Developing a Shape-and-Composition CBIR Thesaurus for the Traditional Chinese Landscape

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Content-Based Image Retrieval (CBIR)

CBIR uses automatic extraction of lower level image features, such as texture, color, shape, and structure, to catalog and retrieve images.

A number of representative generic CBIR systems have been developed in the past ten years, including, for example, IBM’s Query by Image (QBIC) Content search engine.

CBIR approach is potentially useful to investigate relationships among paintings based on objective visual facts.
Previous research by Danqing Zhang, Binh Pham and Yuefeng Li has suggested that the two elemental issues in CBIR, feature extraction and similarity measures, tend to be domain-specific.

CBIR is potentially an excellent and feasible retrieval mechanism for the Chinese landscape in terms of its visual features.
Approximately 1000 paintings were studied to extract the features to be included in the thesaurus.

The thesaurus consists of two parts: Part I (shapes and lines) and Part 2 (composition templates).

Shapes can be divided into two main types: basic shapes and special shapes.

Lines include straight lines, arc lines and wavy lines.

Composition templates characterize visual layout structures that were commonly adopted in the Chinese landscape.
Part I  Shapes and Lines

As the core of the thesaurus, this part includes object types and their varieties that frequently appear in the Chinese landscape. Object types are divided into two main sets: A. *primary elements* and B. *secondary elements*. 
A Primary Elements

SN: This set refers to object types that are always found in the Chinese landscape. It consists of five categories, namely clouds (A1), mountains (A2), plants (A3), rocks (A4), and water (A5).
Part I Shapes and Lines

A Primary Elements

A1 Clouds

- A1.1. With Contours

- A1.2. Without Contours


Part I Shapes and Lines

A Primary Elements

A2  Mountains
- A2.1. Distant Mountains
  - - A2.1.1 Crags
    - - - A2.1.1.1 Adjacent
    - - - A2.1.1.2 Isolated
  - - A2.1.2 Peaks
    - - - A2.1.2.1 Adjacent
    - - - A2.1.2.2 Isolated
    - - - - A2.1.2.2.1 horizontally
    - - - - A2.1.2.2.2 vertically

Part I Shapes and Lines

*Primary Elements*

A2 Mountains

- A2.2. Mountains in a Close View
  - A2.2.1 Crags
    - A2.2.1.1 Adjacent
    - A2.2.1.2 Isolated
  - A2.2.2 Peaks
    - A2.2.2.1 Adjacent
    - A2.2.2.2 Isolated
    - A2.2.2.2.1 horizontally
    - A2.2.2.2.2 vertically

Part I Shapes and Lines

A Primary Elements

A3 Plants

- A3.1 Grass
- A3.2 Reeds
- A3.3 Trees
  - A3.3.1 Popular
    - A3.3.1.1 Bamboos
    - A3.3.1.2 Pine trees
    - A3.3.1.3 Willows
  - A3.3.2 Uncommon

Part I Shapes and Lines

A Primary Elements

A4 Rocks

- A4.1 Ellipse
- A4.2 Irregular polygon
- A4.3 Linglong (pierced and rounded irregular polygon)
- A4.4 Rectangle

Part I Shapes and Lines

A Primary Elements

A5 Water

- A5.1 Non-Waterfalls

- A5.2 Waterfalls

B. Secondary Elements

SN: This set refers to object types that sometimes appear in a Chinese landscape. It contains four categories, namely *animals* (B1), *architecture* (B2), *persons* (B3), and *transportation facilities* (B4).
Part I Shapes and Lines

B Secondary Elements

B1 Animals

- B1.1 Birds
  - B1.1.1 Flying
  - B1.1.2 Sitting on the ground or in the water
  - B1.1.3 Standing

Part I Shapes and Lines

B Secondary Elements

- B1.2 Mammals
  - - B1.2.1 Popular
    - - - B1.2.1.1 Deer
    - - - B1.2.1.2 Donkey/Horse
    - - - B1.2.1.3 Water Buffalo
  - - B1.2.2 Uncommon

Part I Shapes and Lines
B Secondary Elements

B2. Architecture

- B2.1. Bridges
  - B2.1.1 Arch
  - B2.1.2 Beam

- B2.2. Buildings
  - B2.2.1 Multi-storied
  - B2.2.2 Single-storied

Yellow Crane Tower, Wuhan, China, 2006.
Part I Shapes and Lines

B Secondary Elements

B3 Person

- B3.1 In motion
  - B3.1.1 Bending
  - B3.1.2 Walking

- B3.2 In various positions
  - B3.2.1 Lying down
  - B3.2.2 Sitting
    - B3.2.2.1 Facing front
    - B3.2.2.2 Facing left
    - B3.2.2.3 Facing right
  - B3.2.3 Standing

Part I Shapes and Lines

B Secondary Elements

- B4.1. Boat
  - - B4.1.1. Canoe
  - - B4.1.2 Dragon boat
  - - B4.1.3 Fishing boat
  - - B4.1.4 Passenger ship
  - - B4.1.5 Sailing boat
    - - B4.1.5.1 Trapezoid sail
    - - B4.1.5.2 Triangle sail
- B4.2 Carriage

Part II Composition Templates

This part consists of 14 composition templates that are commonly applied to the Chinese landscape. Based on overall layout of objects in the Chinese landscape, the composition templates are classified into two main categories, namely *fully filled* (C1) and *one part* (C2). Abstract rectangles are used to symbolize objects in the painting and illustrate their spatial relationships.
Part II Composition Templates

C1 Full Filled: Objects are represented all over the rice paper or silk.
- C1.1 Non-symmetrical
  - - C1.1.1 Extended
  - - - C1.1.1.1 Horizontally
  - - - C1.1.1.2 Vertically
  - - C1.1.2 Fragmented
  - - C1.1.3 Vertically superimposed
  - - C1.1.4 Zigzagged
- C1.2 Symmetrical
  - - C1.2.1 Bilateral
  - - C1.2.2 Diagonal or
  - - C1.2.3 Up and down


Part II Composition Templates
C2 One Part: *Objects are represented in a certain part of the rice paper or silk.*

- C2.1 Center
- C2.2 Left
- C2.3 Lower
- C2.4 Lower left
- C2.5 Lower right
- C2.6 Right

Tang, Yin. *Luo xia gu wu tu [A single goose in the sunset]*. Ming Dynasty. Source: Ibid., p.79.
Testing the thesaurus

Development of the thesaurus is based on visual features of Chinese landscape.

This thesaurus emphasizes discrimination among object types to improve recall of relevant images.

Results from the thesaurus testing demonstrate that shape features and composition templates are sufficient to represent the content of the paintings.
Thank you!

Questions?
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