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Women's Textile Pattern Designs Based on the Principle of Geometric Perspective

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ABSTRACT

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Geometric perspectives, derived from mathematical principles, is a technique that combines science and art by applying perspective to painting. Geometric perspectives are divided into three categories, namely: one-point perspective, in which there is only one perspective vanishing point in the structure of the perspective, which can show a sense of three-dimensionality; angular perspective, which can bring a sense of space; and a three-point perspective, which is an aggregate of the two. Geometric elements in modern fashion design are developed from the traditional art of geometric patterns. With the rise of different disciplines and the birth of theories, as well as the artistic exploration of geometric elements by designers, geometric elements have been applied in a variety of ways in clothing design. In specific clothing design, designers can express geometric elements as integral content, or as local decorative designs to be integrated into the overall design. Based on the three categories of geometric perspective, this study explores the effects of its application in modern textile patterns respectively and analyses their functions on the clothing as a whole, such as the effect of the optical illusion caused by geometric perspectives in clothing, the expression of linear changes, and the forms of application of the elements of points, lines and planes therein. This research analyses and collates these through a case study approach, and then through a practical research approach, using Photoshop to design three clothes, using the clothing plane renderings to show the effects of each of the three categories of geometric perspectives as they are applied to the textile surface patterns. This study aims to achieve figure modification through the use of simple geometric patterns on textiles. Textile patterns can visually refine the body shape rather than through functional clothing such as corsets, which is conducive to alleviating women's body shame while protecting their health.

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1. INTRODUCTION

1.1 The concept of geometric perspectives

Perspective is a theoretical term for painting that refers to the method or technique of depicting the spatial relationships of objects on a flat surface. The definition of perspective has a broad and narrow distinction: The broad perspective refers to a variety of spatial representations of the method, in the Paleolithic cave paintings 30,000 years ago; The narrow perspective refers to the 14th century depiction of the object, reproducing the space of the linear perspective and other scientific perspective methods. Geometric perspective is a collection of scientific and artistic painting techniques, mainly with the help of "near large and far small " perspective phenomena to express the three-dimensional sense of the object. Geometric perspectives are established with the formation of projective geometry, and there have long been regular theoretical generalizations in the universal application of geometric perspectives, such as the law that parallel lines parallel to the picture remain parallel in the perspective; the law that parallel lines not parallel to the picture should be concentrated and disappear at one point in the perspective; the law of near large and far small, based on the perpendicular distance between the object and the picture; the law of equal magnification and reduction of the height of perspective, etc. (Lu, et al., 1998). Lorenzi et al.(2011) noted that Perspective and Projective Geometry, developed on purpose with the aim of treating points at infinity as ordinary points and at the same time to "paint what the eyes see" and going well beyond. Different from geometry in a purely mathematical sense, the principle of geometric perspective is to express a sense of space and three-dimensionality on a plane through composition, which contains the beauty of order. There are several types of perspectives, and they are classified according to the number of vanishing points used: perspective with one vanishing point, perspective with two vanishing points, and so on(Mello, 2010). Perspective with a vanishing point is called one-point perspective, also known as parallel perspective, as shown in Figure 1-a; two-point perspective, also known as angular perspective, the object has a set of perpendicular lines parallel to the screen, and the other two groups of lines with the screen into a certain angle, and each group has a vanishing point, a total of two vanishing points, as shown in Figure 1-b; if there are three vanishing points in the picture, of which two points on the apparent horizon, then the formation of perspective is known as three-point perspective, as shown in Figure 1-c.

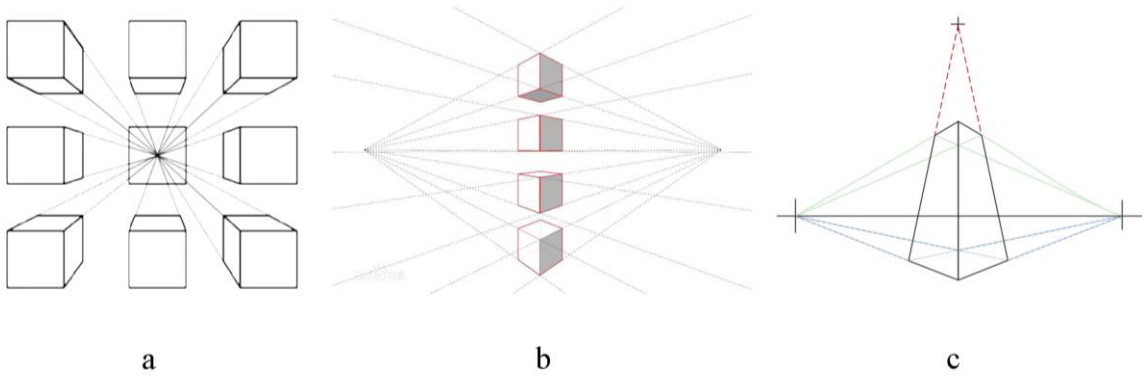

Figure 1: Geometric Perspective

1.2 Application of geometric perspective in textile patterns

In the field of fashion design, the method of geometric perspective can be applied to the design of textile patterns, which can create a variety of visual effects through the combination of different forms of points, lines and planes, as well as repetition, reality, sparsity and other forms of arrangement, which can bring people different feelings and impressions, and has a strong artistic expression. Xiong et al. (2022) pointed out that pattern is a special means of decoration in clothing design, which is used in a variety of ways, not only enriching the details of clothing design, but also highlighting the artistic and practical value of clothing. As an important part of pattern design, geometric patterns have been used by designers in different design styles, and their skillful use of points, lines and planes has a distinctive influence on the style of garments. Zhu (2020) noted that the aesthetics of geometric patterns can achieve a better spatial three-dimensional effect of garment modeling through the superimposed design of multi-layer hollowing. Martel (2016) noted that geometrical patterns tie a painting's subject matter to the picture plane, making a united environment that is embodied in the ratios and proportions that are expressed. Therefore, in the process of designing textile patterns, the proportions between various elements will all bring different effects for the practical application of geometric perspective patterns on the garment plane.

1.2.1 Application of One-Point Perspective (Parallel Perspective)

The application of one-point perspective in clothing helps to establish the unity of space, The perspective method of all the line elements pointing to a common center point in the picture, can bring about the effect of optical illusion, and it is easy for people to produce a pattern of the center of the concave. This is surrounded by the three-dimensional illusion of feelings of convexity, so that the overall clothing has a sense of contraction, a sense of lightness, and it is applied to the obesity, the shoulder width of the overly wide body shape, which can make the body shape look more coordinated. Luo (2021) noted that line elements have guiding properties, whereby the change in directions of line elements can guide the viewer's visual focus. This could cause a shift sequentially along a certain direction, and the gradual change of line elements makes the depth optical illusion pattern form spatial layers. Huang (2018) noted that line is usually a common method of conveying the designer's ideas, in clothing that meets the aesthetic and visual effects, the function of the line is to outline the outer contour, not only to highlight the outer contour to attract the eye, but also to modify the local, reflecting the details, if a design in which the line becomes the main body, it creates a visual route, leading people to follow this route to feel and experience the emotions expressed by the designer. The "visual route" in the article of Huang, in one-point perspective, can directly guide people's attention to focus on the vanishing point, this perspective method applied in clothing patterns, can make the most basic clothing modeling with a sense of three-dimensionality.

As shown in Figure 2, in Mary Katrantzou S/S 2017 Collection, the designer was inspired by the motifs of women's images in ancient Greek frescoes and Mycenaean pottery, and her bold use of geometric motifs and lines gave a three-dimensional effect to the otherwise simple shapes of the garments. The waist of these garments is the location of the vanishing point in the one-point perspective, and when people see these fashions, they are easily attracted by the pattern of the waist.

Figure 2: Mary Katrantzou S/S 2017 Collection

The use of geometric perspectives was also seen in the Mary Katrantzou S/S 2019 Collection (Figure 3), where the designer accentuated the waist-to-hip ratio of the garments through colors and lines, creating the feeling of an optical illusion and making the waist look impossibly thin.

Figure 3: Mary Katrantzou S/S 2019 Collection

Similar effects of perspective and optical illusion are found in the Y/Project S/S 2024 Collection, as shown in Figure 4.

Figure 4: Y/Project S/S 2024 Collection

1.2.2 Application of Two-Point Perspective (Angular Perspective)

If the one-point perspective emphasizes the role of points and lines, then the two-point perspective pays more attention to the "plane" of the performance of the effect of the two-point perspective in the application of textile patterns, which can bring a sense of space for clothing. Liu (2019) noted that the corresponding position of a particular space on the human body surface determines the method of spatial design of clothing, which emphasizes the use of deconstruction and reorganization of points, lines and planes to break the original form of the

geometric plane, increase the local spatial volume of the human body surface, and change the inherent morphology of the clothing that coincides with the human body surface. Applying the principle of a two-point perspective in the design of clothing patterns can make one visually feel the changes in the human body surface, and it is also easier to produce the effect of optical illusion. Mello(2010) noted that, in a perspective with two vanishing points, this is how it works: one set of parallel lines of a parallelepiped is represented as lines converging to one point, and another set as lines converging to another point, What the artist needs to do is to draw a perspective is to sketch his work by placing the objects in the areas of interest, and then draw the parallels as lines converging to the vanishing points. This painting concept is widely used in architectural design and engineering drawings, and can also be applied to the design of textile patterns, such as Optical art-style clothing. In addition to the bold use of color and light effects, the ever-extending repetition of circular and square geometric patterns and stripes is also a common technique in Op art. Dynamism, complexity, spatial three-dimensionality, changes in reality , with a sense of regularity and order are often accompanied by the characteristics of the optical pattern, and is more rigorous and complex in design, creating a strong visual impact(Zeng et al., 2017).

In women's wear design, the pattern applied to the two-point perspective principle can strengthen the chest, waist and buttocks of the clothing, making the human body curve more obvious. Such as Jean Paul Gaultier Fall 1995 Ready-to-Wear Fashion Show Collection (Figure 5), the design of the two ready-to-wear garments respectively emphasized the waist and chest, waist and hips. Polka dots make the patterns present a dynamic effect, the size of the inconsistency of the polka dots embellished in various parts. The law contained in it is similar to the perspective phenomenon of "near large, far small" in geometric perspective, which sets off the figure of the model and plays a role in modifying the human body.

Figure 5: Jean Paul Gaultier Fall 1995 Ready-to-Wear Fashion Show Collection

The same effect of the application of the two-point perspective can be seen in Paco Rabanne S/S 2022 Collection (Figure 6) homage to Victor Vasarely.

Figure 6: Paco Rabanne S/S 2022 Collection

1.2.3 Application of Three-Point Perspective

Mello(2010) noted that the use of a large number of vanishing points allows one to visualize an entire space around a point, yielding interesting images. In three-point perspective, none of the sides or surfaces of the object is parallel to the picture, the object is tilted relative to the picture. On the basis of two-point perspective, all extended lines perpendicular to the horizon are gathered together to form a third vanishing point. Three-point and multi-point perspectives have the characteristics of one-point perspective and two-point perspective, that is, they have both a sense of three-dimensionality and a sense of space. Three-point perspective is suitable for expressing tall and majestic buildings. Looking up at the building gives a sense of openness; looking down at the building gives a sense of depth. Three-point perspective in clothing in the three-dimensional use and sense of space is mainly embodied in the external form, internal structure and decorative patterns, which can be from the clothing space direction on the upper and lower, front and back, inside and outside of the relationship between the spatial level of the space level of the dislocation, asymmetric design and so on the method of expression, but also through the combination of clothing modelling and pattern. A-line garments are more likely to show the effect of three-point perspective, making the human body look taller.

As shown in Figure 7, in Rahul Mishra AFEW S/S 2024, the designer used a radial colorful stripe pattern to make the vanishing point converge between the chests. The wider line pattern at the skirt allows the overall view of the clothing to both sides. The A-line design makes the clothing look more three-dimensional and makes the human body appear more slender.

Figure 7: Rahul Mishra AFEW S/S 2024

In the Jean Paul Gaultier S/S 2018 Collection (Figure 8), Gaultier arranges the Op-style patterns in an orderly manner, using multiple "points" to form a "line", and the "line" extends to different angles to form a "surface", so that the pattern in the A-line garment to show a near large and far small perspective effect, like looking up at the angle of the building.

Figure 8: Jean Paul Gaultier S/S 2018 Collection

A similar application can be found in the Mary Katrantzou S/S 2019 Collection (Figure 9), where the perspectives of 12-a and 12-b are similar to those of the two brands above, while 12-c takes a top-down perspective. This shows that different angles can make a big difference in the presentation of the pattern, but a closer look can reveal commonalities.

Figure 9: Mary Katrantzou S/S 2019 Collection

1.3 Problem Statement

Garments designed with the optical illusion effect have gained popularity over a long period as people have tried to use the effect to enhance their appearance with A-line dresses that accentuate the waist, to striped trousers that provide a visual elongation of the individual's strides (Nyarko et al., 2022). Interesting optical illusion patterns give people a series of strong visual impacts such as distortion, contraction, jumping, etc., and can create a three-dimensional layering on the flat material without splices and folds (Zhang et al., 2023). The aesthetic principle of geometric optical illusion patterns lies in the fact that through the geometric shape of "points, lines, planes" in the angle, size, reality, length, sparseness and proximity, overlap area, as well as texture changes and other elements of the re-combination of the arrangement, to create a distinctive visual illusion effect (Zhang et al., 2023). The look of clothing can be differentiated by diverse textures, fabrics, and dividing a surface, even if the outer shapes of clothes are the same (Kwon, 2013). The different arrangements of geometric patterns show the aesthetic effect of the textile surface, in the design should always grasp the pattern of the law, the geometric pattern by the law of the orderly arrangement and combination out (Di, 2022). The curves of the human body themselves have a unique streamlined aesthetic, and to conform to this unique curvilinear aesthetic, the basic geometry of continuity needs to be appropriately altered in shape and size (Chen, 2023).

In the existing literature, the topics related to the application of geometric patterns in clothing design are the most numerous. There are also more studies and discussions on the application of optical illusion in clothing patterns. In contrast, most of the literature related to geometric perspective belongs to the fields of maths, the field of painting and architecture, or some applied sciences fields. In fact, the principles of geometric perspective can also be used to develop textile patterns. Zhang(2018) noted that the disappearance point of the one-point perspective is set in the best position of the wearer's waist, so that the clothing pattern gives a sense of visual depth, the waist becomes thin, the legs are elongated, and even to achieve the beauty of the chest, waist and hips concave and convex. Therefore, this study tries to arrange and combine simple geometric shapes with the principle of perspective so that they can show a three-dimensional effect on the basic clothing styling. The study purposes are:

i . To analyze the effects shown on clothing of the three perspective types based on geometric perspective.

ii . To sum up the different effects of different types of perspective patterns on textiles on women's figures.

iii . To design a set of clothing renderings that can "show thinness", " show off one's figure " and "seem high ".

1.4 Research Value

Geometric elements can be found everywhere in daily life necessities such as architecture, ceramics and clothing from ancient times to the present day, and the enduring nature of geometric elements proves their good suitability. The characteristics of a combination of art and science contained in geometric perspective can be reasonably applied to the design of textile patterns. Patterns are important artistic language, based on the different forms of geometric perspective of the composition of points, lines and planes, which can bring people a variety of visual experience, so that clothing is full of artistic and interesting.

2. METHODS

This study used a quantitative research method to illustrate current women's requirements for dress style through descriptive research. The researchers collected search keywords for top-selling dresses from China's largest shopping website (https://www.taobao.com) to obtain data. The process is: first of all, enter the website to search for "dress", the price range is set between 79-260, because according to the data on the shopping site, the dresses in the price range accounted for 60% of the total sales; according to the order of sales from high to low, take the top 100 products as a sample. Statistically, in the sales of the top 100 commodities, the frequency of the keyword "show thinness " is as high as 72 pieces, the keyword "show off one's figure" is 21 pieces of merchandise, the title of the commodity includes "suitable for short women" 9 pieces of. The keywords " show thinness " and "figure" keyword have some overlap (that is, appearing in the same commodity title). In addition, other keywords such as " look younger", "French style", and "casual" also appear in the product title, but most of them appear in the same product with other keywords, and only five of them exist separately alone. Overall, "show thinness ", "show off one's figure", and "suitable for short women" appeared most frequently in the titles of the top 100 items (Figure 10).

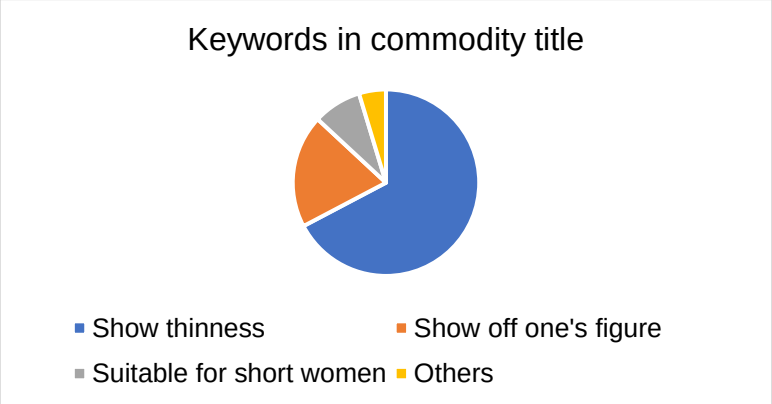

Figure 10: Keywords in Commodity Title

Through the method of literature review and case study, it was found that applying the principle of geometric perspective to textile patterns can make the garments show the three effects mentioned above. The researcher collects the application cases of geometric perspective on garments and carries out secondary research. Specifically, that is, summarise the effects of one-point perspective, two-point perspective and three-point perspective in textile patterns, and discuss their application rules as follows:

Table 1: Effects of Perspective in Textile Patterns

	Characteristic	Effect	Result
One-point perspective	There is only one vanishing point, which focuses all the lines in the frame to a single position.	Makes it easy for the viewer's eyesight to follow the line towards the only vanishing point.	Show thinness
Two-point perspective	There are two vanishing points. The more dispersed the arrangement of the two sets of lines is, the more the intersection of the lines will make the central image more prominent.	Provides a visually magnifying effect.	Show off one's figure
Three-point perspective	Based on the two-point perspective, there is an additional vanishing point, showing an effect similar to a wide-angle lens.	Provides a visual effect of looking up.	The human body looks more slender and taller, perfecting the proportion of the body.

Based on the above research results, this study uses Photoshop to draw clothing renderings in a practical research manner, and displays the characteristics of the three categories of geometric perspective on clothing in the form of patterns, aiming to demonstrate the role and importance of geometric perspective patterns in fashion design.

3. RESULTS

This practical study demonstrates the application of one-point perspective, two-point perspective and three-point perspective in clothing patterns through three design works, using rhombus of varying sizes to represent the relationship between distance and proximity. This study draws lessons from color matching of Mondrian's classic red, yellow and blue primary colors, and aims to clearly show the application effect of geometric perspective in clothing.

3.1 Design 1

This work uses one-point perspective to arrange rhombus patterns in an orderly manner. The rhombus on the upper and lower body simultaneously progresses from a large-to-small fashion towards the waist, culminating in the smallest rhombus at the waist as the vanishing point. A striking yellow color is used for the rhombus pattern of the skirt, as well as blue and black are used for the rest of the skirt, in order to make the perspective more obvious, while the black on both sides can also play a role in slimming down and making the body look more slender.

Figure 11: Design 1

3.2 Design 2

This work uses a two-point perspective method, starting from the rhombus color blocks on the chest, arranging from large to small upwards and downwards respectively, and finally converging into two points that disappear in different directions. This method can highlight the curves of the human body. In terms of color, red, yellow and blue are used to fill the rhombus pattern which are arranged in an orderly manner to make the clothing pattern look simple and distinct.

Figure 12: Design 2

3.3 Design 3

This work uses an A-line design, the distribution of rhombus color blocks on the clothing applies the principle of three-point perspective and adopts a "looking up" angle. The curve of the skirt is used to make the perspective of the pattern have a sense of space and make the human body appear taller. In terms of color matching, four colors, red, yellow, blue and white, are used. Blue is used as the main color to arrange regularly, yellow and white are arranged in crosses, and red is randomly distributed. The application of multiple colors is to make the overall appearance of the clothing bright and not dull, and also to make the perspective effect clear at a glance.

Figure 13: Design 3

4. DISCUSSION

Through this case study and practical research, it can be found that there are many forms of application of geometric perspective in clothing pattern design. Among them, the one-point perspective is suitable to be applied to the waist, which can make the human body look slim, as shown in Figure 14;

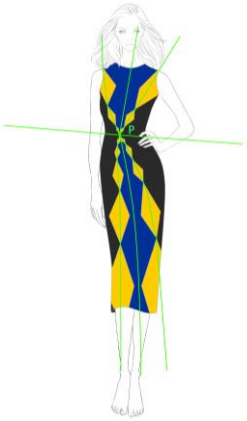

Figure 14

Two-point perspective has the characteristic of making the picture prominent, so it is suitable to be applied to the chest and hips to make the curves of the human body more obvious, as shown in Figure 15.

Figure 15

There are two basic applications of the three-point perspective in clothing design. For example, if one wants to highlight the shoulders, one can choose to arrange the patterns or lines, color blocks and other elements in a top-down manner from large to small, and this type of perspective can be used in T-line or inverted triangular clothing silhouettes; if one wants to make the body look taller, one can arrange the pattern downwards from small to large, and this perspective can be used for A-line garments or dresses with large hemlines, as shown in Figure 16; It is also possible to combine the two, focusing the vanishing point in the center on a certain part, and then arranging them up and down or to the left and right in turn. In such an application, the vanishing point in the center is the one most capable of focusing the gaze, with the rest of the vanishing points coming in a close second.

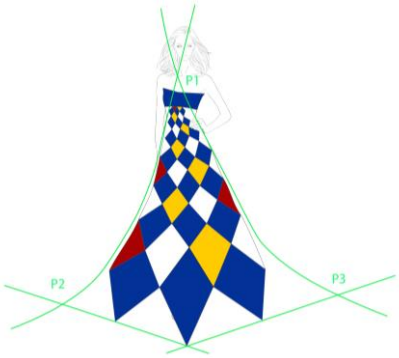

Figure 16

In the study, it was found that geometric perspective can have more than one (three or more) vanishing points, however, if we want to apply it to a garment, we can't just show it with the help of the garment pattern, but we need the interplay between the garment's silhouette, colors, patterns and other elements. A group of geometric perspective patterns of the disappearance of more points, together with the clothing style correspondingly makes it more complex. However in the clothing design work, to find the application of geometric perspective disappearance of the location of the point, will be possible after the extension of the overall shape of the garment, which will make the overall design of the garment process not only much more convenient, but also make the geometric perspective better with the combination of clothing. Therefore, the application of reverse thinking in clothing design may play a multiplier effect.

Applying geometric perspective to clothing design helps to master the combination relationship between various parts of the garment, which includes the combination relationship between the whole and local parts of the garment, and the combination relationship between the contour lines of various parts of the garment. Clothing structure and color, patterns can enrich the type of clothing styles. The application of geometric perspective can reflect the degree of adaptation of clothing to the human body. If we want to use geometric perspectives in clothing modeling, we can let it show through the structural lines of the clothing, such as division and pleat lines,

5. CONCLUSION

Style, color, and material are the three major elements in clothing design. The basic elements that constitute the shape are mainly combined design by the designer’s combination of points, lines, planes, polyhedrons, and other elements to shape the silhouette. Common silhouettes in clothing include H-line, T-line, A-line, and O-line, etc. Pattern is the fourth design element in clothing design after style, color, and material. Textile patterns have a great decorative effect

on clothing. Although the lack of pattern as decoration in the composition of the clothing will not prevent it from becoming a piece of complete clothing, with the addition of patterns, the clothing will be more personalized and artistic.

From the perspective of the fashion design discipline, the pattern includes two parts: basic pattern and professional pattern. Basic pattern mainly researches and solves the basic knowledge of pattern image design, and explores the universal law of pattern and the method of depiction and expression. Professional patterns are divided into two categories: garment pattern design and textile pattern application. The application of geometric perspective enables designers to accurately combine textile patterns with garment modeling to make the finished garment more harmonious. Based on the method of geometric perspective, designers are able to grasp the design law of textile patterns, and the process of pattern composition and combination, color configuration, and others more quickly.

Based on the perspective of geometric perspective, designers combine and arrange patterns according to their own understanding of beauty, which can make garments express beauty and artistry while at the same time highlighting science. Different types of geometric perspective can be presented in a variety of ways, through the pattern of the form, length, number, location, and other differences, as well as between the pattern of the color contrast, the contrast between reality and contrast, static and dynamic contrast to show the relationship between the distance of the pattern, can improve the monotony of the original pattern, so that the clothing is more three-dimensional, spatial and dynamic, and ultimately to achieve the purpose of beautifying the human body.

AUTHORS' CONTRIBUTION

ZZW carried out the case collection, design works, and full-text writing. LZF assisted in data collection. ABA and HBA were responsible for reviewing and refining the article. All authors read and approved the final manuscript.

CONFLICT OF INTEREST

None declared.

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