Tutorial 2: Image Feature Extraction

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Visual Computing Workshop: Image Processing
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May 21st, 2004
Why Image Processing?

- “A picture is worth a 1000 words”
- Alternative form of communication
- Popular medium of information on the Internet
- Not everything can be described in text; not everything can be described in images

**Feature Extraction** - method of capturing visual content of images for indexing & retrieval.

- **visual features**
  - (primitive or low-level image features)

  Domain-specific features:
  - fingerprints, human faces

  General features:
  - color, texture, shape
Feature Extraction

Feature Extraction

Image Database

Mountains and waterfalls

It is a nice sunset.

Text Database

Semantic Gap

Meaning: Sunset
The issue of choosing the features to be extracted should be guided by the following concerns:

- The features should carry enough information about the image and should not require any domain-specific knowledge for their extraction.
- They should be easy to compute in order for the approach to be feasible for a large image collection and rapid retrieval.
- They should relate well with the human perceptual characteristics since users will finally determine the suitability of the retrieved images.
Because of perception subjectivity, there does not exist a single best representation for a feature.

Color feature is one of the most widely used feature in Image Retrieval. Color Histogram is the most used in color feature representation.
Color as low-level feature representation:

- Closely related to human visual perception
- HSV color model

- Encode the spatial distribution of features in images
  - fixed partitioning scheme
  - each image divided into $M \times N$ overlapping blocks
  - 3 separate local histograms (H,S,V) are calculated for every block

- Compact to provide efficient storage and retrieval
  - The location of area-peak for every local histogram determines the value of the corresponding histogram.
Figure 1: The fixed partitioning scheme with overlapping blocks.

\[
\left[ e_{11} e_{12} \ldots 125 \ldots e_{m1} e_{m2} \ldots e_{mn} \right]
\]

Hue Component

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Block Histogram

Pixel value

Occurrence

0 1 2 3 4 5
Two examples of original images and their approximations:
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Color-wise Similarity Retrieval
Texture Feature Extraction

- Textures can be rough or smooth, vertical or horizontal etc
- Generally they capture patterns in the image data (or lack of them), e.g. *repetitiveness* and *granularity*

Texture features:
- Statistical measures:
  - Entropy
  - Homogeneity
  - Contrast
- Wavelets
- Fractals
Shape Feature Extraction

Methods:
1) Global Features:
   (Moment Invariant, Aspect Ratio & Circularity)
2) Local Features:
   Boundary segments

Example Query Input

Color Palette Input

Feature Extraction Process

Retrieval Results