SCHEMA Network of Excellence in Content-Based Semantic Scene Analysis and Information Retrieval Annual Report 2004

http://www.schema-ist.org

The aim of the SCHEMA Network of Excellence is to bring together a critical mass of universities, research centres industrial partners and end users in order to improve the systematic exchange of information by the forging of links between partners. The following research topics, activities and standards are investigated in the SCHEMA Network: Content-based multimedia analysis, Access to the information using query structures that come naturally to human beings, Copyright issues of multimedia, New methods for multimedia access and delivery, MPEG-7 and MPEG-21 standards, User interfaces and human factors. SCHEMA activities include: a common research and development framework for multimedia content analysis, the design and integration of a reference system for content-based semantic scene analysis and retrieval, organisation of international workshops and scientific meetings on a regular basis, organisation of short visits between partners, dissemination of the results of the partnership through common publications, presentations, participation in exhibitions, web pages, workshops, conferences and affiliated members.

Summary of 2004 Activities

The ongoing development of the SCHEMA Reference System progressed significantly this year. The latest version of the Reference System now uses the MPEG-7 reference software (MPEG-7 XM) along with extensions of it (such as indexing support) developed particularly for SCHEMA. A new front-end GUI, which is more user-friendly and integrates new functionalities, has also been developed. A fifth segmentation algorithm (contributed by a SCHEMA affiliated member) is also integrated to the Reference System. New high-level description and processing modules, including a face/non-face classifier, a motion characterization module and a text processing and retrieval algorithm, were also developed and integrated. Applications of the Reference System performing retrieval in new image databases, such as an Alinari art image database, the photo database of the Macedonian Press Agency (MPA), and an extensive collection of news video used for the TRECVID 2004 experiments, were finally developed.

More specifically, the successful participation of SCHEMA in the TRECVID 2004 experiments and the corresponding Workshop, organized by the National Institute of Standards and Technology (NIST) in the USA, was one of the major events for 2004. This participation involved the development of a suitable application for video indexing and retrieval based on the SCHEMA Reference System.

SCHEMA partners continued to follow the latest standardization activities, particularly MPEG. Feedback to MPEG on the usability of the MPEG-7 XM software was provided by the consortium, as a result of the integration of the XM with the SCHEMA Reference System, while SCHEMA additionally participates to the MPEG-7 VCE-2.

The SCHEMA site (http://www.schema-ist.org/SCHEMA) has changed considerably, with the first page now displaying information for upcoming events and news relevant to the Network activities, along with the most recent SCHEMA publications and documents.

SCHEMA organized in 2004 numerous scientific special sessions during well-known conferences like WIAMIS 2004, CIVR 2004, IV 2004, and EUSIPCO 2004. SCHEMA also co-organizes the EWIMT 2004 workshop and will organize WIAMIS 2005 as its final workshop.

SCHEMA Reference System Design

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

A new GUI has been developed for the Reference System (Figure 1). As with the previous version of it, the user has the option to search through the database using predefined image categories. Images relevant to this category are presented to him and the user selects one. The image, along with five segmentation masks is shown and there is the option to perform the search using a region of a segmentation mask or the whole image as input. Images are returned ranked by relevance. The system also integrates a caching functionality, thus speeding up search performance if the same search was performed sometime in the past.
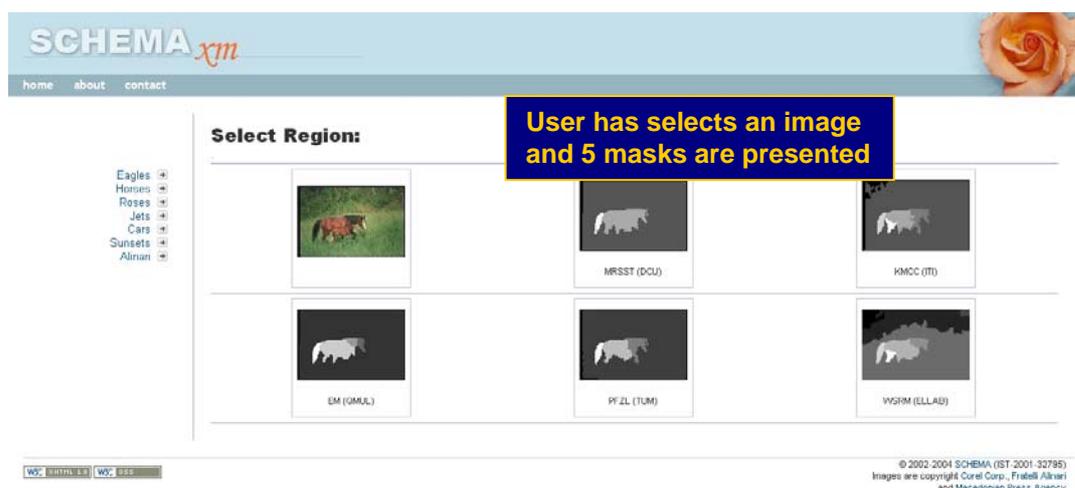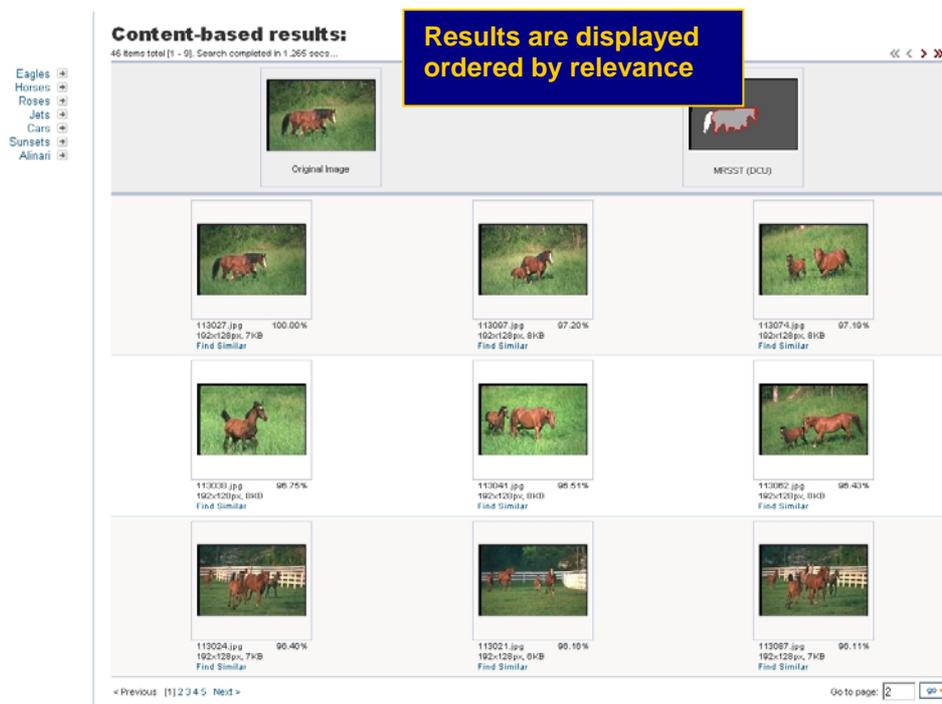
Figure 1. Schema Reference System GUI

In addition to the segmentation algorithms of the Qimera framework, a new (5th) segmentation module, contributed by the University of Patras (affiliated member of SCHEMA) has been integrated to the Reference System. This demonstrates the flexibility of the Schema Reference System and its suitability as a test-bed for different modules.

The MPEG-7 reference software (MPEG-7 XM) is now used in the Reference System for indexing and retrieval. To further improve the performance and usability of the software, several extensions have been implemented specifically for SCHEMA. These are:

- The *MultiImage* extension for indexing and retrieval using multiple MPEG-7 descriptors.
- The *XMServer* extension for retrieval purposes, which provides the ability to use the XM as server thus continuously accepting queries for retrieval. Search time is reduced greatly if this function is used.
- The *indexing* extension for fast retrieval.

By integrating these extensions the performance of the System has been greatly improved in terms of time-efficiency.

The high level descriptors integrated to the System are:

- *Face / non-face classifier*: Detects if an image contains one or more faces and can be used for image categorization

- *Motion description module*: Describes the motion intensity in a video shot and the percentage of camera motion.

- *Text analysis tool*: Ranks text documents according to user input keywords.

Applications of the Reference System

Application on the MPA image database

The database contributed by the Macedonian Press Agency has textual information related to the images. The user can request images associated with keywords entered in a text-box. The content-based search procedure is performed as with the original image database but only images associated to the entered keywords are displayed (Figure 2).
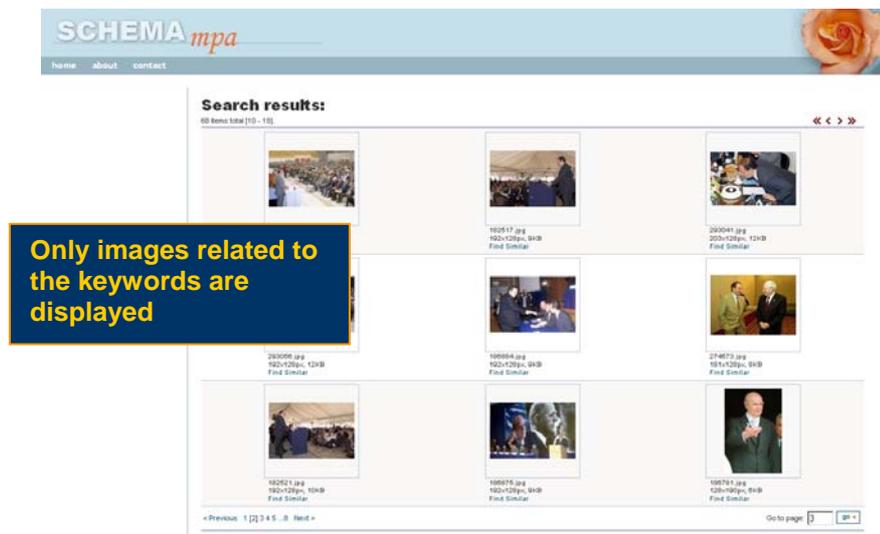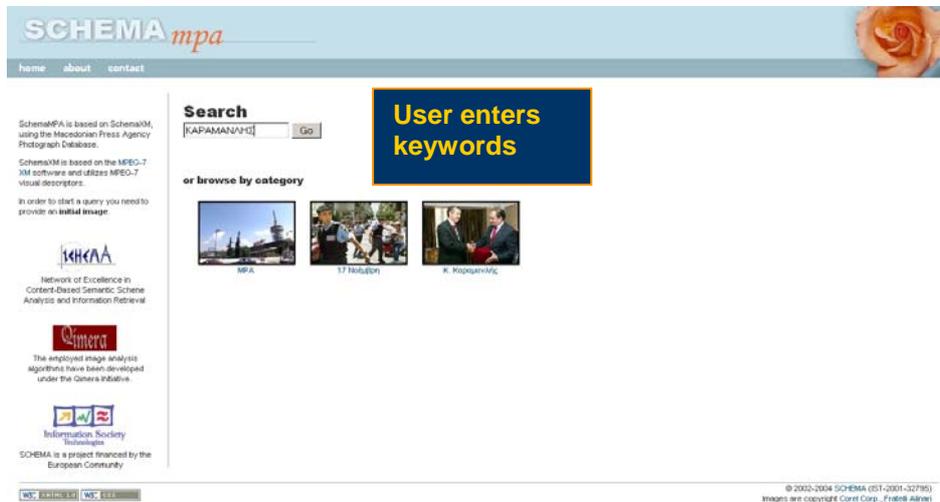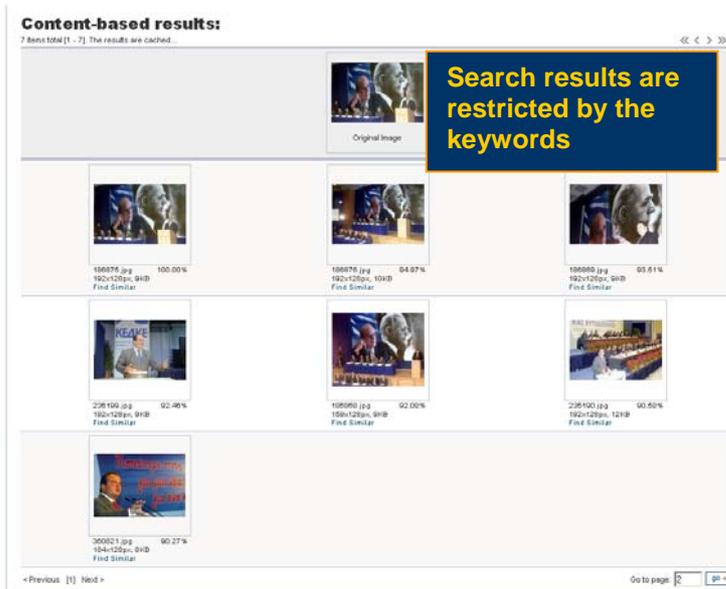
Figure 2. Application of the SCHEMA Reference System on the MPA image database

Application on the TRECVID 2004 test corpus

The TRECVID Workshops are organized annually by NIST in the USA. The Workshops are about video indexing and retrieval and participants are research groups from around the world. A group must complete at least one of four tasks in order to participate to the workshop. These tasks are:

- Shot boundary detection

- Story segmentation

- Feature extraction

- Search

SCHEMA participated in the search task of TRECVID 2004 with an application of the SCHEMA Reference System. For the 2004 search task, approximately 64 hours of video captured by the Linguistic Data Consortium during the last half of 1998 from CNN Headline News and ABC World News Tonight were used for test data. The video was in MPEG-1 format and took up approximately 70 gigabytes. This translated to a collection of approximately 33000 key-frames, accompanied by transcripts of the spoken content of the corresponding shot; the latter were generated by means of Automatic Speech Recognition. Due to the richness of content, this application of the SCHEMA Reference System exploited all available modules, namely:

- Segmentation algorithms

- MPEG-7 XM and its extensions

- Text processing and retrieval

- High level feature extraction (face/non-face, high-level motion characterization)

As a result, a complete interactive application for multi-modal retrieval was collaboratively developed. The TRECVID experiments indicated that the developed application is significantly more effective than approaches not combining different visual

and textual features for retrieval. Snapshots of the developed application are shown in Figure 3.

Figure 3. Application of the SCHEMA Reference System on the TRECVID 2004 test corpus

Benefits of the Reference System

The benefit of this activity for other researchers in the community is that their own systems could be benchmarked against the Reference System, thereby facilitating more rigorous evaluation Alternatively, the system could be used as an integration platform for specific component technologies, allowing researchers to evaluate their algorithms in the context of a complete system without having to build such a system themselves. For industry-based researchers the system provides a technology demonstrator of the research currently maturing in research laboratories.

Contribution to Standards

SCHEMA partners continued to follow the latest standardization activities, particularly MPEG. Two documents providing feedback to MPEG on the usability of the MPEG-7 XM software were jointly authored and were presented at the 68th MPEG Meeting in Munich, Germany and the 70th MPEG Meeting in Palma de Mallorca, Spain. These illustrate the results of the integration of the MPEG-7 XM with the SCHEMA Reference System, and report the development of extensions to the XM that were found to considerably enhance its usability in a real-life image and video retrieval application scenario.

SCHEMA additionally closely follows and participates to the MPEG-7 VCE-2, which is a Visual Core Experiment on Image Categorization. An input document was authored by SCHEMA and was presented at the 70th MPEG Meeting in Palma de Mallorca, Spain, describing the planned SCHEMA contribution to the Core Experiment.

User Involvement, Promotion and Awareness

A number of affiliated members have joined SCHEMA including institutions from outside Europe (Korea, Australia, USA), SMEs and users (Search Software, Content Mine International, LTU Technologies, Centre for Research and Restoration of the Museums of France).

A list of these members is shown in Table 1.

Participant name - Affiliated Members	Country
Search Software	UK
University of Oxford, Image Bioinformatics Research Lab	UK
Content Mine International	D
Microsoft Hellas	EL
Melon Web, Knowledge Solutions	EL
Cultural and Educational Technology Institute	EL
eVision, Visual Search Technology	USA
Monash University, Gippsland School of Computing and Information Technology	Australia
Shangai University, Digital Image & Video Processing Lab	China
JOANNEUM RESEARCH Forschungsgesellschaft mbH, Institute of Information Systems & Information Management	A
University of Trieste, Image Processing Lab	I

University of Queensland, Data and Knowledge Engineering Group	*Australia*
LTU Technologies	*F*
Centre for Research and Restoration of the Museums of France (C2RMF)	*F*
Vienna University of Technology, Interactive Media Systems Group	*A*
Italian National Agency for New Technologies, Energy and the Environment (ENEA), UDA-Advisor Unit	*I*
Kangwon National University, Multimedia Security Lab	*Korea*
Hewlett-Packard Laboratories (HPL)	*USA*
Thomson multimedia R&D France	*F*
Motorola UK Research Lab (MUKRL)	*UK*
Institute for Language and Speech Processing (ILSP)	*EL*
Computational Linguistics Department, University of Saarland	*D*
Multimedia Coding and Watermarking Group (MCWG), University of Patras	*EL*
INESC PORTO - Telecommunications and Multimedia Unit	*P*
Dipartimento Sistemi e Informatica, Università di Firenze, (DSI-UNIFI)	*I*
National Technical University of Athens, Department of Electrical & Computer Engineering, Multimedia Group	*EL*
Middle East Technical University, Department of Electrical & Electronic Engineering, Multimedia Research Group	*TR*
Aristotle University of Thessaloniki, Department of Informatics, Computer Vision and Image Processing Group	*EL*

Table 1: Affiliated members

Interested organisations should send a short profile to schema@iti.gr or complete an online form (http://www.schema-ist.org/SCHEMA/project/become_a_member.html), including their relevant activities. Application are examined by the SCHEMA Steering Committee and an answer is sent back to the applicants within 15 days after.

SCHEMA is clustering with a large number of 5th and 6th FP projects. Most of them participate in the clustering events organised by SCHEMA and in other activities as well.

Companies related to SCHEMA objectives are invited to present their activities and interact with SCHEMA partners during each SCHEMA meeting. So far the following companies have participated to SCHEMA meetings:

- Aliope Ltd. (http://www.aliope.com)

- FRAMEPOOL (http://www.framepool.com)

- SIEMENS, Germany (http://w4.siemens.de/ct/en/technologies/ic/index.html)

- HP labs, Palo Alto, USA (http://www.hpl.hp.com/)

- Future Content Group, BT (http://research.btexact.com/ccl/researchareas/fc/fc_intro.html)

- RealViz (http://www.realviz.com/)

- Gnomon informatics SA (http://www.gnomon.com.gr/)

As a result of the close collaboration between SCHEMA partners and affiliated members, numerous works relevant to the SCHEMA NoE were published in international journals

and conferences, including several joint publications based on collaboration among SCHEMA partners or between SCHEMA partners and affiliated members. All these publications are publicly available from the electronic library maintained at the SCHEMA web site.

After WIAMIS2003, SCHEMA has also supported the organization of 5th International Workshop on Image Analysis for Multimedia Interactive Services (**WIAMIS2004**), April 21-23, 2004, Instituto Superior Técnico, Lisboa, Portugal. More specifically, a Special Session in newly established 6th FP IST-Projects has been organized as a clustering event during WIAMIS 2004. The following seven relevant 6th FP IST projects have participated: aceMedia, Metokis, MediaNet, VISNET, PrestoSpace, DirectInfo and CHIL. More information: http://www.schema-ist.org/SCHEMA/news/show.html?news_id=4.

SCHEMA successfully organized a special session on EU FP5 Projects as part of the 3rd International Conference on Image and Video Retrieval (**CIVR 2004**), which was held in Dublin City University, July 21-23, 2004. The conference was co-sponsored by Dublin City University, Science Foundation Ireland and the IEE and was being held in cooperation with SCHEMA, ACM SIGIR, BCS and IPRCS.

SCHEMA also successfully organized a special session as part of the 8th International Conference on Information Visualisation (**IV 2004**), 14-16 July 2004, London, England.

SCHEMA will support together with BUSMAN and aceMedia projects, the European Workshop on the Integration of Knowledge, Semantic and Digital Media Technologies to be held in London in November 2004 (**EWIMT 2004**). The workshop site is available at: http://ewimt.qmul.net/.

SCHEMA participated with an exhibitor stand and presented the SCHEMA NoE Interactive Visual Search Engine at the **IST 2004** event, on 15-17 November 2004 in Hague.

As previously reported, SCHEMA will support **WIAMIS 2005** as its final conference (to be held in April 2005, Montreaux, Switzerland, organized by EPFL), after the successful cooperation with WIAMIS 2003 and WIAMIS 2004.

Future Work

The development of algorithms and techniques for semantic scene analysis and information retrieval will continue with a collaborative effort on region-based segmentation using syntactic features such as inclusion, compactness, symmetry, shape complexity etc in the merging process. Evaluation of the usefulness of this approach in retrieval will be performed via integration of the algorithm into the SCHEMA reference system, followed by a series of objective experiments.

SCHEMA will continue to follow standardisation activities and report to SCHEMA members and affiliated members. Contribution to standards will continue through the use of the MPEG-7 XM within WP3 and as part of the SCHEMA contribution to MPEG-7 Visual Core Experiment 2 (VCE-2).

Short visits between partners are expected to continue in the framework of SCHEMA. The SCHEMA partners will continue to be engaged in numerous dissemination activities, while SCHEMA will also co-organize the EWIMT 2004 workshop WIAMIS 2005 as its final workshop.

Further Information

- SCHEMA web page: http://www.SCHEMA-ist.org

- SCHEMA Reference System:

  - http://www.schema-ist.org/SCHEMA/results/index.html

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

- Become an Affiliated Member:
  http://www.iti.gr/SCHEMA/project/become_a_member.html