Determination of Pattern Range in Paper Cuttings Automatic Positioning System

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Abstract: Paper Cuttings is one of the traditional folk arts with a long history in China. The tools and materials it uses are simple and widely used. It is an important folk art loved by the masses of our country. In this paper, firstly, according to the functions and characteristics of computer Paper Cuttings patterns, the patterns are classified, and then the range of patterns in the automatic positioning system of Paper Cuttings is determined through polygons and circles.

Keywords: CAD, Paper Cuttings, pattern, Non-Photorealistic Rendering

1 Introduction

Paper Cuttings is an art style widely spread among the people in China, and it is a wonderful flower in the art garden of China. Because of the simple tools and materials, it uses, and the wide range of applications, it can be seen in all kinds of Paper Cuttings in the past and now, no matter in the north or south, the Central Plains or the border areas, the Han nationality or ethnic minorities [1-3]. Paper Cuttings art has its own characteristics in depicting artistic images - to express the images of various things through lines. The creators of Paper Cuttings rely on rich imagination and high generalization, grasp the most moving and expressive images in real life, cut the paper into various shapes with scissors, and organize the lines and patterns with the method of combining the virtual and the real [4-6]. Through the contrast between the virtual and the real, the images are reflected to achieve the modeling effect of "responding to the image", "writing the spirit with the shape" and "having both the shape and the spirit", and create various decorative artistic images.

Paper Cuttings art has a wide range of applications. For example, the art of Paper Cuttings can be found in the graphic design fields such as the modeling of some cartoons, the setting of film and television programs, the modeling in computer games, illustrated cartoons, advertising posters, book binding, printing and packaging, and television media. Many of our most common New Year greeting cards are designed in the form of exquisite Paper Cuttings.

At present, the vast majority of Paper Cuttings is still traditional Paper Cuttings, that is, the process of Paper Cuttings is still in the manual stage. The process of manual Paper Cuttings is complex and the creation cycle is long; At the same time, if you are not familiar with the manual Paper Cuttings technology, you cannot create. According to the current situation of Paper Cuttings, this paper studies the computer Paper Cuttings pattern positioning system. Using the

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automatic positioning system, the outline of the Paper Cuttings image is first drawn, the approximate polygon is calculated according to the outline, and then the central axis of the Paper Cuttings image is calculated [7-10]. According to the central axis point, the required pattern is automatically positioned on the Paper Cuttings outline, and the computer Paper Cuttings image is generated, so as to obtain the Paper Cuttings pattern with national style[11-13].

Compared with manual Paper Cuttings, the application of non-photorealistic graphics rendering technology to generate Paper Cuttings images through computers makes it easy to change the local patterns of Paper Cuttings images. The use of the axis algorithm realizes the automatic positioning of Paper Cuttings patterns, improves the automation of computer Paper Cuttings, and makes the generated Paper Cuttings images more flexible and changeable.

2 Pattern

Pattern is an important part of Paper Cuttings. Among Paper Cuttings patterns, there are many kinds of Paper Cuttings patterns, but their composition has common characteristics. For example, to construct the outline of the Paper Cuttings image, basic structural patterns should be adopted. The five facial structures of the head of an animal image (eyebrows, eyes, nose, mouth) generally adopt specific patterns. Ornamental patterns are commonly used on animal bodies.

According to the functions and characteristics of patterns, patterns are divided into four categories: basic structural patterns, characteristic patterns, specific patterns, and decorative patterns. These four categories constitute a pattern library. Through the pattern library, you can use these patterns to create computer Paper Cuttings images.

2.1 Basic structural pattern

The basic structural patterns are used to construct the outline of the Paper Cuttings image. The patterns include straight lines, circles, arcs and various curves. Using these patterns, you can simply outline the basic images of animals, including some exaggerated head images.

2.2 Characteristic pattern

In addition to the basic structural patterns, Paper Cuttings also has some patterns that reflect the characteristics of its performance objects, such as the tail of horses, chickens and other animals, as shown in Figure 1. Adapt to different requirements for different characteristics of animals through changes in parameters, such as the length of the tail.

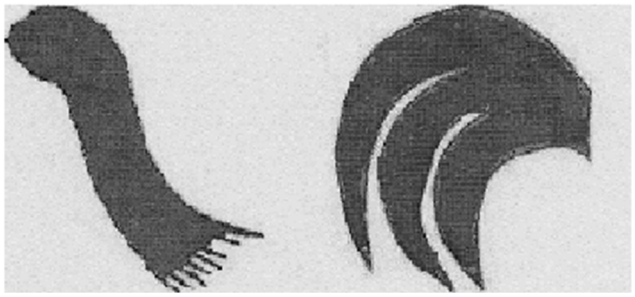

Figure 1 Characteristic pattern

2.3 Decorative patterns

Decorative patterns reflect the stylization of Paper Cuttings forms of expression. They systematize and concretize complex things and changeable natural scenes, and condense them into a simple and clear style after refining and processing. They are highly artistic and ornamental, reflecting the national characteristics of Paper Cuttings art. The most commonly used decorative patterns reflected in animal bodies are crescent, serrated, and blossoming patterns, as shown in Figure 2.

Figure 2 Crescent Pattern and Blossom Pattern

Crescent pattern is a hollow pattern that presents a crescent like shape, as shown in the upper row of Figures 2. It can not only be widely used to shape shapes, such as scales on fish, scales on dragons, feathers on birds, but also to express movement and express clothing patterns. For example, crescent patterns often appear in joints such as the neck, shoulder, elbow, knee, and other moving parts, expressing human body movements and postures.

Blossoming pattern is a patterned and miniature flower head (plum, chrysanthemum, lotus, etc.), or simplified or transformed into an unnamed petal shape or other shapes. It is generally used for embellishment of clothing and utensil patterns, and can also be used for describing environmental flowers and plants, as shown in the lower row of Figure 2.

Serrated pattern is a pattern arranged neatly and resembling serrations. This type of pattern is commonly used in various animal images to represent the fur of animals and give a sense of realism. The arrangement, size, length, thickness, and straightness of serrated patterns should be reasonably applied according to the characteristics of different animals.

3 Determination of pattern range

Patterns should be used in different positions in the image of Paper Cuttings. When generating patterns by computer, the length, thickness, angle, and curvature of the patterns are changed according to user needs through parameter control. During design, the range of patterns is determined to determine whether the patterns do not intersect to improve the efficiency of the calculation. And when the pattern is enlarged or reduced, its range should also change accordingly. The range of the pattern is determined by the polygon and circle types that contain it. The following is an example of crescent and flower patterns to illustrate the range of patterns.

Crescent pattern is a kind of Paper Cuttings pattern that is widely used. Many complex patterns in Paper Cuttings are based on the Crescent pattern. The design of the crescent pattern is mainly achieved using four control points through Besier curves. As shown in Figure 1-3, if the

boundary curve of the upper half of the crescent pattern crosses the four points P_0, P_1, P_2, and P_3. First, calculate the four control points P_0, P_4, P_5, and P_3 that pass through the four Besier curves, and the plotted Besier curve is the boundary curve of the upper half of the crescent pattern. Then, based on the positions of the four points P_0, P_1, P_2, and P_3, determine the two position points P_6 and P_7, and set the transformation coefficient to k, and the position of P_6 is :

$$P_6 = P_0 + k \times (P_1 - P_0).$$

Considering the incompleteness and regularity of Paper Cuttings patterns, some disturbances can be properly added to P_6 points to achieve the effect of artificial Paper Cuttings. Use δ To represent the disturbance, the above formula becomes:

$$P_6 = P_0 + k \times (P_1 - P_0) + \delta$$

In the same way, P7 can be obtained:

$$P_7 = P_3 - k \times (P_2 - P_3) + \delta$$

In this way, the boundary curve of the lower half of the crescent pattern is obtained from the Besier curve passing through the four points P_0, P_6, P_7, and P_3.

Let the straight line passing through Q_1 and Q_2 be parallel to the straight line passing through P4 and P5 and tangent to the Besier curve in the upper half. Assume that the four control points of the Besier curve passing through the four points P_0, P_6, P_7, and P_3 are P_0, P_8, P_9, and P_3. The straight line is parallel to the straight line passing through the two points P_8, and P_9, and is tangent to the Besier curve passing through the four points P_0, P_6, P_7, and P_3 at Q_3. The polygon composed of five points P_0, Q_1, Q_2, P_3, and Q_3 determines the range of the pattern, that is, the crescent pattern is inside the polygon, as shown in Figure 3.

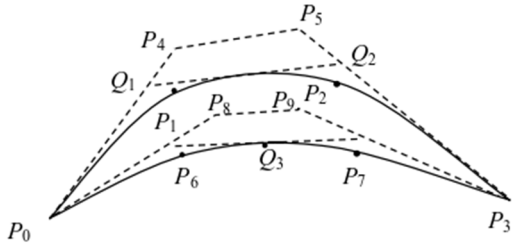

Figure 3 Schematic Diagram of Crescent Pattern Generation

If two Besier curves have intersections (up to one at most) in addition to the two endpoints P_0 and P_3, the intersections are divided into two crescent patterns as shown in Figure 4 for processing.

Figure 4 Polygonal Range of Computer Generated Crescent Pattern

The above crescent pattern generation algorithm only involves four key points, using fewer control points, and generating a highly controllable and delicate pattern. At the same time, the polygon range of the pattern is automatically determined.

A flower pattern generally consists of one or more petal units symmetrically distributed around a single or multi-layer circular pattern. The range of a flower pattern is relatively simple, as long as the circle neighborhood with the center as the center and R as the radius is the range of the pattern, and the center and radius are the control parameters of the pattern. The circular range of the computer-generated flower pattern is shown in Figure 5

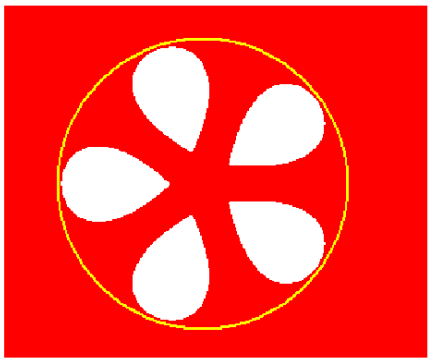

Figure 5 Computer Generated Circular Range of a Flower Pattern

4 Conclusion

This paper studies the determination of the pattern ranges in the automatic localization of computer Paper Cuttings patterns. Through the analysis of Paper Cuttings patterns, the patterns are classified according to their functions and characteristics; And determine the range of the pattern through polygons or circles.

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