–66. [\[CrossRef\]](#)
17. Chen, L.; Halepoto, H.; Liu, C.; Kumari, N.; Yan, X.; Du, Q.; Memon, H. Relationship Analysis among Apparel Brand Image, Self-Congruity, and Consumers' Purchase Intention. *Sustainability* **2021**, *13*, 12770. [\[CrossRef\]](#)