SCHEMA Participation in TRECVID 2004

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Outline

• Background
• Canned system demo
• Under the hood:
  • Image analysis
  • MPEG-7 XM
  • Face classifier
  • Motion features
• Experimental setup & results
• Conclusions
SCHEMA NoE

- EU-funded Network of Excellence
  - Network of Excellence in Content-Based Semantic Scene Analysis and Information Retrieval
- 13 members & 28 affiliated members
  - Universities, research institutes, companies (SMEs & MNCs)
- Activities:
  - Researcher mobility (collaboration, exchanges)
  - Contributions to standards (MPEG-7, JPEG200)
  - Development of a Reference System for CBIR
SCHEMA participation in TRECVID

• Adapt Reference System for TRECVID experiments

• 2 Variants:
  • Text-based searching on ASR only
  • Text & image-based features:
    • Option 1: initiate search with text & high-level features … use visual similarity thereafter
    • Option 2: initiate search with text, high-level features and example image … use visual similarity thereafter
System based on Schema and MPEG-7 XM for the participation of Schema in TRECVID

In order to start a query you need to provide a description.

Please select topic number. A page containing example images for that topic will be displayed.

- [ ] Search using only text
- [x] Search using text and images

Go
Topic #130: Find shots of a hockey rink with at least one of the nets fully visible from some point of view.

**Option 2: Search with text ranking**

hockey  Go
Topic #130: Find shots of a hockey rink with at least one of the nets fully visible from some point of view.

Option 1: Search using examples images with text filtering

Option 2: Search with text filtering

- hockey

- Shots can be either face or non face
- Shots do not contain face
- Shots contain face

- Motion Activity
  - Shots have very small motion activity
  - Shots have small motion activity
  - Shots have medium motion activity
  - Shots have high motion activity
  - Shots have very high motion activity

- Camera Motion Activity
  - Shots have small camera motion activity
  - Shots have medium camera motion activity
  - Shots have high camera motion activity
  - Shots have very high camera motion activity
Search results:
16 items total [1 – 9].
Select Region:

Submit new query for this topic
Content-based results:
300 items total (1 - 9). The results are cached...
Select Region:

Submit new query for this topic

MRSS (DCU)

KMCC (ITT)
Topic #130: Find shots of a hockey rink with at least one of the nets fully visible from some point of view.

Option 1: Search using examples images with text filtering

Filtering keywords: hockey

- Shots can be either face or non-face
- Shots do not contain face
- Shots contain face

Motion Activity
- Shots have very small motion activity
- Shots have small motion activity
- Shots have medium motion activity
- Shots have high motion activity
- Shots have very high motion activity

Camera Motion Activity
- Shots have small camera motion activity
- Shots have medium camera motion activity
- Shots have high camera motion activity
- Shots have very high camera motion activity
Select Region:

Submit new query for this topic
Acquisition of results

• In each variant and option, when the user found a keyframe/shot that was relevant to the topic, he would add it to the result set by clicking on it
  • Process similar to a shopping cart application
Image Analysis

- 2 region-based segmentation algorithms:
  - Modified RSST (MRSST)
    - Bottom-up colour-based pixel merging
  - K-Means-with-Connectivity-Constraint (KMCC)
    - Hierarchical k-means clustering of colour & texture features
MPEG-7 XM

- MPEG-7 eXperimentation Model (XM) used for:
  - Low-level feature extraction for images or regions
  - Descriptor matching for search & retrieval
- XM requires 3 modifications to make it suitable for use in a “real” IR system
XM Modification 1

- MultiImage module:
  - New module to support extraction and matching of multiple descriptors
  - Normalisation of working point of matching functions
  - Linear combination of distance values using default weights

<table>
<thead>
<tr>
<th>MPEG-7 DESCRIPTORS SUPPORTED BY THE MULTIIMAGE MODULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color Layout</td>
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<tr>
<td>Color Structure</td>
</tr>
<tr>
<td>Dominant Color</td>
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<tr>
<td>Scalable Color</td>
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</tbody>
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XM Modification 2

- XM Server
  - Re-engineer software to allow XM to run continuously in the background, accessed via TCP socket communication
XM Modification 3

- **Indexing**
  - Use pre-computed similarity values
  - Hierarchically partition search space
Face Classifier

- J. Luo and A. Savakis [ICIP 01]
- Extension:
  - Apply image segmentation
  - Classifier trained on segmented face regions
  - Significant improvement for distant faces
Motion Features

• MPEG-7 Motion intensity:
  ● “Very Low”, “Low”, “Medium”, “High”, “Very High”

• Global camera motion:
  ● Runs of 0 motion vectors in MPEG-1 P-frames
  ● “Low”, “Medium”, “High” estimated using a Fuzzy C-Means algorithm
Experiments

- 8 users, each searching for 12 topics
  - 6 using text-only, 6 using text & image features
- 10 minutes were given to each tester to find as many shots as possible, relevant to the given topic
- Conducted remotely in 3 different labs
- 2 runs for each system submitted
Evaluation
Evaluation
Evaluation

SCHEMA vs Median (run XM_1)

SCHEMA vs Median (run XM_2)

SCHEMA vs Median (run Text_1)

SCHEMA vs Median (run Text_2)
Conclusions

• Performance of SCHEMA-XM better than SCHEMA-Text
  ● Inclusion of low-level features, regions and high-level "filters" aids retrieval for certain topics

• Performed reasonably well in comparison to median ... for first timers
Thank you!

• SCHEMA Reference System:
  • [http://media.iti.gr/SchemaRS/](http://media.iti.gr/SchemaRS/)
  
  • SCHEMA Ref Sys (Corel DB)
  • SCHEMA XM (Corel DB)
  • SCHEMA MPA (Macedonian Press Agency DB)