Lesson 11

# Media Retrieval

- Information Retrieval
- Image Retrieval
- Video Retrieval
- Audio Retrieval

# **Information Retrieval**

- Retrieval = Query + Search
- □ Informational Retrieval: Get required information from database/web
- Text data retrieval
  - via keyword searching in a text document or through web
  - via expression such as in relational database

#### Multimedia retrieval

- Get similar images from an image database
- Find interesting video shots/clips from a video/database
- Select news from video/radio Internet broadcasting
- Listen specific sound from audio database
- Search a music
- Challenges in multimedia retrieval
  - Can't directly text-based query and search?
  - How to analysis/describe content and semantics of image/video/audio?
  - How to index image/video/audio contents?
  - Fast retrieval processing and accurate retrieval results

# Audio Visual Content/Feature



## Image Content – Image Features

- What are image features?
- Primitive features
  - Mean color (RGB)
  - Color Histogram
- Semantic features
  - Color distribution, texture, shape, relation, etc...
- Domain specific features
  - Face recognition, fingerprint matching, etc...

# Mean Color and Color Histogram

- Pixel Color Information: R, G, B
- **Mean Color** (R,G or B) = <u>Sum of that component for all pixels</u>



Number of pixels

• Histogram: Frequency count of each individual color







## **Color Models and HSI**

- Many color models: RGB, CMY, YIQ, YUV, YCrCb, HSV, HSI, ...
- HSI (Hue, Saturation, Intensity): often used



### Similarity between Two Colors

The similarity between two colors, i and j, is given by:

$$C(i, j) = W_h H(i, j) + W_s S(i, j) + W_i I(i, j)$$

where

$$H(i, j) = \min\left(\left|H_i - H_j\right|, 12 - \left|H_i - H_j\right|\right)$$
$$S(i, j) = \left|S_i - S_j\right|$$
$$I(i, j) = \left|I_i - I_j\right|$$



The degree of similarity between two colors, i and j, is given by:

$$CS(i, j) = \begin{cases} 0\\ 1 - \frac{C(i, j)}{C \max} \end{cases}$$

if  $H(i, j) > H \max$ otherwise

## Content Based Image Retrieval (CBIR)

□ CBIR: based on similarity of image color, texture, object shape/position
 □ Images with similar color → *dominated by blue and green*



### **Color Based Image Retrieval**

Images with similar colors and distribution/histogram





### **Shape Based Image Retrieval**



Images with similar shapes



# **Spatial Relation Based Image Retrieval**

#### Images with similar shapes and their relation



## **Correctness and Accuracy in CBIR**



□ CBIR accuracy is counted by a percentage of targeted/corrected image(s) in top-n candidate images, for example

$$C_1, C_2, C_3, ..., C_{n-1}, C_n, C_{n+1}, ..., C_M$$
  
90%

□ Hybrid retrieval using color and texture plus shape can improve accuracy

### Hybrid Retrieval – Combined Similarity

- ◆ The Similarity Measure of Color: CS
- ◆ The Similarity Measure of Shape: SS
- ◆ The Similarity Measure of Spatial Relation: SRS

### → Combined Similarity Score:

$$S = Wc * CS + Ws * SS + Wsr * SRS$$

Where CS, SS, SRS are the similarity scores of Color, Shape and Spatial Relations, and  $W_C$ ,  $W_S$ ,  $W_{SR}$  are the weights of Color, Shape and Spatial Relations

# Query by Scratch in CBIR



Please try such image search in the <u>Hermitage Web site</u>. It uses the QBIC engine for searching archives of world-famous art.

# Query by Example in CBIR

Select Options Search Options   Select the Image to be Searched on   Random Browsing Upload Image   Number of Random Images Enter The full path of the Image   24 Enter   24 Enter   Enter The full path of the Image   24 Enter   Enter   1 2   5 2   6 2   7 2   8   2 3   7 2   8   2   9   9   9   1   5   1   2   6   2   7   2   3   4   2   3   4   2   5   2   6   2   3   4   2   3   4   2   5   2   6   2   2   3   4   2   3   4   2   5   5   5   5   5   5   5   6   2   2   2   3   4   2   3   4   2   5   5   5   5   5   5 <th></th> <th>Content-Based Image Reteriva</th> <th>Sytem(CBIR)</th> <th>?</th>		Content-Based Image Reteriva	Sytem(CBIR)	?
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# Query by Example in CBIR (cont.)



# Video Retrieval

#### Video retrieval:

- Find interesting video shots/segments from a movie, TV, video database
- It is hard because of many images (>10fps) and temporal changes
- Methods of video retrieval

**Non-text-based:** Key frames via CBIR, color, object, background sound, etc. **Text-based**: Extract caption, i.e., overlayed text, speech recognition, etc.



# Key Frame Extraction and Video Retrieval



- 1. Decompose video segment into shots
- 2. Compute key/representative frame for each shot
- 3. Query by QBIC
- 4. Use frame from highest scoring shot

### Various Clues/Contents in Video Retrieval



### Video Caption Extraction in Video Retrieval





Time-Based Minimum Image:



Final VOCR Results: FREEMAN BLOCK LOS ANGELES COUNT SHERIFF



### Transcript via Speech Recognition for Video Retrieval

- Generates transcript to enable text-based retrieval from spoken language documents
- Improves text synchronization to audio/video in presence of scripts





Raw Video

### Video Retrieval by Combining Different Features



## MPEG-7: Audiovisual Content Description



**Feature Extraction:** Content analysis (D, DS) Feature extraction (D, DS) Annotation tools (DS) Authoring (DS) MPEG-7 Scope: Description Schemes (DSs) Descriptors (Ds) Language (DDL) Ref: MPEG-7 Concepts Search Engine: Searching & filtering Classification Manipulation Summarization Indexing

# Example of MPEG-7 Annotation Tool



# MPEG-7: Image Description Example



### Automatic Video Analysis and Index

Scene Cuts







Camera	Static	Static	Zoom
Objects	Adult Female	Animal	Two adults
Action	Head Motion	Left Motion	None
Captions	[None]	Yellowstone	[None]
Scenery	Indoor	Outdoor	Indoor



## **Audio Retrieval**

### Audio retrieval:

- Find required sound segment from audio database or broadcasting
- Find interesting music from song/music database or web

### Methods of audio retrieval

### Physical features of audio signal:

- Loudness, i.e., sound intensity (0~120dB)
- Frequency range: low, middle or high (20Hz~20KHz)
- Change of acoustic feature
- Speech, background sound, and noise
- Pitch

### Semantic features of audio:

- word or sentence via speech recognition
- Male/female, young/old
- Rhythm and melody
- Audio description/index
- Content Based Music Retrieval (CBMR)

# Music Retrieval by Singing/humming



- > A note has two important attributes
  - Pitch: It tells people which tone to play
  - Duration: It tells people how long a note needs to be played
  - Notes are represented by symbols



### Music Retrieval by Singing/humming (Cont.)



## **Demos of Content-Based Image Retrieval**