SCHEMA Participation in TRECVID 2004

Vasileios Mezaris[1], Haralambos Doulaverakis[1], Stephan Herrmann[2], Bart Lehane[3], Noel O'Connor[3], Ioannis Kompatsiaris[1], and Michael G. Strintzis[1].

[1]Informatics and Telematics Institute (ITI)/Centre for Research and Technology Hellas (CERTH)

[2]Institute for Integrated Systems, Munich University of Technology

[3]Centre for Digital Video Processing, Dublin City University, Ireland

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

SCHEMA rs :: SchemaXM

http://media.iti.gr/SchemaRS/trec/index.html

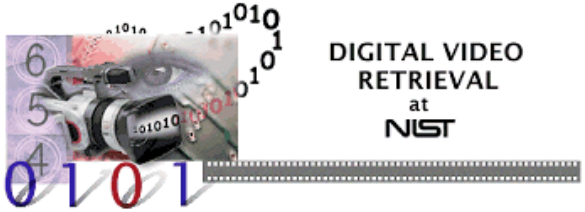
Google

SCHEMA xm

home about contact

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 containg example images for that topic will be displayed

Select topic

- Search using only text
- Search using text and images

Go

W3C XHTML 1.0 W3C CSS

SCHEMA rs :: Query

http://media.iti.gr/SchemaRS/trec/query.html?topic=130&system=text&example=yes

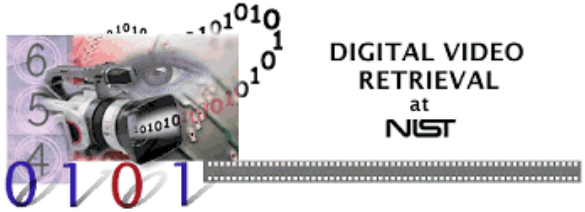
Google

SCHEMA xm

home about contact

Time Elapsed 8:22

Choose new topic



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

W3C XHTML 1.0 W3C CSS

SCHEMA rs :: Search results

http://media.iti.gr/SchemaRS/trec/search.html?q=hockey&topic=130&system=text

Google

SCHEMA xm

home about contact

Time Elapsed 9:07

Submit new query for this topic

0 shots selected

Search results:

16 items total [1 - 9].

shot47_134_RKF.jpg12.77
Add shot
View Larger Image

shot91_90_RKF.jpg 12.06
Add shot
View Larger Image

shot52_141_RKF.jpg 9.85
Add shot
View Larger Image

shot71_197_RKF.jpg 9.85
Add shot
View Larger Image

shot12_116_RKF.jpg 9.42
Add shot
View Larger Image

shot116_175_RKF.jpg9.03
Add shot
View Larger Image

shot53_185_RKF.jpg 8.66

shot84_61_RKF.jpg 8.66

shot65_180_RKF.jpg 7.73

SCHEMA rs :: Query

http://media.iti.gr/SchemaRS/trec/query.html?topic=130&system=both&example=yes

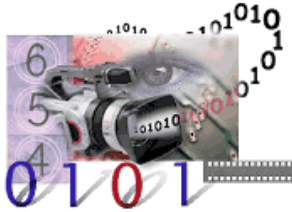
Google

SCHEMA xm

home about contact

Time Elapsed 4:08

Choose new topic



DIGITAL VIDEO RETRIEVAL at NIST

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 ranking

hockey Go

Face

- (•) Shots can be either face or non face
- ( ) Shots do not contain face
- ( ) Shots contain face

Motion Activity

- [x] Shots have very small motion activity
- [x] Shots have small motion activity
- [x] Shots have medium motion activity
- [x] Shots have high motion activity
- [x] Shots have very high motion activity

Camera Motion Activity

- [x] Shots have small camera motion activity
- [x] Shots have medium camera motion activity
- [x] Shots have high camera motion activity

W3C XHTML 1.0 W3C CSS

SCHEMA rs :: Search results

http://media.iti.gr/SchemaRS/trec/search.html?q=hockey&topic=130&system=both&face=2&mmed=1&mhi=1&

Google

SCHEMA xm

home about contact

Time Elapsed 0:58

Submit new query for this topic

0 shots selected

Search results:

16 items total [1 - 9].

shot47_134_RKF.jpg12.77
Add shot
View Larger Image

shot91_90_RKF.jpg 12.06
Add shot
View Larger Image

shot52_141_RKF.jpg 9.85
Add shot
View Larger Image

shot71_197_RKF.jpg 9.85
Add shot
View Larger Image

shot12_116_RKF.jpg 9.42
Add shot
View Larger Image

shot116_175_RKF.jpg9.03
Add shot
View Larger Image

shot53_185_RKF.jpg 8.66

shot84_61_RKF.jpg 8.66

shot65_180_RKF.jpg 7.73

SCHEMA rs :: Select Region

http://media.iti.gr/SchemaRS/trec/search.html?img_id=1053185&q=HOCKEY&system=both&topic=130&face=2

Google

SCHEMA xm

home about contact

Time Elapsed 8:36

Submit new query for this topic

0 shots selected

Select Region:

MRSST (DCU)

KMCC (ITI)

W3C XHTML 1.0 W3C CSS

SCHEMA rs :: Content-based results

http://media.iti.gr/SchemaRS/trec/search.html?x=64&y=43&img_id=1053185&algorithm=5&q=HOCKEY&examp

Google

SCHEMA xm

home about contact

Time Elapsed 4:45

Submit new query for this topic

0 shots selected

Content-based results:

300 items total [1 - 9]. The results are cached...

Original Image

100.00
shot53_185_RKF.jpg

Add shot
View Larger Image

100.00
shot60_176_RKF.jpg

Add shot
View Larger Image

100.00
shot78_148_RKF.jpg

Add shot
View Larger Image

100.00
shot78_150_RKF.jpg

Add shot
View Larger Image

100.00
shot62_172_RKF.jpg

Add shot
View Larger Image

100.00
shot103_68_RKF.jpg

Add shot
View Larger Image

SCHEMA rs :: Select Region

http://media.iti.gr/SchemaRS/trec/search.html?img_id=1053185&q=HOCKEY&system=both&topic=130&face=2

Google

SCHEMA xm

home about contact

Time Elapsed 8:36

Submit new query for this topic

0 shots selected

Select Region:

.

MRSST (DCU)

KMCC (ITI)

W3C XHTML 1.0 W3C CSS

SCHEMA rs :: Content-based results

http://media.iti.gr/SchemaRS/trec/search.html?x=142&y=55&img_id=1053185&algorithm=1&q=HOCKEY&exam

Google

SCHEMA xm

home about contact

Time Elapsed 5:12

Submit new query for this topic

0 shots selected

Content-based results:

298 items total [1 - 9]. The results are cached...

Original Image

KMCC (ITI)

100.00
shot53_185_RKF.jpg

Add shot
View Larger Image

100.00
shot75_180_RKF.jpg

Add shot
View Larger Image

100.00
shot78_148_RKF.jpg

Add shot
View Larger Image

100.00
shot89_102_RKF.jpg

shot2_76_RKF.jpg 100.00

Add shot

100.00
shot80_170_RKF.jpg

SCHEMA rs :: Query

http://media.iti.gr/SchemaRS/trec/query.html?topic=130&system=both&example=yes

Google

Time Elapsed 2:19

Choose new topic

DIGITAL VIDEO RETRIEVAL at NIST

SCHEMA

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

Face	Motion Activity	Camera Motion Activity
Shots can be either face or non face	Shots have very small motion activity	Shots have small camera motion activity
Shots do not contain face	Shots have small motion activity	Shots have medium camera motion activity
Shots contain face	Shots have medium motion activity	Shots have high camera motion activity
	Shots have high motion activity	
	Shots have very high motion activity	

SCHEMA rs :: Select Region

http://media.iti.gr/SchemaRS/trec/search.html?x=96&y=78&q=&topic=130&example=yes&img_id=73&system=

Google

SCHEMA xm

home about contact

Time Elapsed 6:23

Submit new query for this topic

0 shots selected

Select Region:

MRSST (DCU)

KMCC (ITI)

EM (QMUL)

PFZL (TUM)

WSRM (ELLAB)

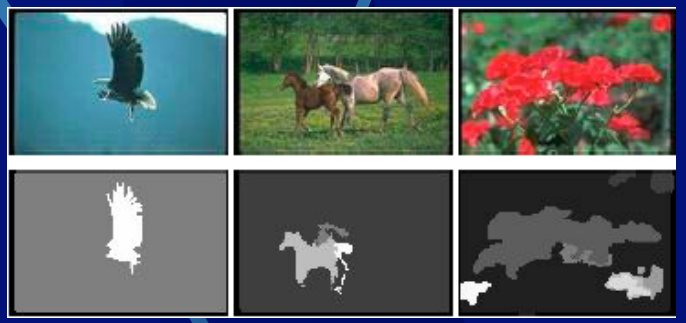
W3C XHTML 1.0 W3C CSS

Acquisition of results

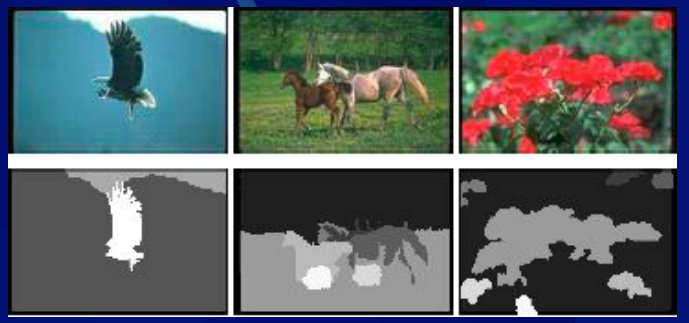
- In each variant and option, when the user found a keyframe/shot that was relevant to the topic, he would add it to the result set by clicking on it
  - Process similar to a shopping cart application

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



MRSST



KMCC

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

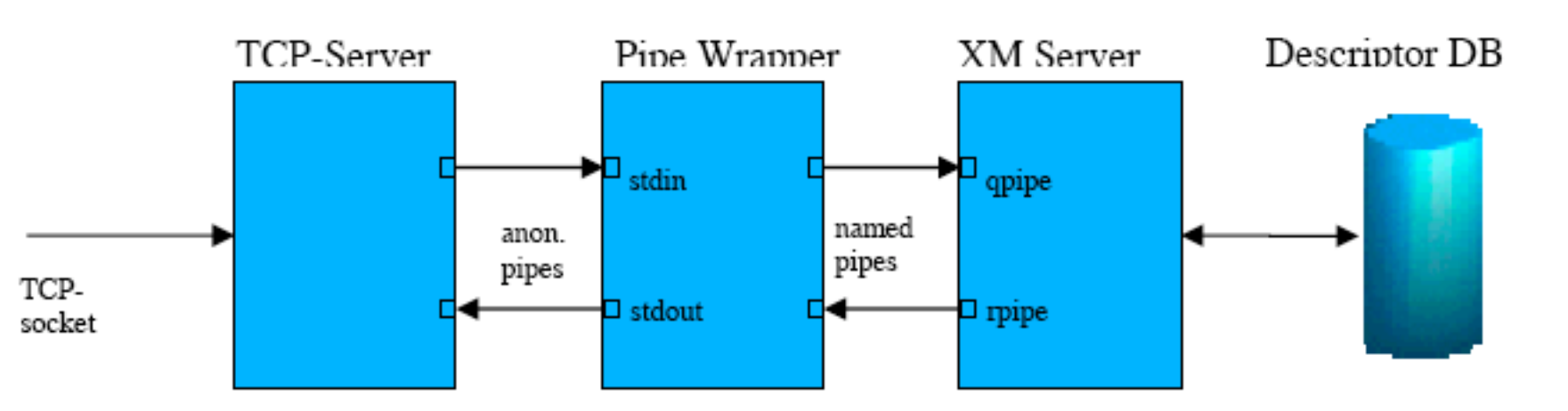
- MultiImage module:
  - New module to support extraction and matching of multiple descriptors
  - Normalisation of working point of matching functions
  - Linear combination of distance values using default weights

MPEG-7 DESCRIPTORS SUPPORTED BY THE MULTIIMAGE MODULE

Color Layout	Edge Histogram
Color Structure	Homogeneous Texture
Dominant Color	Contour Shape
Scalable Color	Region Shape

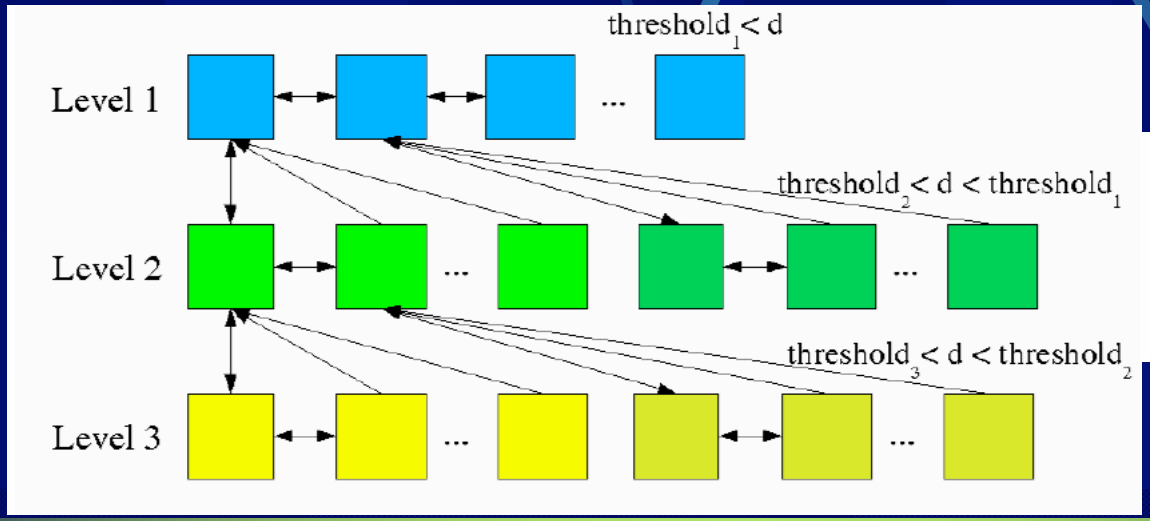
XM Modification 2

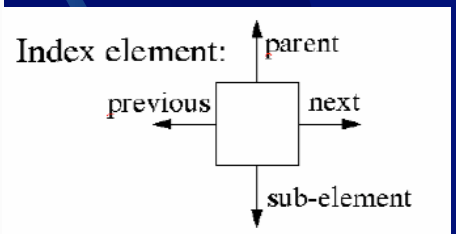
- XM Server
  - Re-engineer software to allow XM to run continuously in the background, accessed via TCP socket communication



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

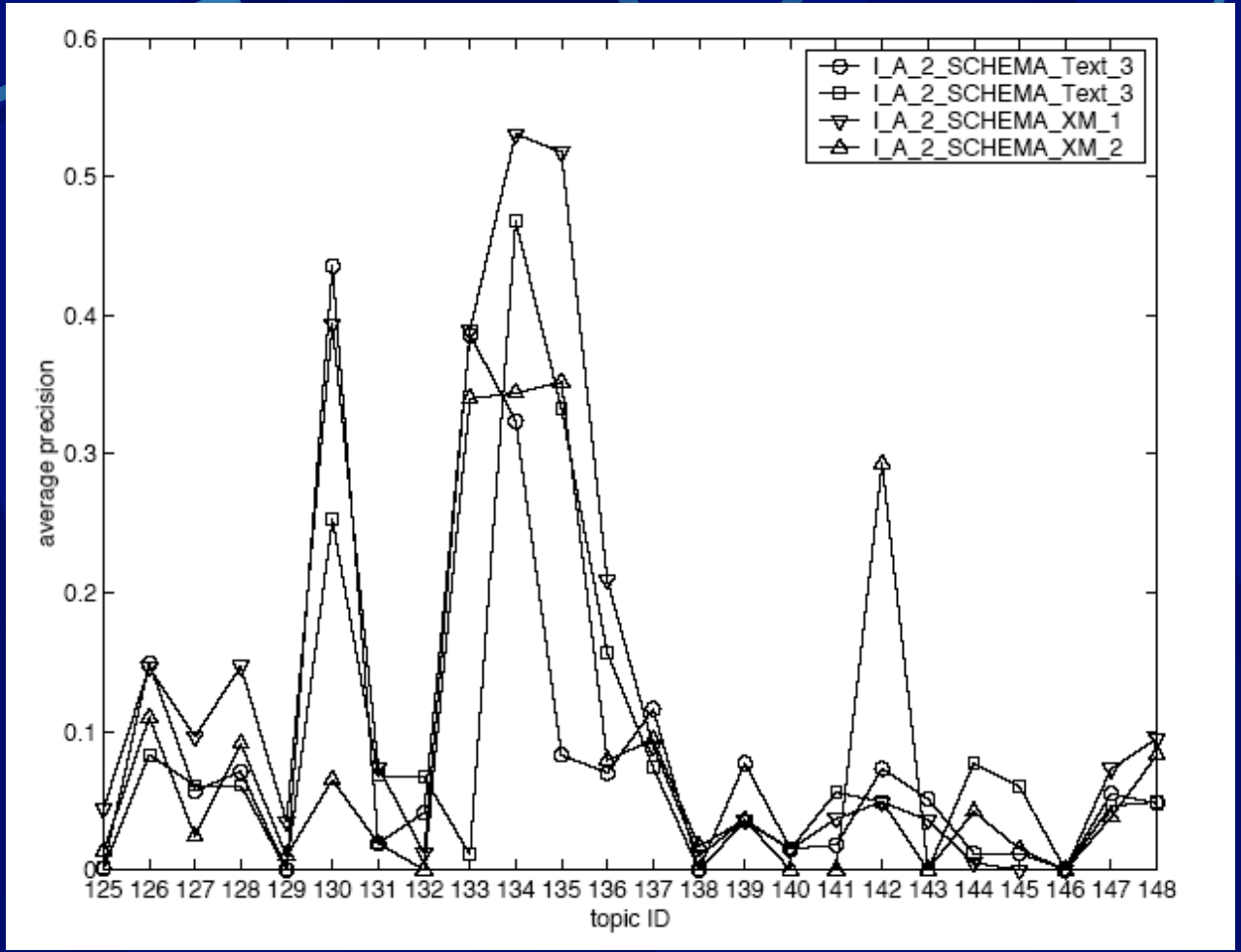
Motion Features

- 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

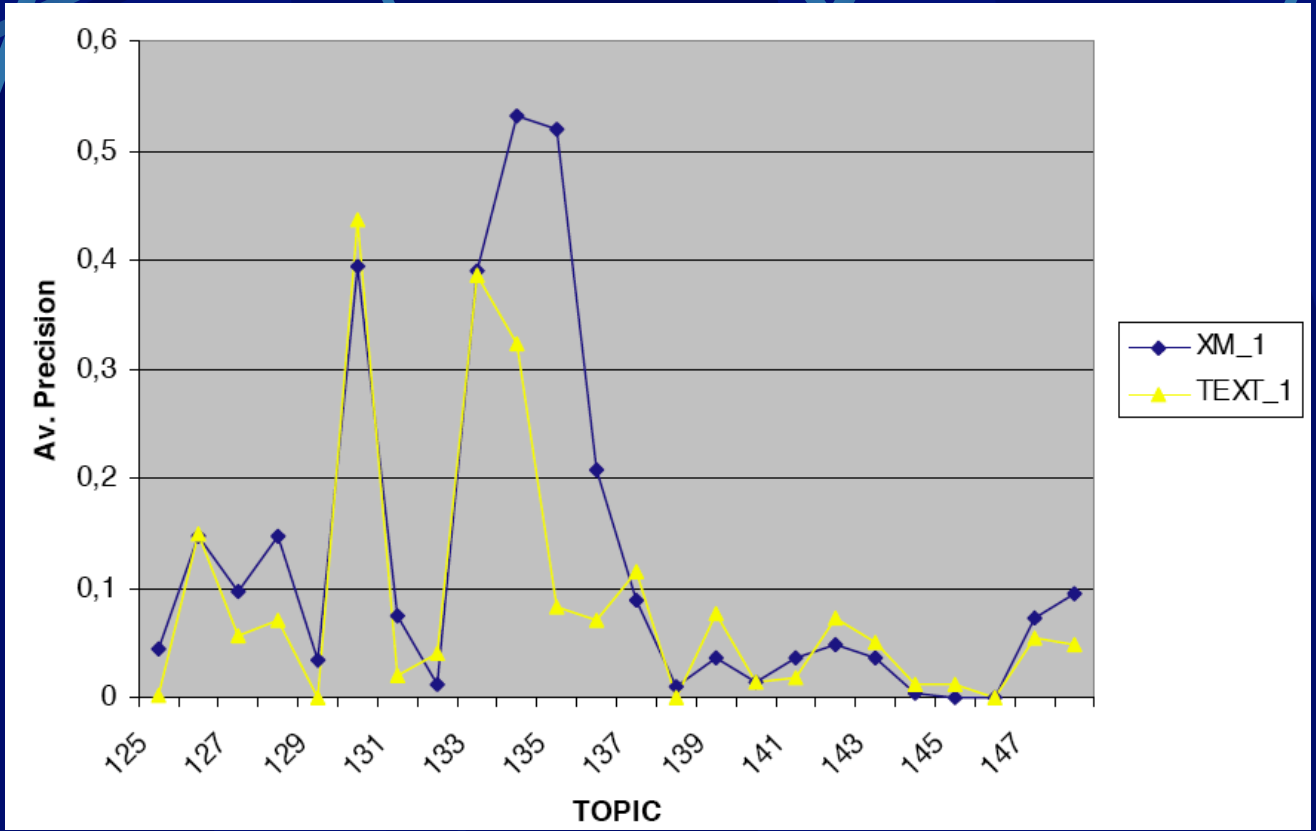
Experiments

- 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

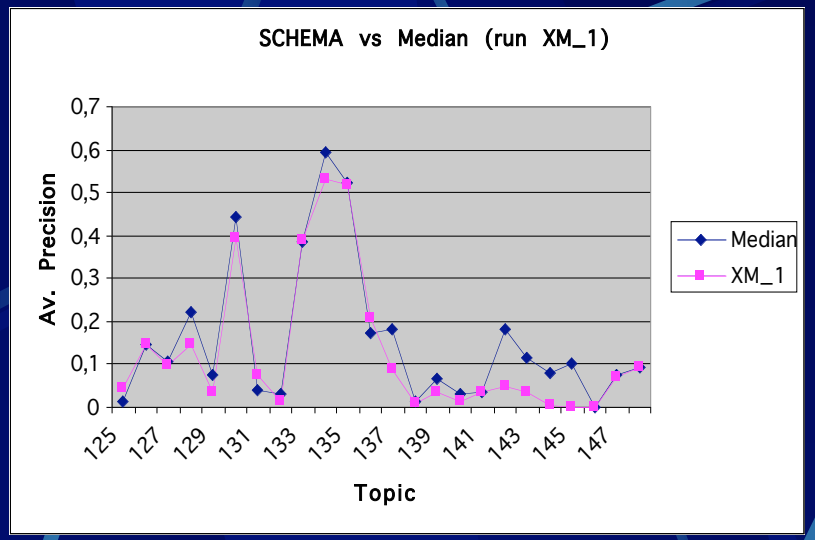
Evaluation

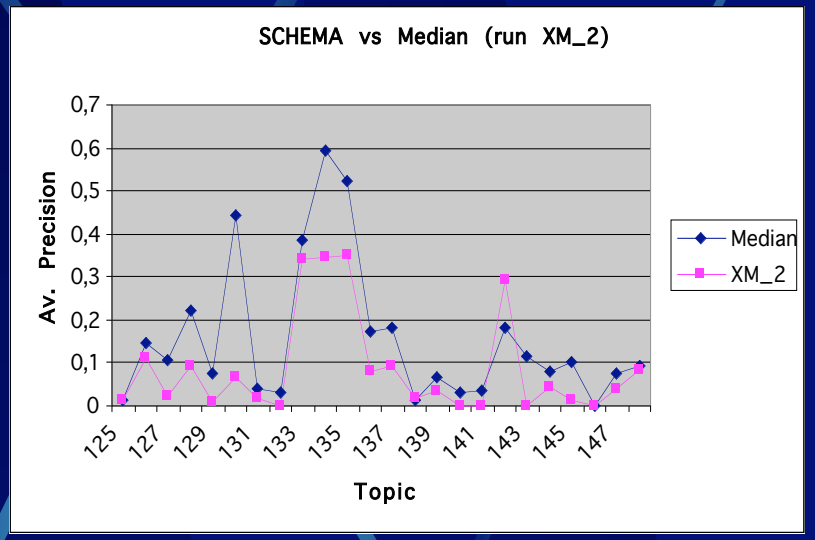

I_A_2_SCHEMA_Text_3
I_A_2_SCHEMA_Text_3
I_A_2_SCHEMA_XM_1
I_A_2_SCHEMA_XM_2
average precision
topic ID
0
0.1
0.2
0.3
0.4
0.5
0.6
125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148

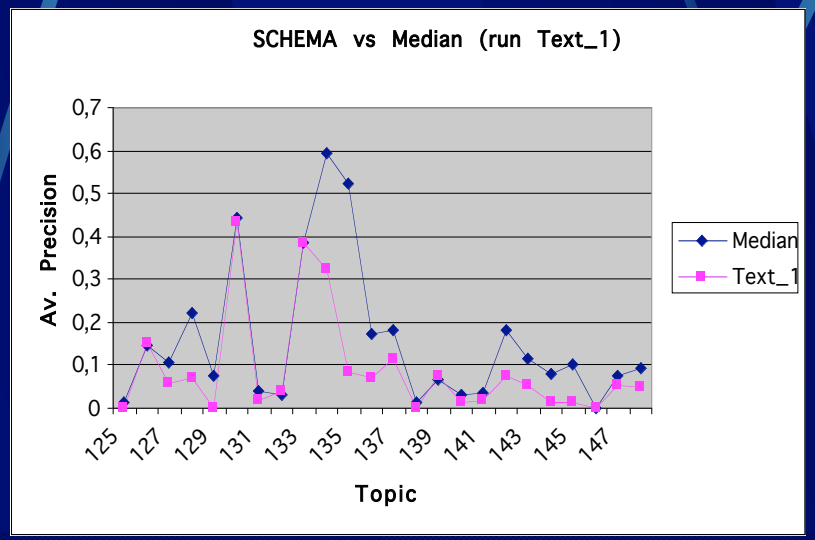
Evaluation

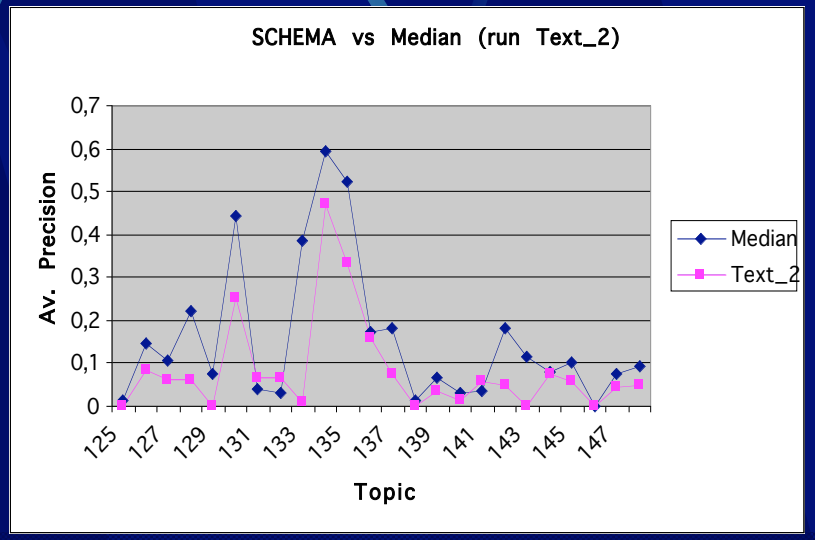

0,6
0,5
0,4
0,3
0,2
0,1
0
Av. Precision
125
127
129
131
133
135
137
139
141
143
145
147
TOPIC
XM_1
TEXT_1

Evaluation


SCHEMA vs Median (run XM_1)
Av. Precision
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
125 127 129 131 133 135 137 139 141 143 145 147
Topic
Median
XM_1


SCHEMA vs Median (run XM_2)
Av. Precision
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
125 127 129 131 133 135 137 139 141 143 145 147
Topic
Median
XM_2


SCHEMA vs Median (run Text_1)
Av. Precision
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
125 127 129 131 133 135 137 139 141 143 145 147
Topic
Median
Text_1


SCHEMA vs Median (run Text_2)
Av. Precision
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
125 127 129 131 133 135 137 139 141 143 145 147
Topic
Median
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/
    - SCHEMA Ref Sys (Corel DB)
    - SCHEMA XM (Corel DB)
    - SCHEMA MPA (Macedonian Press Agency DB)