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THE RECOGNITION OF THE COMPOSITION OF PAINTINGS BY CHINESE FLOWER AND BIRD PAINTERS

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ABSTRACT

In order to produce Expert System for Chinese flower and bird paintings, one needs a data base of the painting composition techniques of the painters. In this paper, paintings by actual painters were input into a computer using a scanner, and the arrangement of painting elements in the compositions was recognized. At this stage, the authors were able to determine the similar painting elements and the composition type in a single painting.

1 INTRODUCTION

In order to produce Expert System for Chinese flower and bird paintings, one needs a data base of the painting composition techniques of the painters. The authors are currently studying the recognition of painters' composition as the first step to making this data base. At this stage, the authors were able to determine the similar painting elements and the composition type in a single painting. Even though, in the recognition experiment, the computer recognition of composition does not perfectly match the arrangement of painting elements in the composition of a painting by an actual painter, the computer is qualitatively able to recognize painting elements and the types of composition.Therefore, this method should be applied for the practical recognition of the painter's style and composition techniques.

2 MANIPULATION OBJECT

There are five fixed compositional styles, namely S-shaped composition, triangular-shaped composition, crossed-line-crossing-shaped composition, cross-shaped composition and circular-shaped composition [1],[2]. The composition is constructed of painting elements (the basic units which compose a painting, e.g. flowers, leaves, bines, birds, fish and insects). In most cases, the composition selected by a painter belongs to one of the above five composition types. A combination of certain of these composition types may sometimes characterize a particular painter. Thus, one needs to recognize the painting elements and the composition type in paintings of each painter. Paintings by a certain painter can be characterized by the arrangement of the composed painting elements, and thus, the authors are able to reproduce the composition of the painter by recognizing the painting elements and the composition type. In this study, paintings by actual painters were input into a computer using a scanner, and the arrangement of painting elements in the compositions was recognized. Figure 1 shows some examples of paintings by certain painters.

Fig. 1 The input image.

3 RECOGNITION OF THE ARRANGEMENT OF PAINTING ELEMENTS IN THE COMPOSITION

The composition types (patterns of painting elements arranged in the composition) indicated that for the works of painters, there was a large difference in the patterns. Because of this, when the authors recognized the arrangement by pattern matching, the amount of data increased, because we had to desig-

nate the model of composition type pattern for each painting, and the time required for recognition became longer. It was also difficult to recognize the arrangement when we input into the computer the paintings of the next painter. Taking these problems into consideration, we decided to conduct the recognition process of the arrangement by the following procedures:

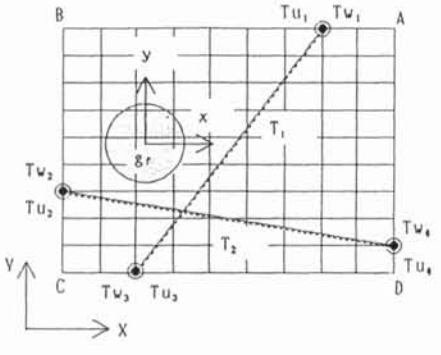
1. Determine the position of a painting based on the image put in the computer.

2. Determine where the painting elements are located.

3. Match painting elements with a single painting to determine similar painting elements.

4. Recognize the arrangement by pattern matching using the the model for composition type pattern, because the elements composing a painting are expressed by form and black and white.

5. Determine the composition type based on the composition rules and the relationship between the vertical and horizontal relationships between painting elements. One composition rule is that the conditions including black and white, density and degree of concentration should remain constant [1],[2].



●: Twi, Rough position of the tips of the divided lines
○: Tui, Position of the tips of the cosposition lines
◯: sf, Range of painting elements
—: Ti, Dividing lines
···: Comsposition lines

Fig. 2 The composition model of painting element and composition type.

4 A MODEL FOR COMPOSITION TYPE PATTERNS AND COMPOSITION RULES

4.1 MODELS

The models utilized (in the process of recognition) are the composition type model of a single painting and the model for painting elements each of which composes that painting. Although each model is produced on its own coordinate system, the two are treated conceptually as one composition model as shown in Fig. 2. The following 2 types of parameters are given to the model:

- The parameter whose value changes during the matching process.

  1. The ranges of values of the painting elements, s_f (f=1,2,3,...,n).

  2. The value of the relative positions of the frame centroids $G_i(X_{Gi}, Y_{Gi})$ of painting elements, which compose a painting.

- The parameter whose value does not change during the matching process.

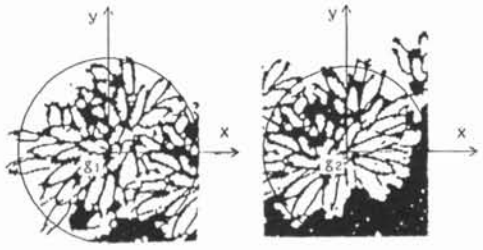
  1. The coordinate values, $g(x_{gf}, y_{gf})$, of the position of painting element centroid.

  2. The value for the length of the dividing line, T_i(i=1,2,3), which is the parameter of the composition type and which was given before the processing, and the value of the ratio of the distance to the tip of the composition line, Tui.

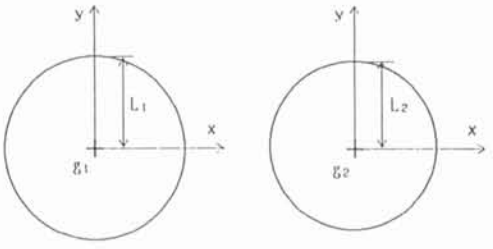
4.2 COMPOSITION RULES

Composition rules are used in model matching. Given the composition knowledge, we assume that the range of painting elements and frame centroid will change when we input a painting by a painter into the computer. Thus, we determine a length for dividing lines and determine the position patterns for the tips of composition lines in advance and select some pattern based on the range of painting elements and frame centroid. We gradually change the length of the dividing line based on this pattern and terminate the processing when we decide that the distance to the tips of the composition lines of the model has best

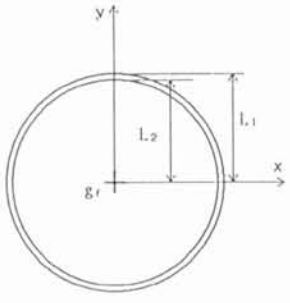
matched the value of the ratio.



(a-1)



(a-2)



(a-3)

L_f: Radius range of the painting elements
+: $g(x_{gf}, y_{gf})$, Centroid of the painting elements

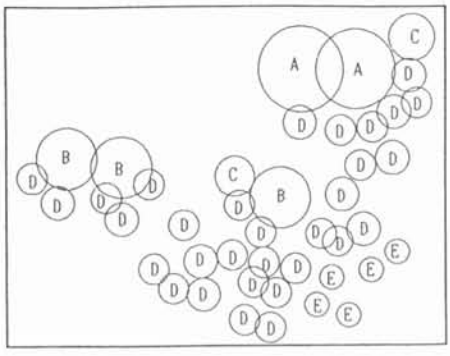
Fig. 3(a) The process of painting elements model matching.

5 MODEL MATCHING

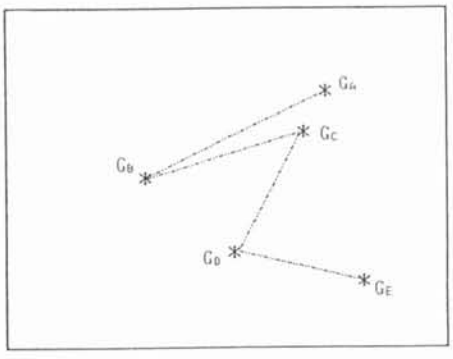
We describe the method to match a model as follows:

- When processing an image, we determine the data for existing painting elements.
- We prepare the method to modify a model in the computer as a composition rule.

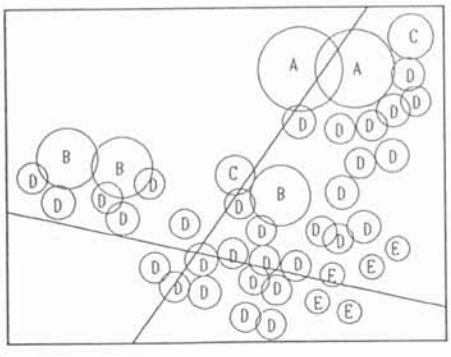
Matching is done according to the processing procedure as indicated in Fig. 3 (a) and (b).



(b-1)



(b-2)



(b-3)

—: Dividing lines
*: $G_i(X_{Gi}, Y_{Gi})$, Frame centroids
----: Distances between the frame centroids

Fig. 3(b) The process of composition type model matching.

(A) Matching among painting elements

We match painting element models within the coordinate system with the painting element centroid $g(x_{gf}, y_{gf})$ as the origin and pass on the result to the frame coordinate system.

Figure 3 (a) shows the painting element model. The painting element centroid $g(x_{gf}, y_{gf})$ and the radius range L_f (f=1,2,3,...,n) are determined during the image processing, and the range of painting elements s_f is calculated based on these values.

- Figure 3 (a-1) establishes the painting element model with the painting element centroid $g(x_{gf}, y_{gf})$ as the origin.
- Figure 3 (a-2) indicates L_f, obtained from the image processing, and the similar painting element L_{ra} is determined by Eq. (1) using L_f.

$$L_{ra} = \frac{L_f}{L_{(f+1)}}, \qquad L_{(f+1)} \leq L_f$$

if $1 \leq L_{ra} \leq 1.2$ then L_f and $L_{(f+1)}$ is a similar painting element. (1)

- Figure 3 (a-3) shows an example of the results obtained by matching. Finally, this model is passed on to the frame coordinate system.

(B) Matching composition types

Figure 3 (b) illustrates the matching processing procedures for composition type models, using the painting shown in Fig. 1 as a recognition example.

- Figure 3 (b-1) expresses similar painting elements.
- As shown in Fig. (b-2), the frame centroid, $G_i(X_{Gi}, Y_{Gi})$, of similar painting elements (i=1,2,3,...,n) is calculated.

$$X_{Gi} = \left(1 \Big/ \sum_{f=1}^{n} s_f\right) \cdot \sum_{f=1}^{n} s_f \cdot x_{gf},$$

$$Y_{Gi} = \left(1 \Big/ \sum_{f=1}^{n} s_f\right) \cdot \sum_{f=1}^{n} s_f \cdot y_{gf}. \quad (2)$$

- By using the distances between the frame centroids of the similar painting elements, the length of the dividing line and the tips of the composition lines are determined, and thus the composition model is determined. Given the composition knowledge, the dividing line and the tips of the composition lines are determined by using the number of divisions in both the vertical and horizontal directions of the frame in relation to the position of each painting element [1]. Figure 3 (b-3) indicates the results in which the composition type was determined in such a way. This result recognizes the composition of a painter.

6 RESULTS AND DISCUSSION

After inputting paintings by Lang Xiao, a modern Chinese flower and bird painter, into the computer by scanner and determining the borders of the paintings, the authors matched the elements and composition types within a single painting to determine similar painting elements and the composition type. The results of these procedures are shown in Figs. 3 (a) and 3 (b).

Even though, in the recognition experiment, the computer recognition of composition does not perfectly match the arrangement of painting elements in the composition of a painting by an actual painter, the computer is qualitatively able to recognize painting elements and the types of composition. Therefore, this method should be applied for the practical recognition of the painter's style and composition techniques.

7 CONCLUSION

At this stage, the authors were able to determine the similar painting elements and the composition type in a single painting. We plan to recognize the types of painting element arrangements and the utilization of open space to reproduce the composition of an actual painting by a painter.

REFERENCES

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[2] Sun, Q.-S.: flower and dird-painting skill questions and answers, Hebei Fine Arts Publishing House (China) (1985).