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Abstract:
This deliverable is a result of WP 6: Dissemination and Exploitation and describes opportunities for exploitation of the technologies developed in the SCHEMA Network of Excellence. SCHEMA results, especially in the area of visual analysis for visual search applications, may be exploited in a range of markets for a wide range of applications. This report identifies the key exploitable technologies arising from SCHEMA, and discusses their applicability to various markets and domains.

Keyword List: Exploitation plan, marketplace, return on investment, business opportunities, pricing, risk analysis, competition, entry requirements.

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Table of Contents

1 Introduction

This document describes opportunities for exploitation of the technologies developed in the SCHEMA Network of Excellence. SCHEMA results, especially in the area of visual analysis for visual search applications, may be exploited in a range of markets for a wide range of applications. This report identifies the key exploitable technologies arising from SCHEMA, and discusses their applicability to various markets and domains.

In this report, we first describe some applications which benefit from the technologies developed in SCHEMA, then we go on to examine some general background information, relating to possible customers and markets for those applications. Following that, we examine some specific exploitation opportunities, including exploitation models. Partner exploitation plans are described in section 4.2, followed by some conclusions and recommendations for further analysis.

2 SCHEMA technologies and applications

The SCHEMA Network of Excellence has developed, tested and refined methods for visual analysis of images which enable visual segments such as regions or objects to be discovered, and for which low-level features can be extracted for subsequent use in applications such as indexing, search and retrieval, and image protection (e.g. region based watermarking), SCHEMA has also developed modules extracting higher-level descriptors characterizing content at a semantic level, e.g. modules determining whether an image or a clip is outdoor or indoor, whether it contains a face or not, whether it contains a specific soccer event such as goal, etc, which can also be used to assist users in retrieval tasks related to image and video.

The technologies inherently assist users with tasks involving image and video processing, whether it is a commercially focused task (such as collating media for advertising) or a leisure activity (such as managing a home media collection). The benefits may be realised both for situations where the images themselves are the valuable asset for sale, and when the images are used to support purchasing decisions of other tangible assets.

Where images and video are assets to be purchased, it is critical that a user is able to rapidly find and pay for the exact image they have in mind for their application, as well as for the content owner to be able to track and protect their assets. Where a user is unable to formulate a textual query (or in addition to this in some cases), it is very useful to be able to offer a query-by-example service, such that the user can supply an example image, and the service provider has tools available to visually analyse the image and find similar images from their collection. Rapid and accurate matching is more likely to result in a conversion of a query to a purchase. Conversely, endless browsing of unrelated images is likely to frustrate a prospective purchaser, and would send them to another service provider.

Where video and images support other assets, such as related to retail where visual search can be used to support e-commerce applications, or in cultural applications where a visual catalogue of artefacts is made available to visitors, SCHEMA technologies can assist the user in finding the article that they want by visual analysis of what is available and by matching an example of what the customer might be looking for with what is being offered at the time of search.

3 Exploitation plan context

3.1 Cultural archives

The new challenge for a traditional archive or museum (photographic archives, art museums, …) is to digitise its products catalogue, enriching the contents with textual information and creating new kinds of goods. Image and video archives and generally speaking, digital content providers, have created their web sites getting in contact with new market segments both for business and for educational purposes. At this time an aggregation process has been revealed: small and medium sized content providers are going to create partnerships and share knowledge and markets.
Archives and cultural institutions are developing distributed configurations of content and services as well as new search engines adaptable to users' needs. This involves developing new processes not only for searching but also for content management: from image generation to cataloguing and information adding. An important consequence of the image segmentation technology is also the evaluation of new IPR issues and content protection procedures: the improper and illegal usage of protected images has to be detected more easily.

As long as innovative channels are going to be accessible, digital archives need to integrate new technologies and services for digital image processing and delivery. The possibility to search images by means of features and other images and not only with keywords, seems to be an important challenge. For example, Alinari's image-archive research department is testing some search agents able to "retrieve images by images": a customer could be interested to find all the images that are somehow similar to one specific image he chooses (e.g. a family photo).
Of course the visual query engines are supposed to be integrated into the existing database, as the image needs also the cataloguing information for advance searches including also textual information.

3.2 Internet based image markets

During recent years we have witnessed a rapid growth of images online, the Web is transforming from a text-centric marketing medium to incorporate more multi-media content. At least 10 billion "dollar images" are available on the Internet today and we expect more than 30 billion "dollar images" by 2005. For every "dollar image" today there are several additional images (thumbnail, regular view, detailed view) and the growth of available bandwidth allows users to reach a much higher volume of data.

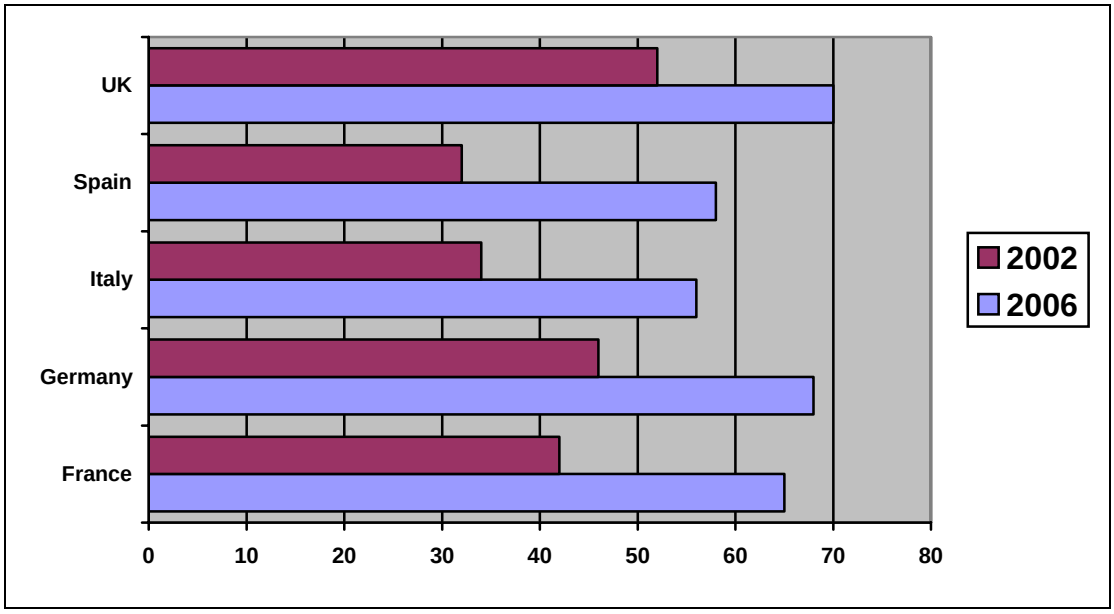

Figure 1: Internet users in Europe expressed in % on the population (source: EITO/IDC, published in May 2003- [2]).

The impact of e-commerce on the imaging and video market, requires advanced and innovative techniques for managing image assets. In fact, the process of serving and managing images today is still very much manual. Then, customers also need a solution that can satisfy their needs for efficient access and management.
One of the most important requirements needed are new integrated platforms that deliver any image or video, to any device and in any way with new tools. These requirements have been expressed in the educational market (www.mobilearn.org/) considering new access tools and wireless networking.

The key reasons that guarantee a success factor for the e-commerce are:

Influence: in the sense that images help choosing and selling products and services (for a digital archive both are valuable: book as set of images, services as e-Learning archive, etc.).

Relevance: searching tools should be related to the content. As we are witnessing the migration from a text-based Web into an image-based Web, the relevance of the contents needs new strategies and tools.

Efficiency: a great difference factor between text-engines and image-engines is the "user". The knowledge of the user and his/hers language influence the results gathered. We have made many tests with users having different ages and culture level to evaluate our internal search engines. The results show visible differences and even very easy concepts are interpreted and searched in different ways. To retrieve the minimum number of images that are relevant to the search the user should know many keywords (vocabulary) and understand the few mechanism of searching and filtering the results. On the other side the image-search is more simple and efficient.

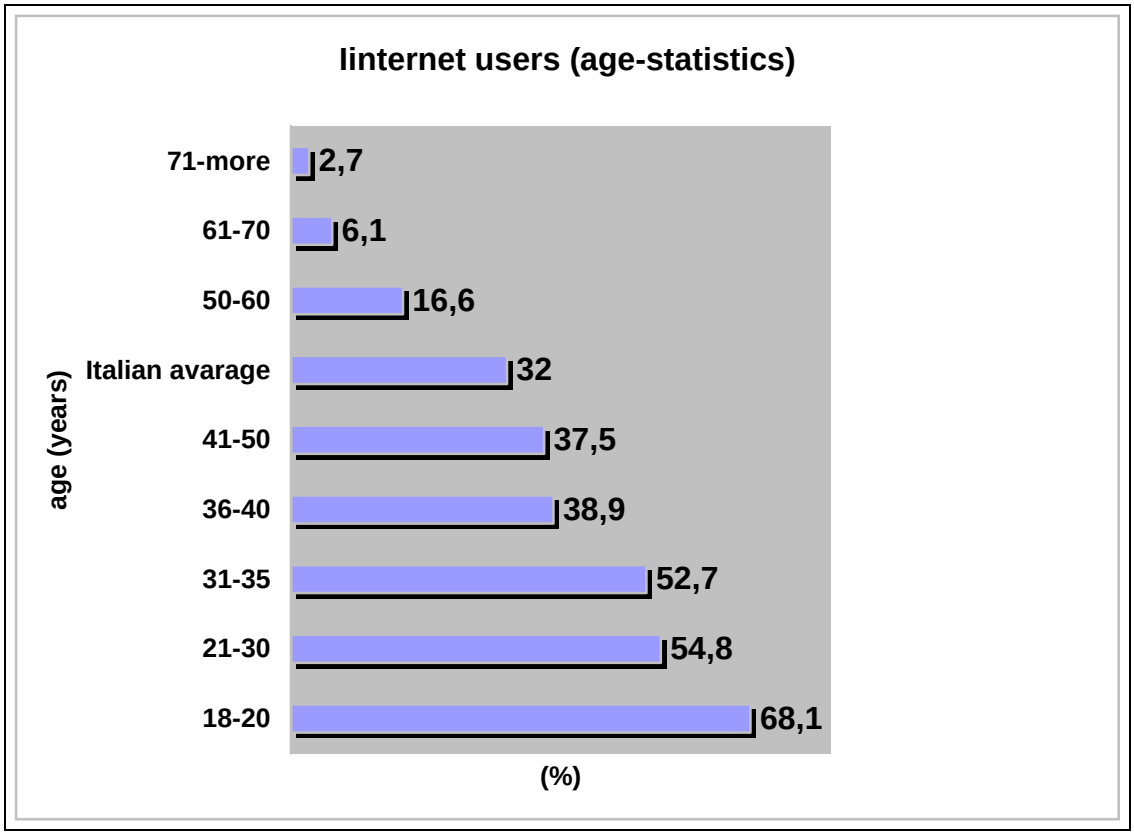

Figure 2: (source: Censis 2003- [1]) The internet users distribution on age basis published on May 2003.

The exploitation of new tools as query engines, needs the combination of some factors:

- Accessibility to a large volume of data: in a large and distributed archive the probability of finding significant results increases.
- Age: the users who would get great benefit from a visual query engine are mostly the young and lower education ones. This allows exploitation of a very large number of users (see figure above).
- Satisfaction (by the query): the results must be relevant to the query.
- Pay (electronically): the transaction should be as easy and fast and secure. The users who pay electronically are not yet as numerous as expected (see next table).

Users who pay electronically- year 2003			
	Internet users (%)	Not internet users (%)	Total (%)
Total of the population			
Persons having credit card	49,9	28,8	35,6
Bancomat	71,9	45,8	54,2
Up to 39 years			
Persons having credit card	40,3	28,8	34,7

Bancomat	66,8	52,2	59,7
Over 40			
Persons having credit card	66,0	28,8	36,1
Bancomat	80,5	43,5	50,7

Table 1: Users who pay electronically- year 2003 (source Censis 2003, published May 2003-[1]).

The market for e-commerce imaging can be fragmented into business (B2B), educational (B2E) and customer (B2C) domains.
Customers and professional companies (editors, magazines, etc.) will look to vendors that have

- Large volume of contents
- Proven industry experience
- Strategic partnerships
- Broad resources
- Flexible deployment models - enterprise

The estimates [3] done in year 2000 report of 196 million individuals, 2.5 million businesses online, 7.2 million sites featuring 1 billion web pages (with more added 1.5 billion every day). In the meantime the users accesses have increased thanks also to the larger bandwidth, but some barriers do still remain. One of these barriers is the low usability of the business sites and the frustration of the customers with finding the information they are looking for. It has proven that the users do abandon their search if they have to look at too many web pages. In which way can the user find more easily among some millions contents (images and videos) in few time and buy it? The solution can be the "Image-Information": instead of using only keywords the user is helped by using as input an image or a drawing or a simplified image.

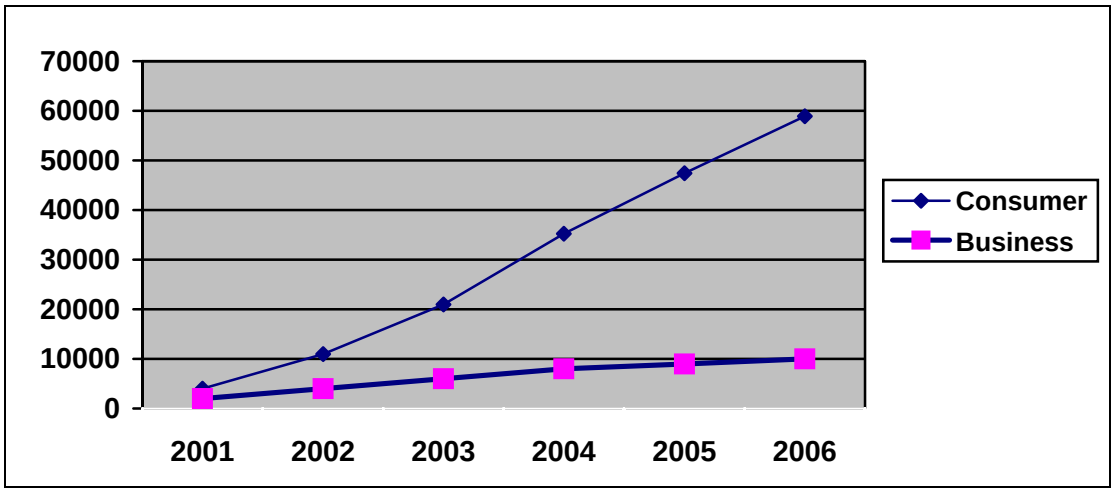

Figure 3: Large bandwidth in Europe, the users are expressed in thousands (source: EITO/IDC, published in May 2003- [2]).

3.3 Image and video markets

Images are used for a wide range of purposes, including design, marketing, advertising, artistic purposes, recreation and education. Online, the image market has a classic **supplier-consumer** form, with a relatively small number of image suppliers, each holding very large numbers of copyrighted images in digital form. The use of these images is sold, under various conditions, to end users who range from marketing executives to major corporations to state bodies to students and faculty in fine arts universities.

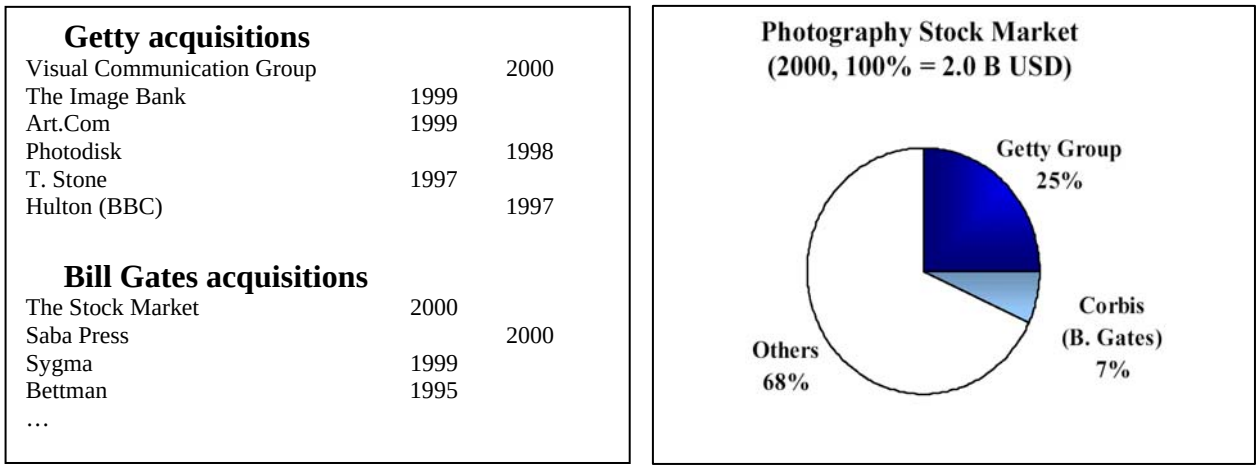

Figure 4: The photography stock market has experienced significant consolidation due to Getty's and Bill Gates' acquisition strategies.

- With the development of broadband networks, almost all images are likely to migrate to internet.
- With the availability of digital platforms and easier accessibility to digital archives, B2B and B2C is expected to take a substantial growth.

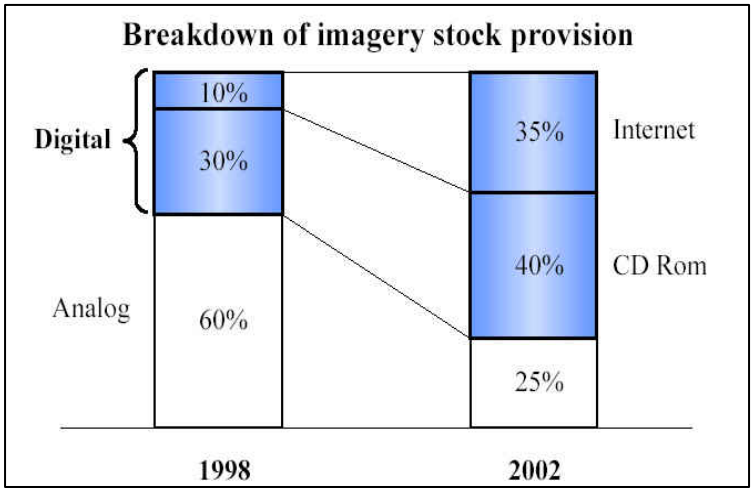

Figure 5: source AT Kerney (2002).

Major issues in this market include

- the protection of images after they have been supplied to the customer, in order to ensure that they are not re-used without the authorization of the copyright holding body. This is referred to as digital rights management

- promotion of digital image archives
- revenue collection and pricing policies over the Internet
- searching for and retrieving an appropriate image for a particular end-user need (here SCHEMA has a fundamental role)
- provision of secure access to the digital image archives (SCHEMA could be used also to search for images used by third parties improperly)
- the difficulty which cultural institutions experience when coming to terms with the complex technologies needed for digital rights management and Internet distribution
- the need for end users to learn new access methods and search tools for each archive, if they wish to search through as comprehensive a set of online resources as possible.

These issues have led to the clear identification of a new market niche, the **facilitator**, which acts as a broker between the image archives and the end users, carrying out such functions as revenue collection, promotion and digital rights management for the supplier on the one hand, while providing advanced search tools and intuitive user interfaces to the end user on the other hand.

New markets for images and video are emerging, with the proliferation of mobile services. Initial market changes were first seen in Japan with the launch, some years ago, of the i-Mode service, which allowed users to download graphics and animations onto their mobile phones. More recent services, such as the Vodafone M-Pay service, allow users to select and download sports video clips via their mobile operator. T-Mobil also provide Cinema Electric video content via mobile. Content includes extreme sports, fashion and models, and greetings.

At the same time, on-line shopping for retail items and intangibles (such as banking or insurance services) has significantly increased, as Internet usage rises (see Figure 1 above). As opportunities for on-line sales increases, so do the number of new entrants, leading to greater competition for customers. Current on-line sales portals such as Amazon, tend to provide static photographs of their product out of context. This obviously provides simpler indexing and retrieval of images, but may not be helpful to the user who wishes to get some idea of the size of the object (e.g. "would this flower bouquet fit on my table"), or the subtleties of the object "e.g. "does that sofa match my curtains").

4 Exploitation opportunities

4.1 Typical applications and opportunities

A number of video and image distribution systems exist in the market already, for both internet (high bandwidth) and mobile applications. SCHEMA technologies can save purchasers money by reducing the time they spend searching, and by only providing the very best matches to their requirements. In mobile domains where air-time and data transfer are expensive, these are key benefits, but the benefits also

apply to home and professional fixed line users who have costs associated with bandwidth provisioning in their local system.

An example of this latter use scenario is in the mobile Operator 3 UK's high-speed video-streaming service called Quickplay. The service enables customers to play video clips on their mobile phones in real time, rather than having to download and save them first. Quickplay also allows 3's customers to watch longer video clips of up to 8 minutes, which would otherwise use up memory on the handset and could take up to several minutes to download. It is important for customers to be able to find the clips they want on the content provider or operator's server, and this applies equally in fixed and mobile environments. Other example services of this type are http://www.soccerclips.net/ which is a website containing clips of football matches aimed at fixed line internet users, and Vodafone m-pay system for pay-per-view football video highlights and interviews from UK premiership clubs http://mpay-bill.vodafone.co.uk/p_football.html.

In using such services, often the customer may not be able to express their search in a textual way, or may have something in mind that they do not know (or cannot remember) the name of. This is especially relevant to people who do not speak the language in which the image or video content has been indexed. Alternatively, the user may have an example image, such as a still image of a trailer advertising a film but does not know the name of the film they are seeking. In all these cases, the SCHEMA technology can be used to provide user value and benefits in analysing an example image to find similar results or to find a video sequence in which similar content appears.

A service provider could add a SCHEMA search by example interface to their application, enabling users to benefit from the additional capability. The service provider would also implement SCHEMA analysis and identification software in their back-end processes, such that their content was already pre-analysed and therefore user requests could be rapidly satisfied. The additional cost to the service provider in implementing the SCHEMA software would be recovered by the additional sales of content which result from users being able to find what they want more readily.

It is possible that image sales into various markets could increase rapidly in future years. If the example of the mobile phone ring tones market were to be followed, downloading of images to use as wallpaper and icons (and avatars) for phone book entries would be expected to rise. Sales of mobile phone ring tones jumped 40 percent during 2003 to $3.5 billion, according to a study by telecommunications consultancy, The Arc Group. SCHEMA technology is ideally suited to stimulating the image download market, especially to mobile, where users may seek purchasable content relating to their own personal environment or circumstances. For example, the user takes a photo using their mobile phone camera, and sends it to the SCHEMA enabled image search service, to find similar images which could be purchased for their home image collection, phone wallpaper, or for showing to friends later. In this case, the SCHEMA analysis software need not necessarily be implemented on the mobile phone, as the analysis can be carried out off-line, with the mobile user notified when their matching images are available.

There are many software solutions available to content owners for management of their material, whether it is internal to an organisation or external. An example is in police applications where much video and image evidence is collected within the scope of any one case, and must be logged and indexed so that it can be referenced during the enquiry and used in court at the end of the enquiry. Many police services use off-the-shelf content management software such as Virage and Convera. With such systems, the ability to later retrieve specific content depends on the accuracy of the annotation done at the time the content is acquired into the database. This may make it difficult for subsequent users to find material relating to a case they did not work on, and may also be hard for other police services who use a different vocabulary or language to find appropriate content relating to a new crime.

SCHEMA has clear benefits in such applications. There is no requirement for the originating officer to completely describe every scene and every shot that is entered into the database, nor the retrieving officer to be required to formulate a specific textual query. With SCHEMA visual analysis based search and interpretation of scene contents, subsequent users of the database need only present the system with an example of the item or objects they are seeking, in the knowledge that visual matches will be retrieved. As an example, some video material from a surveillance camera may be acquired by the database, and the operator annotating it does not notice that a green bag is in the scene. In a subsequent case, some undercover video footage shows a green bag being used in a drugs case. By using the example green bag to search through previous material, the officers would be able to automatically find additional evidence which could be used in the case.

In the above example, SCHEMA technology would be used to provide specific user benefits in that valuable police officer time in annotating material is no longer needed, as the query by example enables appropriate matches to be found. The SCHEMA tools can also be used to segment objects within scenes, to offer candidate objects for the officers to search on. A possible exploitation path for SCHEMA is to partner with established content management software providers such as Virage or Convera in order to integrate SCHEMA results into their products. The development costs incurred by the software provider would be recovered by increased sales of their products which are significantly enhanced by the SCHEMA functionality.

SCHEMA technology has clear benefits in professional image and video applications, where the content assets are purchased by professionals for their work assignments. Typical examples include

- the newsroom or magazine editor's office, where stock images are used to illustrate news stories. The journalist or sub-editor may have the "perfect" image in mind, but cannot describe it in words due to complexity (multiple items in the scene), subtlety (images conveying emotions which cannot be precisely described), or language issues.
- artistic and creative professionals using images to illustrate advertising material, brochures etc. In many cases, the artist does not necessarily know what they are seeking, and can only converge on the right content after browsing related content, and asking the system to "find more images like

these". SCHEMA technology can assist the user by analysing the desired content, and offering interpretation of it, as well as finding related examples.

In these cases, SCHEMA technology integrated with any search engine capable of querying video archives would be beneficial to the user, who might be prepared to pay a premium for their search results (covering development costs of the search system) if these results satisfy their requirements.

One area of possible exploitation could be in on-line and in-store retailing applications, where the user wishes to find an item to purchase by looking through the retailer's image database which shows examples of the product. In some cases, a user may see an image in the database which is close to the idea of the product that they have in mind, but they are unable to express precisely the difference between the object presented and the one they seek. Using this "imperfect" retrieved image to search for examples of further objects, the customer is soon able to find the item they seek, and the query is converted to a purchase.

Not only is the SCHEMA query by example functionality of benefit in converting a user query into a purchase decision, in addition SCHEMA technology allows objects of interest to be segmented from other objects in an image, which means that the retailer can populate their on-line (or in-store) catalogue with the items in a natural setting. Thus multiple images of a chair within the context of a sitting room may be provided, with the retailer certain that the chair will be correctly segmented, analysed, and matched to customers looking for chairs of that design, colour, size etc. For the customer, it is also possible for them to provide query images of their own, where they have modified the colour or shape of an object in the image using a conventional software tool such as PhotoShop, in order to find out e.g. if the retailer has the same chair but in a different colour, size etc.

For exploitation in e-purchasing applications, SCHEMA technology would need to be integrated into on-line or in-store image catalogues. Since such catalogues are often very specific to the retailer, this market may be harder to access than some of those mentioned above, but nevertheless represents a genuine commercial opportunity for SCHEMA partners.

4.2 Models of exploitation

This section describes the SCHEMA partners' and affiliated members' expected market applications and the exploitation coming from the project results.

Moreover, the exploitation plan is strongly connected to the dissemination activities, which use events, workshops and dissemination meetings to refine possible market applications and commercial use of the scientific results. It must be considered that academic partners in most cases cannot exploit the project outcomes directly. However, there are opportunities for licensing software and technology to existing suppliers in the markets described above, and working with them in partnerships and joint ventures. In some rare cases, it may be possible for a SCHEMA academic partner to launch a spin-off company to exploit project results, but this usually requires careful protection of the project's intellectual property via patents during the project lifetime.

Filing of patents by SCHEMA partners can also benefit all members if the technology can subsequently be used within a commercial product e.g. as an add-on or plug-in to a software suite sold to professional content owners or end consumers. Such successes would raise the general awareness of the benefits of SCHEMA outcomes, and would lead to commercial interest in other parts of the system.

Exploitation via other projects and sources is also possible. For example, segmentation or watermarking modules may be exploited independently in the context of a range of applications, which may not be tightly coupled with other SCHEMA exploitation activities. As an example, an analysis module for sports videos could be used by one content owner for inventory purposes (automatic or semi-automatic labelling of archive material) or by another for asset tracking (finding occurrences of their material being broadcast) or by yet another for competitor analysis (finding out who is distributing material similar to their own). The key to all these applications is forming a partnership with a supplier of some base system or software to a range of customers, such that the SCHEMA module can be integrated into an existing workflow.

In the following sections, the exploitation plans for each partner will be described.

5 Centre for Research and Technology - Hellas/Informatics and Telematics Institute (CERTH/ITI)

5.1 Partner Activities

Project coordinator of the SCHEMA Network of Excellence is the Centre for Research and Technology – Hellas / Informatics and Telematics Institute (CERTH/ITI) (P1). CERTH/ITI is participating in 13 EC 6th Framework Programme IST projects and numerous other EC and National projects. CERTH/ITI demonstrates algorithms and results relating to image and video segmentation, indexing and retrieval, watermarking for indexing, user interfaces for retrieval, databases and authoring tools.

5.2 Transfer of Technology - innovative development

The focus of CERTH/ITI regarding the development and transfer of technology under the auspices of the SCHEMA Network of Excellence has been on the development of the SCHEMA Reference System. The SCHEMA Reference System is a general module-based architecture for content-based analysis, representation, indexing and retrieval of image and video data. It comprises (i) five segmentation modules contributed by SCHEMA partners and affiliated members, (ii) an indexing and retrieval module based on an evolved variant of the MPEG-7 eXperimentation Model, i.e. a non-normative part of the MPEG-7 Standard realizing the normative descriptors and supporting search and retrieval functionalities, (iii) high-level feature extraction modules, e.g. face/non-face binary classifiers, and (iv) a user interface to integrate all the above in a prototype image and video indexing and retrieval system. Standard content used for research purposes, i.e. the Corel image gallery, has been employed for developing and demonstrating the SCHEMA Reference System.

For the purpose of transfer of technology and to promote the exploitation of the SCHEMA Reference System, commercial images contributed by Alinari, a SCHEMA

partner, have also been used in combination with the Corel images. Additionally, specific variants of the Reference System have been tailored for indexing and retrieval of purely commercial content, namely the image database of the SCHEMA partner, Macedonian Press Agency, consisting of 7000 high-quality images, and the TRECVID 2004 test corpus. The latter comprises approximately 70 hours of news videos broadcast by major news networks, made available to SCHEMA as a result of its expected participation in the TRECVID 2004 experiments.

In addition to the above, CERTH/ITI has worked together with the Munich University of Technology (TUM), a SCHEMA partner, on integrating with the SCHEMA Reference System the latest versions of the MPEG-7 eXperimentation Model, as these become available. CERTH/ITI and TUM have also given feedback to MPEG on the use of the MPEG-7 XM as part of a retrieval system, as a result of this process.

Other CERTH/ITI contributions to the state-of-the-art in content analysis and content-based retrieval include:

- Development of image and video segmentation algorithms, both for raw, uncompressed data (color images and video) and for MPEG-2 compressed video. Specifically, for color images, an algorithm has been developed to enable their unsupervised segmentation, with particular emphasis put on the time-efficiency of the segmentation process. This algorithm has been integrated with the Qimera framework and with the SCHEMA Reference System. For video, an algorithm for the segmentation of raw video and one for the segmentation of MPEG-2 compressed video have been developed, the latter being particularly suitable for use in large video databases due to its real-time operation.
- Development of new retrieval methodologies extending the Query-by-Example paradigm, which has been adopted by the SCHEMA Reference System, with techniques including ontologies and relevance feedback. These could be integrated with the SCHEMA Reference System as new modules supporting additional retrieval functionalities.
- Development of domain-specific semantic image and video analysis algorithms, including high-level feature extraction modules, e.g. face/non-face binary classifiers, and knowledge-assisted analysis algorithms for automatic analysis and understanding of compressed sports video. Parts of these technologies, i.e. a face/non-face binary classifier, have already been integrated with the SCHEMA Reference System.

5.3 Application demonstrators

CERTH/ITI has coordinated the development and has made available at http://media.iti.gr/SchemaRS three versions of the SCHEMA Reference System:

- **SchemaRS**, which is the original version of the SCHEMA Reference System utilizing proprietary feature descriptors. It integrates five color image segmentation algorithms. It employs as data the Corel image gallery and a set of commercial Alinari images.
- **SchemaXM**, which employs the MPEG-7 XM software and utilizes standardized MPEG-7 visual descriptors. It again employs 5 segmentation algorithms and, as data, the Corel image gallery and a set of commercial

Alinari images, and is shown to offer superior performance compared to its predecessor, SchemaRS.

- **SchemaMPA**, which demonstrates the use of the latest version of the SCHEMA reference System in indexing and retrieval of commercial content. This is achieved by combining SchemaXM with a commercial image collection contributed by the Macedonian Press Agency, consisting of 7000 high-quality images.

CERTH/ITI is also coordinating the development of **SchemaTREC**, which is based on SchemaXM but includes several additions that make possible the efficient manipulation of the TREC 2004 test corpus, comprising approximately 70 hours of video.

Additionally, CERTH/ITI has participated in the development of the Qimera framework by contributing a color image segmentation algorithm and by integrating it with Qimera.

5.4 Scientific publications

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3. V. Mezaris, I. Kompatsiaris, and M. G. Strintzis, "Region-based Image Retrieval using an Object Ontology and Relevance Feedback", EURASIP Journal on Applied Signal Processing, Special Issue on Object-Based and Semantic Image and Video Analysis, vol. 2004, no. 6, pp. 886-901, June 2004.

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8. V. Mezaris, H. Doulaverakis, R. Medina Beltran de Otalora, S. Herrmann, I. Kompatsiaris, and M. G. Strintzis, "A test-bed for region-based image retrieval using multiple segmentation algorithms and the MPEG-7 eXperimentation Model: The Schema Reference System", Proc. 3rd International Conference on Image and Video Retrieval (CIVR2004), July 2004, Dublin, Ireland, Springer LNCS vol. 3115, pp. 592-600. ***(joint publication with TUM)***

9. V. Mezaris, I. Kompatsiaris, and M. G. Strintzis, "Compressed-domain object detection for video understanding", Proc. Workshop on Image Analysis For Multimedia Interactive Services (WIAMIS), April 2004, Lisbon, Portugal.

10. V. Mezaris, I. Kompatsiaris, and M. G. Strintzis, "Still image objective segmentation evaluation using ground truth", Proc. Fifth COST 276 Workshop on Information and Knowledge Management for Integrated Media Communication, October 2-3, 2003, Prague, Czech Republic, pp. 9-14.

11. V. Mezaris, I. Kompatsiaris, and M. G. Strintzis, "An Ontology Approach to Object-Based Image Retrieval", Proc. IEEE International Conference on Image Processing (ICIP 2003), Barcelona, Spain, September 2003, vol. II, pp. 511-514.

12. V. Mezaris, I. Kompatsiaris, E. Kokkinou and M. G. Strintzis, "Real-time compressed-domain spatiotemporal video segmentation", Proc. Third International Workshop on Content-Based Multimedia Indexing (CBMI03), Rennes, France, September 22-24, 2003, pp. 373-380.

13. N. O'Connor, S. Sav, T. Adamek, V. Mezaris, I. Kompatsiaris, T. Y. Lui, E. Izquierdo, C. Bennström, and J. Casas, "Region and object segmentation algorithms in the Qimera segmentation platform", Proc. Third International Workshop on Content-Based Multimedia Indexing (CBMI03), Rennes, France, September 22-24, 2003, pp. 381-388. ***(joint publication with DCU, QMUL, UPC)***

14. V. Mezaris, N. V. Boulgouris, I. Kompatsiaris, D. Simitopoulos, and M. G. Strintzis, "Segmentation and Content-based Watermarking for Image Indexing", Proc. Fourth COST 276 Workshop on Information and Knowledge Management for Integrated Media Communication, March 31 – April 1, 2003, Bordeaux, France, pp. 13-18.

15. E. Izquierdo, J. R. Casas, R. Leonardi, P. Migliorati, Noel E. O'Connor, I. Kompatsiaris and M. G. Strintzis, "Advanced Content-Based Semantic Scene Analysis and Information Retrieval: The SCHEMA project", Proc. Workshop on Image Analysis for Multimedia Interactive Services (WIAMIS), April 2003, London, UK. ***(joint publication with QMUL, UPC, UNIBS, DCU)***

16. V. Mezaris, I. Kompatsiaris, and M. G. Strintzis, "Ontologies for Object-based Image Retrieval", Proc. Workshop on Image Analysis For Multimedia

Interactive Services (WIAMIS), April 2003, London, UK, pp. 96-101.

17. I. Kompatsiaris, E. Triantafyllou and M. G. Strintzis, " A World Wide Web Region-based Image Search Engine", 2002 International Tyrrhenian Workshop on Digital Communications, IWDC 2002, September 8th - 11th, 2002, Palazzo dei Congressi, Capri, ITALY.

18. V. Mezaris, I. Kompatsiaris, and M. G. Strintzis, "Still Image Segmentation Tools for Content-based Multimedia Applications", Proc. 2002 Tyrrhenian International Workshop on Digital Communications (IWDC 2002), Capri, Italy, September 2002, pp. 273-279.

5.5 Relationship with similar technologies

The development of the SCHEMA Reference System follows the general query-by-example approach including some specific functionality:

- A region or object based approach is adopted where images or frames are first segmented by a number of analysis algorithms and then during the retrieval procedure users can define the specific region they are interested in instead of using the whole image.
- It integrates different sources of information such as low-level features, conceptual features (face/non-face) and textual description.
- It is fully MPEG-7 compliant since it integrates the MPEG-7 XM application.
- It is web based and integrates a friendly graphical user interface.

5.6 Local market

Customer profile

Visual search can be useful in a number of applications and services:

- Services for efficient management, retrieval and transmission of multimedia content targeting application developers, multimedia database management, WWW search engines (portals), e-commerce, etc
- Management of multimedia archives for audio-visual applications (photographs, graphic arts, marketing, web design, etc)
- Management of personal content stored in PCs (content from personal video and photo cameras, mobile phones, etc)
- Content-based analysis and retrieval in video applications
- Semantic Web
- Efficient management, retrieval and transmission of multimedia content in applications such as: mobile communications (GPRS, 3G), Digital Television, Medical applications, Content search for copyright management and protection and Security – Face recognition.

Pricing and business opportunity

Pricing will be negotiated on an individual basis according to the specific application and service where the technology is going to be used.

Part of the ITI business plan is to produce in 2-3 years spin-off commercial companies capable of exploiting its research. Such spin-off companies will produce and distribute innovative high technology products based on research results and results from R&D projects. The Centre for Research and Technology Hellas (CERTH), where ITI belongs, was in fact founded so as to accomplish Technology Transfer, encouragement of entrepreneurship and innovation. The Informatics and Telematics Institute as a member of CERTH has all the necessary support including legal support, business management, marketing, distribution sales channels and accounting in order to create innovative enterprises. The Greek General Secretariat for Research and Technology is currently funding the set-up of the following spin-off company:

"SerVisio: Providing Services in Intelligent Content-Based Management and Search of Visual Data", GSRT-PRAXE. ITI is currently in negotiations with ATC S.A. (www.atc.gr) for participating in the funding scheme and using the visual search technologies in the News Asset product. This solution constitutes an innovation in the management of large volumes of documents of any format (text, image, video, sound), offering an integrated and secure electronic environment for storage, retrieval and management of sensitive information. ATC delivers customer-driven solutions that give businesses the power to communicate with their customers. (banks, insurance houses, museums, newspapers, magazines, TV and radio stations, monument restoration agencies, etc).

Risks

Many companies do no seem to be ready to integrate and exploit visual based search technology. The current financial situation allows investment in necessary technologies only.

Current and future competition

There are a lot of companies offering visual search technologies. LTU technologies (http://www.ltutech.com/) is among the most relevant and well-known European company.

Market entry requirements

Most companies do not want a stand-alone application but a module that can be easily integrated within their workflow. High performance of the technology is necessary.
The technology should be able to solve existing every day real life problems in addition to offering new functionalities.

Intellectual Property Rights

ITI holds the IPR for the algorithms contributed either to Qimera or SchemaRS. The IPR of the integrated software have to be further investigated.

6 Fratelli Alinari I.D.E.A. (ALI)

6.1 Enterprise activity

Fratelli Alinari, the world's oldest picture archive with over 3.5 million vintage images from around the world, is today the leader in traditional and multimedia photographic publishing and is a synonym for the highest quality in the production of artistic prints. Alinari will propose user requirements for indexing and retrieval systems and evaluate, benchmark and run routine verification test for the current project algorithms and solutions. The Company will take part in the design of an architecture and navigation scheme for content-based semantic scene analysis, interpretation and understanding. Alinari will also take part in the exploitation and dissemination activities of the Network of Excellence, including by helping the Consortium to identify and solve issues related to IPR protection and security issues (picture-watermarking). Alinari is providing within the project a quality set of images to be tested and evaluated for monitoring and quality assurance purposes. Alinari is also testing, validating, benchmarking and demonstrating the system also through Alinari's exhibitions and Alinari's monthly cultural events. Alinari has very strong expectations from Qimera technology for possible industrial and commercial implementation. Through the I3A organization, Alinari is actively promoting the JPEG 2000 standard and new search engines such as Qimera to be integrated inside the archive business model. Alinari promoted SCHEMA results during many international events and workshops: Sarasota (US), annual I3A member's event, (November 2002), Las Vegas, Photo Marketing Association (conference and paper), March 2003, EVA Florence 2003 etc. Companies like HP, Kodak, Corbis, Adobe, Hitachi and Digimarc have shown already strong interest into the technology and it is wise to expect a massive and broad adoption of the newest image technology for its digital archive in the near future.
During the testing activities Alinari has also drafted specific innovative projects where Qimera would represent the core innovation: from multimedia messaging services for mobile environments, to distributed architecture of digital archiving with market services and of course for the creation of search engines that find images by means of other images.

6.2 Transfer of Technology - innovative development

Alinari will provide images, know how and cultural feedback for archives, cultural institutions and educational organizations. Also the software developed within SCHEMA framework software.

The project is currently demonstrated through ongoing and under discussion EC projects (clustering). Here is the list of the projects:

- **SCHEMA**: e-TEN project for e-learning and market dissemination. Qimera evaluated for possible online usage (some tests have been addressed to the educational users referring new search engines). SCHEMA project has been completed in February 2004 with success.

- **SCULPTEUR**: High quality 3D image acquisition.

- **TNT:** watermarking and IPR project. Qimera could be used for its search engines and searching for images that have been pirated, in line with all the scopes of the project which is addressed to trading on trusted networks
- **2KAN:** an IST project referring the new JPEG 2000 standard for advanced networks. Qimera does not yet support this image file format. JPEG 2000 could increase the performances of Qimera as the JP2 file keeps included some information that could help the segmentation algorithm.
- **aceMedia:** is an Integrated Project that will integrate knowledge, semantics and content for user-centred intelligent media services.
- **ECMADE:** e- TEN project on web museums for architecture and design. This project could represent a market validation for some ready made Qimera applications in the field of architecture image retrievals.

6.3 Application demonstrators

Alinari has also presented the Qimera characteristics during a number of events, workshops (ANAI-SEPIA, UNESCO, etc.) and some demos.

Alinari is going to study the possibility of integrating Qimera platform and SCHEMA results inside its educational and business web oriented products.

6.4 Scientific publications

Alinari regularly submits and presents technical and scientific papers in scientific journals and international events and workshops. Here is a list of papers and publications:

1. Sam H. Minelli; Andrea de Polo - Image segmentation search engine applied to a distributed archiving architecture for content retrieval system to educational products – 8th International Conference INFORMATION VISUALISATION 14 – 15 – 16 July 2004 (London), IEEE-iV04 (published July 2004). Paper presented during iV04 conference – London, 15 Jul 2004.
2. Sam H. Minelli; Andrea de Polo - Image segmentation search engine: advanced access to an image archive database- EUSIPCO-12th European Signal Processing Conference, September, 2004, Vienna, Austria (published September 2004). Paper presented during EUSIPCO Conference Vienna, 8 September 2004.
3. Alinari online, DSP 2002 - 14th Intl Conference on Digital Signal Processing, Santorini, Greece, July 1-3, 2002, Proceedings,
4. Sam H. Minelli; Andrea de Polo - The JPEG2000: testing results about the new digital image compression standard- EVA Conference 2004 (Florence, Italy) - Electronic Imaging & the Visual Arts - (Published March 2004).
5. Sam H. Minelli; Andrea de Polo - Digital Archive Management and Architecture Requirements Guidelines- WIAMIS 2003- 4th European Workshop on Image Analysis for Multimedia Interactive Services- (April 2003).

6. Sam H. Minelli; Andrea de Polo - Innovative channels for digital images delivery: MMS technology enhancing picture messaging for mobile and internet environments.- IEEE Transactions on Consumer Electronics (November 2003, U.S.A.).

7. Andrea de Polo, ECDL2002, Digital Libraries, September 2002, Rome, Pontifician University

8. IEEE, Rochester, NY (US), project presentation, September 2002

9. Andrea de Polo EVA Gifu (Japan), November 2002, Proceedings

10. Andrea de Polo EVA 2003 Florence (Italy), Proceedings

11. Photo Marketing Association, Las Vegas (US), March 2003, Proceedings

6.5 Customer profile

Alinari's customers can be divided into:

business:
graphic designers;
editors,
reporters;
advertisers
restorers;
Police (image of original piece of art);
medical;
web designers;
architects;
art buyers;
writers;
web advertisement;
designers;
educational:
researchers;
students;
professors.
number of online-clients:
more than 12.000 online business professional users
more than 20.000 online edu users

6.6 Relationship with similar technologies

Alinari has started to evaluate available market products similar to SCHEMA. For the evaluation process Alinari has used a set of 20.000 images. The number of visual query engines evaluated up to now are 4 a part from SCHEMA-RS and SCHEMA-XM: one developed in the U.S.A, one developed in Canada, one in Italy, and the last one developed in France. The global statistical results have not been published yet as some of the engines are under Non Disclosure Agreement.

6.7 Local market

Pricing

The pricing of the integration of the Qimera platform inside Alinari's search engines depends on the integration costs and on the compatibility with its technology. Moreover, the licence costs must be considered.

Business opportunity

The image segmentation search engine called Qimera, can be integrated into a distributed archiving architecture for content retrieval system to realize educational products and support the teaching workflow. Both teachers and students could access much higher volume of digital content (images, text, video) with the possibility to interact inside a common platform. The distributed architecture guarantees IPR management and reduces the general costs.

An integrated educational application for both universities and high schools is expected to allow the professors and teachers to create specific course modules and tests for examining the students. Examples are:

- history domain application: the professor requires the students to find images referring to historical personages and reporting on the places, events, chronicle.
- Art domain application: the professor requires the students to analyze a painting reproduction and to find similarities and correspondences with similar artists.Science domain application: the student preparing an exam on astronomy needs images on eclipses and planets from an image database that has not been catalogued by keywords (rough image database).

Risks

Alinari has evaluated the exploitation risks of integrating Qimera as being very low. The market image search engines that will integrate Qimera will be more competitive: the segmentation sw allows reaching market segments that otherwise would not be exploited. In fact, one of the most important consequences of this technology is language-independence. Up to now searching meant "searching by key words". Now there will also be the possibility to search an image using another image and the process will be the same in Italy as in China or elsewhere.

Current and future competition

Currently there are few competitors offering digital image archives but we can foresee that the image search engines will soon be of great importance in the image trading market. Moreover, new products will be created both for professional and for educational users.

Market entry requirements

The market requirements should be addressed more to an application product: Qimera is an advanced search engine and it must be addressed to targeted users. A market analysis and market validation should be explored. What we have verified by interviews is that the image segmentation search engines can generate real new products. In the same time these products seem to need user platforms that exhaustively use them inside integrated solutions. University teachers requested some Qimera features inside their courses but with the support of other editing functionalities that let the students interact dynamically with the professor and other students as well.

Intellectual Property Rights

The segmentation software is a new instrument to assist with IPR management and content protection. It will enable detection of piracy and false products.

7 Tampereen Teknillinen Korkeakoulu (Tampere University of Technology – TUT)

7.1 Activities

Tampere University of Technology (TUT) (P2) is project coordinator of the Algorithm Group of COST211 quat. The TUT aim is to achieve a fast, real-time and reliable image and audio/video (AV) browsing, indexing and retrieval framework, MUVIS, which is also capable of video summarization and extraction of the well-defined key features of the AV media. The MUVIS framework is mainly designed to work on specific AV databases that may be created from arbitrary TV channels or live cameras or even from any available multimedia items. Consequently, it will have strong practical usage potential and give performance criteria on such usage areas. Another goal is to develop tools for managing and mining multispectral images in distributed environment. Databases contain Terabytes of data. TUT already has strong links and will cooperate with Nokia Mobile Phones, Tampere Technology Center and Purdue University, ABB Industry Drives, Saanio&Riekkola Corp.

7.2 Transfer of Technology - innovative development

The developed MUVIS framework has been adopted as the reference software for COST 211quat. It is genuinely used to develop, improve and test various techniques and algorithms on the area of content-based multimedia indexing and retrieval. It is an open framework and shared through WEB site http://muvis.cs.tut.fi. It is one of the first frameworks that the latest multimedia formats such as MPEG-4 (SP) video, H.263+, MP3 (MPEG-1, 2 Layer 3), AAC (MPEG-2,4 Advanced Audio Codec) and JPEG-2000 have been successfully indexed and tested for their retrieval performances. Furthermore the MUVIS framework supports the following processing capabilities and features:

- An effective framework structure, which provides an application independent basis in order to develop audio and visual feature extraction techniques that are dynamically integrated to and used by the MUVIS applications for indexing and retrieval.
- Real-time audio and video capturing, encoding and recording,

- Alien multimedia items can also be handled under MUVIS via multimedia conversions into one of the convertible formats that MUVIS supports,
- Hierarchic video handling and retrieval,
- Video summarization via scene frame extraction from the shot frames available in the video bit-stream,
- A novel *Progressive Query* mechanism, which provides faster query results along with the query process and lets the user browse among the queries obtained and stops an ongoing query in case the results obtained so far are satisfactory.
- An enhanced retrieval scheme based on explicit visual and aural queries initiated from any MUVIS database that includes audio/video clips and still images.
- All the MUVIS applications and the available visual and Audio Feature eXtraction (*FeX* and *AFeX*) modules within current MUVIS framework are developed to provide and indexing and retrieval scheme that is robust to (independent from) the multimedia formats, types, encoding/capturing parameters, etc.

Recently a new group has been formed to accomplish content-based multimedia indexing and retrieval for Mobile platforms. It is so called M-MUVIS (Mobile MUVIS) since MUVIS provides the core part of the project and also used as the reference software. First successful demonstrations have been recently achieved for the Nokia phones.

7.3 Application demonstrators

The entire MUVIS framework can be freely downloaded from http://muvis.cs.tut.fi including the sample multimedia databases, user manuals, publications, etc.

7.4 Scientific publications

1. Proceedings of the WIAMIS Workshop, Lisboa, Portugal, April 2004.
2. Proceedings of the 6th International Conference on Digital Signal Processing and its Applications, DSPA 2004, Moscow, Russia, March 31 - April 2, 2004.
3. Proceedings of the First International Symposium on Control, Communications and Signal Processing, ISCCSP 2004, Hammamet, Tunisia, 21-24 March 2004.
4. Proceedings of IEEE International Conference on Image Processing, ICIP 2003, Barcelona, Spain, 14-17 September 2003.
5. Proceedings of the 2003 Finnish Signal Processing Symposium, FINSIG'03, Tampere, Finland, pp. 120-123, 19-20 May 2003.
6. Proceedings of the International Symposium On Intelligent Signal Processing and Communication Systems (ISPACS), Awaji Island,Japan, 2003.
7. Proceedings of the Seventh International Symposium on Signal Processing and its Applications, ISSPA 2003, Paris, France, pp. 1-8, 1-4 July 2003.
8. Proceedings of the Third International Workshop on Content-Based Multimedia Indexing, CBMI 2003, Rennes, France, pp. 405-412, 22-24 September 2003.
9. Proceedings of the IWDC 2002 Conference on Advanced Methods for

Multimedia Signal Processing, Capri, Italy, September 2002.
10. Proceedings of the WIAMIS Workshop, pp. 338-345, London, 2003.
11. Proceedings of the NORSIG-2002, 5th Nordic Signal Processing Symposium, On Board Hurtigruten M/S Trollfjord, Norway, October 4-7, 2002.

8 BTexact Technologies

8.1 Activities

BTexact Technologies (BTexact) (P3) is the advanced communications technologies company from British Telecommunications plc and the project Coordinator of the Management Committee of COST211 quat. Btexact Technologies will further extend its current activities in multimedia content understanding and retrieval, with particular emphasis on user-oriented video emotional load analysis and content-preserving ROI coding, as well as efficient content access in compressed domains. Active collaborations and exchange of information with academic visitors will be actively sought within the Network.

8.2 Exploitation plan

Having demerged and sold its BT Cellnet operation (now mm02) BT is now a predominantly fixed line telco. In common with most, if not all, telcos operating in an intensely competitive environment, BT is seeing its revenues from traditional telephony decline. Again in common with most telcos, BT is looking to Broadband to provide new revenue streams. It is aiming to have five million customers on its high-speed ADSL network by 2006, having already gone from 1 million to 3 million in the 16 months to August 2004. While early successes were achieved largely on the basis of a "better internet experience" it is likely that the later stages will require a more compelling offer. This may include content on demand type services. BT and others around the world have on occasions investigated options for and even trialled video-on-demand (VoD) but not proceeded to commercial service. However technology is pushing DSL systems to higher bit rates and new compression algorithms are improving picture quality. These and other market place developments have the potential to produce a scenario for commercial success with content services. There is no doubt that once the libraries associated with these services offer more than a relatively modest amount of material, then advanced search and selection methods become necessary.

Other expanding areas include security and surveillance. These cover the gamut of government and public agencies, corporates, SMEs and private individuals. BT already has a presence in all of these sectors and sees the provision of content analysis as added value over and above the traditional business of merely transporting images from camera to observer.

In readiness for the above, BT is carrying out research activity, including the SCHEMA project and others, so that it has expertise and knowledge available when the time is right. Nevertheless, BT has not disclosed any plans to commercialise SCHEMA technology.

BT designs, develops and deploys some of the biggest and most complex IT systems and communications networks in the world. BT also has thought leadership in technology, influencing the creation of international standards and providing a

respected benchmark for the industry. However, BT is not a manufacturer; it partners with best of breed suppliers to provide the solutions to be rolled out across the UK and where appropriate, other parts of the globe. Thus, mass deployment of technology developed in SCHEMA would be done in collaboration with key partners. For the most part, the other SCHEMA partners would not be classified as "key". That is not intended to be derogatory, nor to denigrate their skills. It is simply the truth that:

- SCHEMA is basically a research project and will not (and was not intended to) deliver a complete solution ready for deployment.
- Most of the partners (including the particular part of BT working in SCHEMA) do not operate in the rigorous environment required to develop solutions for commercial service.
- Most of the partners do not adequately understand the commercial aspects of the value chain from content authors through to content consumers. The technologies studied in SCHEMA are but a small part of the vast total picture when all the technology and business aspects are considered.

These statements should not be viewed as negatives, but rather as placing SCHEMA in context when exploitation of results is discussed. BT believes the SCHEMA project to be an extremely valuable endeavour, providing insight into several areas and issues. That the results are more likely to be exploited as groundwork for future research studies and product developments rather than directly as immediate products or services does not diminish their usefulness.

9 Université Catholique de Louvain (UCL)

9.1 Activities

Université Catholique de Louvain (UCL) (P4) is project coordinator of the network of excellence SIMILAR related to multimodal interfaces research, which groups 32 research institutions and several industrial companies. UCL is also project coordinator of the Art.Live IST project related to mixed realities and transfictions applications of MPEG-4 scenes composers. UCL is prime contractor of the PRIAM IST project whose aim is to develop generic tools for navigating through huge images through the use of the JPEG-2000 standard. UCL has also developed through past European projects a strong and pioneering expertise in watermarking technology for images. Several projects are still on duty on this thematic. UCL has several international scientific collaborations including partners in France (ENST-Paris and CNRS-Nice) MIT at Boston and Berkeley in San Fransisco. UCL is an early partner of COST 211.

9.2 Transfer of Technology - innovative development

UCL has transferred technologies developed partly in the frame of SCHEMA to Belgian SMEs including Spin-offs from the laboratory, to European partners thorough participation to European consortiums and to the scientific community through the development of open-source platforms implementing compliant standard reference software.

Regarding the transfers to spin-offs, the core competencies in motion analysis and MPEG-4 scene compositions have been used by the alterface company (www.alterface.com). Contacts about segmentation and augmented reality for post-production have also been taken with axell communications (http://www.axellcom.com). The developed competencies in JPEG-2000 and the related open-source reference software have been transferred to telemis (www.telemis.com) for medical images communications and to EVS (www.evs.tv) for applications in the field of digital cinema.

9.3 Application demonstrators

In the domain of JPEG-2000 a demonstrator is fully available at www.openjpeg.org . A benchmarking platform for the assessment of watermarking algorithms is available at www.openwatermark.org

9.4 Scientific publications

1. Annabelle Gouze, Jérôme Meessen, Yannick Verschueren, Michel Barlaud, Marc Antonini and Benoit Macq, "Efficient navigation through quincunx mega images", *CBMI'03 - Third Intl Workshop on Content-based Multimedia Indexing*, Sept. 22-24, 2003, Rennes France.

2. Takatoshi Suenaga, Jérôme Meessen, Yannick Verschueren and Benoit Macq, "JPEG 2000 Over Mail Protocol", *SPIE 2003 - SPIE International Conference on 'Applications of Digital Image Processing*, Aug 3-8, 2003, San Diego, CA, USA.

3. Jérôme Meesen, Takatoshi Suenaga, Marcela Iregui Guerrero, Christophe De Vleeschouwer and Benoit Macq, "Layered architecture for navigation in JPEG2000 Mega-Images" , *WIAMIS 2003 - 4th European Workshop in Image Analysis for Multimedia Interactive Services*, April 9-11, 2003, London, UK, Proc., pp. 92-95

4. B. Macq, J. Dittmann and E.J. Delp, “Benchmarking of image watermarking algorithms for digital rights management”, *Proceedings of the IEEE* ,Vol. 92 , Issue 6 , pp. 971 – 984, June 2004.

9.5 Relationship with similar technologies

UCL has also developed visual hash technologies (RASH) also available at www.openwatermark.org It is based on Radon projections and scene changes analysis.

That kind of technology can be considered as a non-semantic video indexing process.

10 Laboratoire d'Informatique, Signaux et Systemes de Sophia - Antipolis (Centre National de la Recherche Scientifique, Universite de Nice - Sophia Antipolis - I3S)

10.1 Activities

Laboratory I3S (P5) of the *Centre National de la Recherche Scientifique* (CNRS) and the University of Nice - Sophia Antipolis focuses its research on segmentation and compression of images and video sequences.

In compression, early work in collaboration with Princeton University resulted in the development of the 9-7 wavelet filter. It was implemented on DSP chips by Analog Device (chip ADV601) and by Texas Instruments. It is now part of the JPEG-2000 standard.
In collaboration with the *Centre National d'Etudes Spatiales* (CNES) of Toulouse, a multiresolution scan-based wavelet transform algorithm was proposed and retained for the next generation of earth observation satellites PLEIADE. A patent has been submitted by the CNES and the CNRS. The team also collaborates on motion-compensated wavelet transform with the *Università Federico II di Napoli* and Boston University.

Research in segmentation is done in the framework of multimedia, e.g., for MPEG-4 and MPEG-7 applications. The team was involved in several industrial contracts with the CNES and France Telecom R&D. In an international context, the team was involved in European project COST 211 and is currently part of European project COST 292 (SEMANA) and network of excellence SIMILAR (FP6). Besides European projects, current collaborations on active contours and joint segmentation/motion estimation include the *Université Catholique de Louvain* (UCL), the *Ecole Polytechnique Fédérale de Lausanne* (EPFL), and Boston University.

10.2 Transfer of Technology - innovative development

Innovative work and transfer of technology was done and will be done by I3S in domains developed by Schema.
Innovative developments are proposed in the field of image compression with model-based allocation using spline fitting of distortion/rate curves for JPEG-2000-like algorithms. A transfer of technology to France Telecom (http://www.francetelecom.com/en/) was done for fast video segmentation applied to telecommunications. In the same area, a joint PhD thesis with RealViz (www.realviz.com) is about to begin on video segmentation, motion, and tracking for the cinema industry.

10.3 Scientific publications

1. Gouze, M. Antonini, M. Barlaud, B. Macq., *"Design of signal-adapted multidimensional lifting scheme for lossy coding"*, To Appear in IEEE Transactions on Image Processing.
2. F. Precioso, M. Barlaud, T. Blu, M. Unser, *"Smoothing B-spline active contour for fast and robust image and video segmentation"*, To Appear in IEEE Transactions on Image Processing.
3. M. Cagnazzo, T. André, M. Antonini, M. Barlaud, *"A model-based motion compensated video coder with JPEG2000 compatibility"*, Proc. ICIP, October

2004.

4. Herbulot, S. Jehan-Besson, M. Barlaud, G. Aubert, *"Shape gradient for multi-modal image segmentation using mutual information"*, Proc. ICIP, October 2004.

5. S. Jehan-Besson, M. Barlaud, G.Aubert, *"DREAM^{2}S: Deformable regions driven by an eulerian accurate minimization method for image and video segmentation"*, International Journal on Computer Vision, Vol. 53, pp. 45-70, 2003.

6. Gouze, J. Meessen, Y. Verschueren, M. Barlaud, M. Antonini, B. Macq, *"Efficient navigation through quincunx mega images"*, Proc. CBMI, September 2003.

7. S. Jehan-Besson, M. Gastaud, M. Barlaud, G. Aubert, *"Region-Based Active Contours Using Geometrical and Statistical Features for Image Segmentation"*, Proc. ICIP, September 2003.

8. M. Gastaud, M. Barlaud, G. Aubert, *"Tracking Video objects using active contours and geometric priors*", Proc. WIAMIS, April 2003.

11 Dublin City University, Centre for Digital Video Processing (DCU)

11.1 Activities

The Centre for Digital Video Processing (CDVP), at Dublin City University (DCU), is a cross-disciplinary research centre and a collaboration between the School of Computing and the School of Electronic Engineering at Dublin City University. In 1999 we were awarded "University Designated Research Centre" status. Our mission is to research and develop techniques and tools to automatically analyse and index digital video information and allow content-based operations such as browsing, searching, alerting, filtering and summarisation. The Centre consists of 7 full-time staff members, 7 postdoctoral researchers, and over 20 research students. As well as our over-arching goal of developing context-aware, effective access to large video libraries, we are currently pursuing two important specific directions, namely video access from wireless mobile devices, and object-based indexing and access to video content.

11.2 Transfer of Technology - innovative development

As basic technology matures in the CDVP laboratories it is transferred into application demonstrators (see below). These application demonstrators become the mechanism by which technology is transferred to industry, via a well established University process, either by licensing specific components or spinning out companies in their own right. The CDVP has already spun off one campus company, Aliope Ltd, that leverages it's research output in the context of a specific commercial market.

11.3 Application demonstrators

The CDVP's philosophy is to incorporate the output of its basic research into a suite of demonstrators, which are then deployed as working systems with real users. This helps to focus our research into useful and practical directions. Over the years we have developed the following application demonstrators:

- Fischlar-TV: records broadcast TV from any of 8 terrestrial broadcast, analyzing and indexing the content for subsequent browsing via a number of specially designed interfaces
- Físchlár-News: records the Irish main evening news every day and automatically segments news story boundaries using combined audio-visual analysis to provide story-based news searching/browsing to its users.
- Físchlár-Nursing: provides access to educational videos for DCU's School of Nursing.

In addition, a number of systems have been created that illustrate the results of audio-visual analysis in an indexing context. Such systems include: scene classification in movies, object-based retrieval of cartoon characters, object-based retrieval in natural video and object segmentation and tracking, scene detection in still images.

SCHEMA provided travel funding to conferences and short visits for researchers working on aspects and components of the systems outlined above. The actual development of these systems and associated components was funded from other sources. SCHEMA partially funded a PhD student to carry out work contributing to building the retrieval system for SCHEMA's involvement in TREC 2004.

11.4 Scientific publications

1. "A Framework for Event Detection in Field-Sports Video Broadcasts based on SVM generated Audio-Visual Feature Model. Case-Study:Soccer Video". Sadlier D, O'Connor N, Murphy N and Marlow S. *IWSSIP'04 - International Workshop on Systems, Signals and Image Processing*, Poznan, Poland, 13-15 September 2004.

2. International Conference in Image and Video Retrieval (CIVR2004) Enser P, Kompatsiaris Y, O'Connor N and Smeaton A and Smeulders A (ed). *CIVR2004 - International Conference in Image and Video Retrieval*, Dublin, Ireland, 21-23 July 2004.

3. "A generic news story segmentation system and its evaluation", O'Hare N, Smeaton A, Czirjek C, O'Connor N, and Murphy N. *ICASSP 2004 - IEEE International Conference on Acoustics, Speech, and Signal Processing*, Montreal, Quebec, Canada, 17-21 May 2004.

4. "The Físchlár-News-Stories System: Personalised Access to an Archive of TV News", Smeaton A, Gurrin C, Lee H, Mc Donald K, Murphy N, O'Connor N, O'Sullivan D, Smyth B and Wilson D. *RIAO 2004 - Coupling Approaches, Coupling Media and Coupling Languages for Information Retrieval*, Avignon, France, 26-28 April 2004.

5. "Automatic Detection and Extraction of Artificial Text in Video", Malobabic

J, O'Connor N, Murphy N, and Marlow S. *WIAMIS 2004 - 5th International Workshop on Image Analysis for Multimedia Interactive Services*, Lisbon, Portugal, 21-23 April 2004.

6. "A Combined Audio-Visual Contribution to Event Detection in Field Sports Broadcast Video. Case Study: Gaelic Football", Sadlier D, O'Connor N, Marlow S, and Murphy N. *ISSPIT'03 - IEEE International Symposium on Signal Processing and Information Technology*, Darmstadt, Germany, 14-17 December 2003.

7. "Dublin City University Video Track Experiments for TREC 2003", Browne P, Czirjek C, Gaughan G, Gurrin C, Jones G, Lee H Marlow S, McDonald K, Murphy N, O'Connor N, O'Hare N, Smeaton A, and Ye J. *TRECVID 2003 - Text REtrieval Conference TRECVID Workshop*, Gaithersburg, Maryland, 17-18 November 2003.

8. "Efficient Contour-based Shape Representation and Matching", Adamek T and O'Connor N. *MIR 2003 - 5th ACM SIGMM International Workshop on Multimedia Information Retrieval*, Berkeley, CA, 7 November 2003.

9. Region and Object Segmentation Algorithms in the QIMERA Segmentation Platform O'Connor N, Sav S, Adamek T, Mezaris V, Kompatsiaris I, Lui TY, Izquierdo E, Bennstrom CF, Casas JR. *CBMI 2003 - International Workshop on Content-Based Multimedia Indexing*, Rennes, France, 22-24 September 2003.

10. "Mobile Access to the Físchlár-News Archive", Gurrin C, Smeaton A, Lee H, Mc Donald K, Murphy N, O'Connor N and Marlow S. *Mobile HCI 2003 - 5th International Symposium on Human Computer Interaction with Mobile Devices and Services, Workshop on Mobile and Ubiquitous Information Access*, Udine, Italy, 8-11 September 2003.

11. "Face Detection and Clustering for Video Indexing Applications", Czirjek C, O'Connor N, Marlow S, Murphy N. *Acivs 2003 - Advanced Concepts for Intelligent Vision Systems*, Ghent, Belgium, 2-5 September 2003.

12. "Advanced Content-Based Semantic Scene Analysis and Information Retrieval: the SCHEMA Project", Izquierdo E, Casas J, Leonardi R, Migliorati P, O'Connor N, Kompatsiaris I and Strintzis M. *WIAMIS 2003 - 4th Workshop on Image Analysis for Multimedia Interactive Service*, London, U.K., 9-11 April 2003.

13. "QIMERA: A Software Platform for Video Object Segmentation and Tracking", O'Connor N, Adamek T, Sav S, Murphy N and Marlow S. *WIAMIS 2003 - 4th Workshop on Image Analysis for Multimedia Interactive Service*, London, U.K., 9-11 April 2003. (Full-text PDF SIZE: 105K)

14. "Voice Processing for Automatic TV Sports Program Highlights Detection", Marlow S, Sadlier D, O'Connor N and Murphy N. *Proceedings of 8th International Symposium on Social Communication*, Santiago de Cuba, Cuba, 20 -24 January 2003.

12 Munich University of Technology (TUM)

12.1 Activities

Munich University of Technology (TUM) (P8) has strong experience in image and video segmentation algorithms. TUM is a key contributor to the MPEG-7 standard and it maintains the MPEG-7 XM reference software. TUM will demonstrate software and hardware solutions for image and video segmentation and will represent the Network of Excellence consortium in the MPEG-7 meetings.

Transfer of Technology - innovative development
Video analysis and indexing have been the main research areas of TUM regarding transfer of technology. This section summarizes the foremost contributions to state of the art technology.

- Video analysis towards real time applications. Besides the acquired expertise in video segmentation and analysis TUM is ready to export this technology to more demanding applications and scenarios where accuracy and response time are critical issues e.g. surveillance, driver assistance applications, etc. A hardware implementation of an abstract software library for image analysis is an on-going activity that TUM has been recently developing and hopefully will be an important milestone regarding technical achievements and technology transfer.

- TUM, aware of its leading role in MPEG-7 within the SCHEMA Network of Excellence, has focused on indexing and retrieval of large video/image databases. The goods of this work have many application fields and it has as first impact "ready to use" technology in such application domains like film/news production, medical imaging, security, intellectual property, etc among others.

12.2 Application demonstrators

- TUM has presented a colour analysis algorithm within COST 211, this algorithm has been as well later on integrated within the QIMERA activity.

- The XMServer has been one of the latest achievements as part of the constant development of the MPEG-7 Reference Software (XM). The new architecture of the XM achieves much shorter response times without undermining the quality of the results.

A new hierarchical indexing and retrieval approach for large video/image databases has been developed and presented as well within SCHEMA.

12.3 Scientific publications

1. *"Experimental results for a Search & Retrieval System" using MPEG-7 still*

image descriptors" 68th MPEG Meeting (March 2004, Munich) co-authored with ITI

2. *"Bringing User Satisfaction to Media Access: The IST BUSMAN Project"* IV04 (July 2004, London)
3. *"A test-bed for region-based image retrieval using multiple segmentation algorithms and the MPEG-7 eXperimentation Model: The Schema Reference System"* co-authored with ITI CVIR (July 2004, Dublin)

12.4 The local market

Pricing
t.b.d on effort base

Business opportunity
TUM expertise in video analysis and MPEG-7. To develop image/video analysis applications based on MPEG-7 descriptors

Risks
Scientific results sometimes cannot be as predictable as one could wish.

Customer profile
Companies with strong research and development interest in video analysis/indexing products/applications

Intellectual Property Rights
Patent on Multimedia Databases (Stephan Herrmann).

13 Queen Mary, University of London (QMUL)

13.1 Activities

The Multimedia and Vision group in Queen Mary, University of London (QMUL) (P9) has enjoyed a distinguished reputation for innovation over 10 years and their academic staffs are acknowledged international figures, having won national and international awards. The group currently develops an efficient system for accessing video on the Internet and general video databases. Specifically, hierarchical video querying, video annotation, video cataloguing and interactive navigation over distributed networks and general video databases are the core research issues addressed in this context. QMUL will strive for co-operation with the BBC and Motorola UK to support the objectives of the Network of Excellence.

13.2 Transfer of Technology - innovative development

The achievements of research within SCHEMA will be exploited as the basis of future research in the department. We have also set up companies to exploit our research in co-operation with the College Business Office. Suitable achievements will be exploited through this route, in co-operation with an industrial partner where possible.

13.3 Application demonstrators

System demonstration within the QUIMERA framework and the SCHEMA reference software

13.4 Scientific publications

The results of SCHEMA are/will be disseminated by presenting papers on the work at major international conferences, submitting the results of the work to international journals and incorporating new material in the taught courses of the department, particularly the postgraduate courses such as the MSc in Digital Signal Processing and Multimedia. The results will also contribute to the PhD studies of the research students in the group.

13.5 Intellectual Property Rights

Any IP rising from this project IPR will be managed by the college legal department.

14 Universitat Politecnica de Catalunya (UPC)

14.1 Activities

The Image Processing Group of Universitat Politecnica de Catalunya (UPC) (P10) has a strong background in video analysis and coding. The group has developed, in particular, a large number of low-level tools for image segmentation, hierarchical segmentation, object tracking, motion estimation, coding of partitions and bit allocation. More recently, the group has focused in video indexing, depth-oriented segmentation, face detection and facial feature extraction. This research activity has been the basis for collaborations within
international projects and for relevant contributions to MPEG4 and MPEG7 standards. With regards to European projects, the group was the prime contractor of the RACEII MORPHECO project. It has actively contributed to the RACEII MAVT project, ACTS projects MoMuSys, Vidas, Diceman, Hypermedia, IST projects InterFace, Advisor, Mascot and Faethon and in the Schema NoE. The group is currently involved in the Integrated Project CHIL, and the FP6 NoEs Similar and Muscle. Furthermore, the Image Processing group at UPC organized the IEEE ICIP-2003 conference in Barcelona in 2003.

14.2 Transfer of Technology - innovative development

In the framework of the Schema NoE, UPC has developed generic and specific innovative tools for content-based video analysis. Generic video analysis tools are related to segmentation and object extraction through syntactic region-based analysis algorithms (syntactic analysis refers to the study of particular configuration in the structure of the regions that compose complex objects). Some results have been published and form the core of two PhD theses being completed at the Image Processing Group. Other video analysis tools are specific developments related to particular applications such as counting people in demonstrations and contributions to the Qimera initiative.

These achievements (specially the generic tools) are to be exploited as the basis of further research in the Image Processing Group. The Group is actively seeking local partners interested in specific developments at the moment. During the last year, the Group has equipped a Smart Room with sensors and display equipment in the lab,

aiming at on-site demonstrations of the capabilities of content-based analysis tools for real time applications providing services in the room

14.3 Application demonstrators

Segmentation tools contributed to the Qimera initiative. Further video analysis demonstrators currently being built for the Smart Room at UPC.

14.4 Scientific publications

1. C. Ferran, J.R. Casas, “Binary-Partition Tree creation using a quasi-inclusion criterion”, International Conference on Information Visualization 2004, London, England, July 14-16, 2004
2. J.R. Casas, A. Puig, P. Puig, "Spatial-temporal Video Analysis for Improved Pedestrian Detection: Application to Density Estimation and Tracking in Demonstrations", 5th European Workshop on Image Analysis for Multimedia Interactive Services 2004, Lisbon, Portugal, April 21-23, 2004
3. C. Dorea, M. Pardàs, F. Marqués, "A region-based algorithm for image segmentation and parametric motion estimation", 5th European Workshop on Image Analysis for Multimedia Interactive Services 2004, Lisbon, Portugal, April 21-23, 2004
4. E. Izquierdo, J. R. Casas, R. Leonardi, P. Migliorati, Noel E. O’Connor, I. Kompatsiaris and M. G. Strintzis, Advanced Content-Based Semantic Scene Analysis and Information Retrieval: The SCHEMA project, Workshop on Image Analysis for Multimedia Interactive Services (WIAMIS03), London, 2003
5. X. Giro-Nieto and F. Marques, Semantic Entity Detection using Description Graphs, Proc. Workshop on Image Analysis For Multimedia Interactive Services (WIAMIS), April 2003, London, UK
6. José Luis Landabaso, Montse Pardàs, and Antonio Bonafonte, HMM Recognition of Expressions in Unrestrained Video Intervals, IEEE International Conference on Acoustics, Speech and Signal Processing, ICASSP'03, Hong Kong, 2003
7. P. Salembier, Overview of the MPEG-7 Standard and of Future Challenges for Visual Information Analysis. EURASIP Journal on Applied Signal Processing, Volume 4, pp. 1-11, April 2002
8. P. Salembier, J. Llach, L. Garrido, Visual Segment Tree Creation for MPEG-7 Description Schemes. Pattern Recognition, Volume 35, Issue 3, pp. 563-579, March 2002

14.5 Relationship with similar technologies

Content-based techniques for image/video retrieval share most of the tools of the analysis step with technologies providing information services from audiovisual input. Applications related to multimedia coding and description, surveillance

applications, human-computer interfaces and services based on multimodal interfaces can benefit from this situation. Enhancement of visual analysis with multimodal data extracted using audio analysis tools (speech activity detection, speaker ID, detection of acoustic events, speech recognition) is particularly promising.

15 Fondazione Ugo Bordoni (FUB)

15.1 Activities

The new Ugo Bordoni Foundation, heir of the former research body of the Italian PTT administration, was incorporated in 2000, following the liberalisation of the telecommunications industry, as a non-profit private organisation. The Statute of the Foundation conforms itself to the provisions of the Italian Constitution, which reads "high culture institutions, universities and academies have the right to establish their organisation autonomously within the limits imposed by the State laws" (Article 33).
The Foundation is a cultural institution subject to the supervision of Ministry of Communications, with the purpose to perform and support scientific and applied research in the fields of communications, computer science, electronics and multimedia, in order to promote scientific progress and technological innovation.

15.2 Purposes

In detail, purposes of the Foundation foreseen in its Statute are:

- to elaborate and to propose development strategies of the communications area and to uphold them within national and international competent bodies;
- to support the Ministry of Communications in solving, in an organic and interdisciplinary way, the technical, economical, financial, managerial, legal, and regulatory issues inherent in its activity;
- to provide cultural and scientific tools for the welfare and protection of the citizens and of users as well as to the market development;
- to promote co-operation and co-ordination with scientific activity of Universities and other research bodies
- to elaborate studies and research according to the indications of the Board;
- to support education and training in the area.

Organisation and personnel

The Foundation is not structured in areas of activity; rather, the necessary skills are aggregated as and when requested in specific projects and activities. This allows the necessary degree of flexibility and of adaptation to the changing needs of the various customer and activities. For each project, a Project Manager is appointed by the Director of Research, according to the necessary skills.
The Foundation currently counts on more than 100 employees, that comprise about 60 researchers with a University degree, 20 technicians and 20 members of administrative staff.

15.3 The role of public and private investors

A quite novel aspect in the new incorporation is the integration among public and private institutions that actively support the Foundation. There are three main sources of funds, namely the Public Administration, private partners, and self financing, that will be briefly detailed in the following.

15.4 The Public Administration

The Ministry of Communications finances projects that are carried out by the Foundation in two ways.
Some resources are granted by law to the Foundation for specific projects, such as the national monitoring network of electromagnetic fields and the experimentation for migration towards digital television.
Other project load onto a budget that the Ministry specifically allocates. The Foundation can make proposals for new projects, that are submitted for evaluation and approval in the regular meetings of the *Technical and Scientific Committee*, which comprises representatives of both the Ministry and the Foundation. A new project can be approved only if there is enough budget for it.
The projects aim to provide a high level technical and scientific support to the ministerial personnel and encompass various aspects, ranging from organisational issues (e.g. the update and improvement of the Ministry information system), to support in technical activities (e.g., procedures for the issue of licences), and to advanced studies (e.g. development of effective methodologies for the assignment of frequencies). The projects always foresee an interaction between the Foundation personnel and their counterparts of the Ministry, who are the actual *customers* of the work. This allows the Ministry to keep control of the progress and of the achievements of ongoing projects with a regular and "hands on" feedback.
A more formal verification of the progress is carried out during the meetings of the aforementioned Technical and Scientific Committee where reports on the status of all ongoing projects are presented.

15.5 Private partners

Private partners, on the other hand, support financially the Foundation, which in turn provides an independent and highly qualified consultancy over regulatory and organisational issues (e.g. the optimisation of the spectrum subdivision among existing mobile radio operators) and a neutral environment for debates involving competing operators and possibly the Ministry. The Foundation acts as an intermediary among the competing operators and between them and the Ministry. All the major fixed and mobile telecommunications operators are partners of the Foundation, holding a seat with right of voting within its board: this guarantees the neutrality of the Foundation in possible disputes.

15.6 Self financing

Apart from the two sources above mentioned, the Foundation partly finances itself through the participation to funded activities, such as European and national research projects, and through research and development contracts on specific themes and framework agreements, that may be signed with both public institutions and private companies.

15.7 Main current activities and areas of expertise

The list below recalls the main projects and areas of activity performed in 2003. It is not exhaustive, and it is mainly meant to show the variety of areas where the Foundation expertise may be employed.

- Experimentation for the migration towards digital television
- Monitoring network of the electromagnetic field
- Security of networks and services
- Intellectual property rights protection in the digital era

- Automatic language treatment
- Radio systems and frequency management
- Constitution of the national register of frequency allocations
- Accessibility and usability of WWW without discrimination of disabled people ("webxtutti" project)
- Wireless LANs for schools and for local communities ("internet@scuola" and "TERRA" projects)
- Advanced and economically sustainable techniques for fast Internet access and usage (project "intern.it" project)
- National research programme in the ICT sector to promote development and competition, in co-operation with operators and manufacturers
- Experimentation of multi-channel fibre optics link at 40 Gbit/s ("ATLAS" project)
- Video-communication and distance learning for institutional users on multi-service broadband networks ("FORMA TLC" project)
- National field prediction model for 3G mobile radio systems
- Web portal to promote dissemination of web-based broadband applications to enterprises ("AGIRE DIGITALE" project)
- Enabling technologies for future multimedia applications

15.8 Scientific publications

1. L. Capodiferro, V. Casieri, A. Laurenti, G. Jacovitti
   "Multiple feature based multiscale image enhancement"
   International Conference on Digital Signal Processing 2002, DSP2002, 1-3 July 2002, Santorini, Greece

2. L. Capodiferro, A. Graziano, A. Laurenti, G. Jacovitti
   "Image Error Concealment by Multiresolution Edge Extrapolation"
   2002 Tyrrhenian International Workshop on Digital Communications, IWDC 2002, 8-11 September 2002, Capri, Italy

3. L. Capodiferro, E. D. Di Claudio, F. Iacolucci, A. Laurenti, G. Jacovitti
   "Two-Channel Technique for High Dynamic Range Image Visualization"
   iV04- 8th Internation Conference INFORMATION VISUALIZATION, 14-15-16 July 2004, London, England

4. L. Capodiferro, A. Neri, M. Nibaldi, G. Jacovitti
   "Robust Detail Recognition and Location Technique for Image Retrieval in Digital Repositories" iV04- 8th Internation Conference INFORMATION VISUALIZATION, 14-15-16 July 2004, London, England

16 University of Brescia (UNIBS)

16.1 Activities

The University of Brescia (UNIBS) (P12) will address the issues of content-based multimedia analysis, and MPEG-7 and MPEG-21 standards. Specific issues for which a common interest and interdisciplinarity in skills exist could be considered as a

starting point for new project ideas on innovative topics. Regarding standardization we will prepare contributions to MPEG-7 and MPEG-21 standards, on issues related to content-based multimedia description creation and simplification.

16.2 Transfer of Technology - innovative development

In the context of the project, the University of Brescia (UNIBS) has studied algorithms and methods for content analysis and indexing in audio-visual sequence.

The main research results will be exposed to the Scientific Community and Industry operating in multimedia systems research and technology through publications in scientific journals and international conference proceedings. Dissemination of the research results will be also provided by documents/possibly demonstrators placed on the WWW. Another significant exploitation of the research will be to provide an active participation of UNIBS to ISO/MPEG7 standardization activity.
Finally the educational sector in which UNIBS operates will benefit from the project achievements. It plans to use the proposed methodology in the context of distance learning and security applications, and for audio-visual information retrieval from library databases is guaranteed.

16.3 Scientific publications

1. R. Leonardi, P. Migliorati, M. Prandini, “A Markov Chain Model for Semantic Indexing of Sport Program Sequences”, Proc. WIAMIS’03, pp. 20-26, 9-11 April 2003, London, U.K.

2. E. Izquierdo, J.R. Casas, R. Leonardi, P. Migliorati, Noel E. O’Connor, I. Kompatsiaris, M.G. Strintzis, “Advanced Content-Based Semantic Scene Analysis and Information Retrieval: The SCHEMA Project”, Proc. WIAMIS’03, pp. 519-528, 9-11 April 2003, London, U.K.

3. F. Lazzaroni, R. Leonardi, A. Signoroni, “Adaptive Dilation Analysis for Wavelet Coding with EMDC”,

4. Picture Coding Symposium, PCS 2003, pp.423-426, Saint-Malo, F, Apr.2003

5. N. Adami, R. Leonardi, P. Migliorati, “An Overview of Multi-modal Techniques for the Characterization of Sport Programmes”, Proc. SPIE - VCIP’03, pp. 1296-1306, 8-11 July, 2003, Lugano, Switzerland.

6. R. Leonardi, P. Migliorati, M. Prandini, “Semantic Indexing of Sport Program Sequences by Audio-Visual Analysis”, Proc. IEEE ICIP’03, 14-17 Sept. 2003, Barcelona, Spain.

7. S. Benini, F. Guerrini, R. Leonardi, P. Migliorati, Effective Image Fingerprint Extraction Based on Random Bubble Sampling, International Workshop on Image Analysis for Multimedia Interactive Services (WIAMIS 2004), Lisboa, Portugal, April 21-23, 2004.

8. R. Leonardi, P. Migliorati, M. Prandini, "Semantic Indexing of Soccer Audio-Visual Sequences: a Multi-Modal Approach Based on Controlled Markov Chains", IEEE Trans. on Circuit and Systems for Video Technology, May

2004.

9. F. Guerrini, R. Leonardi, P. Migliorati, “Image Retrieval with Random Bubbles”, Proc. EUSIPCO 2004, pp. 1035-1038, September 6-10, 2004, Vienna, Austria.

10. M. Dalai, R. Leonardi, “L-norm based second generation image coding”, To appear in Proc. ICIP’2004.

17 Macedonian Press Agency (MPA)

17.1 Activities

The Macedonian Press Agency (MPA) (P13) is the second national Greek news agency. It has been operating as an independent news organization since 1991. It was transformed into a Limited Liability company in 1994. MPA will propose user requirements for indexing and retrieval systems for digital publishing and evaluate current algorithms and solutions. The Macedonian Press Agency cooperates with all Balkan news agencies (ATA (AL), MIA (MK), TANJUNG (YU), ROMPRESS (RO), BTA (BG), ANADOLU (TR), ANA (EL)), as well as the news agencies of Black Sea countries, the French news agency (Agence France Presse), Chinese XINHUA, and the Russian ITAR-TASS. It will strive for co-operation with all of these partners under the Network of Excellence framework

17.2 Transfer of Technology - innovative development

The Macedonian Press Agency was founded in the beginning of 1991 in Thessaloniki and is the second national Greek news agency. It has been operating as an independent news organization since the very beginning. It was transformed into a Limited Liability company in 1994.

MPA during its short lifetime became known as the most reliable source of information on events occurring in the Balkan and the Black Sea countries. It is also considered as a "bridge" with the Greek communities abroad. The MPA being committed to its goal for peace and understanding, has taken the first step along with the Bulgarian news agency (BIP) in creating the Association of the Balkan News Agencies (ABNA).

In a short period of time, the Macedonian Press Agency, based on its capable staff of journalists and collaborators, the network of correspondents, the columnists and its scientific council, evolved into one of the most active, better organised and equipped news agencies that operate in south-eastern Europe. More than 250 mass media within the country as well as 300 news organizations of the Greek diaspora worldwide, use the wealth of information that MPA daily provides.

The MPA understood very early the potential that technology could bring to the news media industry. In 1994 it dispatched its first news bulletin in the Internet, while from 1995 it maintains its own Internet site (http://www.mpa.gr). MPA also operates thematic portals on various subjects (local government, sports, events) as well as photo and online video services. MPA has its own research and development team in order to support these and other activities.

17.3 Application demonstrators

MPA participated in a research and development project supported by the Greek Secretariat for Research and Technology which results (PhotoBox) are closely related to the SCHEMA NoE. The goal was to develop an online stock photography system based on the JPEG2000 standard. Advanced search facilities were also developed. The SCHEMA reference system is a good candidate for incorporation into this system.

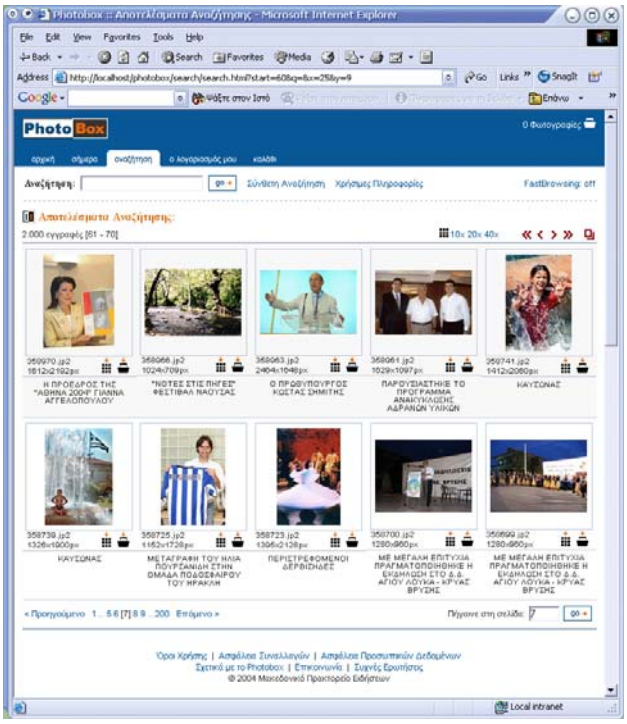

Figure 6: Screenshot of the "PhotoBox" on-line stock photography system

17.4 Relationship with similar technologies

Although many photography sites are available none is based on JPEG2000. JPEG2000 gives us the ability to maintain a single file and produce various resolutions of the same image at will. This improves management of the photographs and makes the system a lot faster for end users (through JPEG2000's advanced compression mechanisms). Unfortunately the penetration of the technology in end-user applications is still not very high so an hybrid approach was realized. The user can switch on the JPEG2000 features if he has the required plugin to view the images, otherwise the system defaults to plain JPEG.

17.5 The local market

Customer profile

The customer base of MPA is more than 250 news media within the country (Newspapers, Magazines, radio stations, television) as well as 300 news organizations of the Greek diaspora worldwide, public administration organizations from Greece and abroad (Ministries, Local Authorities, Embassies, Other Organizations) as well as other News Agencies. MPA also publishes a magazine, which is distributed to Greek communities worldwide.

Pricing

MPA operates on a subscriber basis. Most of its services are available online and its customers can choose from different configurations depending on their needs.

Business opportunity

News information is a valuable commodity. The problem facing those in the industry is to sell this large amount of data to as large a customer-base as possible at as high a price as possible. Up to now the industry has made no real effort to allow the valuable information in news stories to be extracted and analysed easily. On the other hand, the reliance on the timelines of information produced by agencies is becoming less secure as new methods of publishing emerge and the competition from broadcast news stations and Internet providers increases.

Added value is needed to make the information valuable even when the immediate events it refers to are no longer of current interest. This can be achieved by re-examining the business and considering it more from an information management point of view rather than as news story generator.

MPA sees the SCHEMA reference system as a business opportunity not only for the technology behind it but also for the differentiation it can provide to its photo and video services. Features such as content-based search and search-by-example are not currently widely used but this may change in the future as the technology matures. The target for news organizations is the provision of fast and accurate tools for searching in large archives of data.

Risks

No actual risks can be identified at this stage in incorporating content-based search and retrieval mechanisms into photo and video services other than direct costs.

Current and future competition

The competition for photo and video services is large within the news industry. MPA tries to cope with this providing not only timely and accurate content but also using technology to facilitate the use of its services for the end user. As more and more organizations are entering the electronic media arena this competition will probably grow more. Content-based search and retrieval mechanisms may prove to be the differentiating factor that can put as ahead.

Market entry requirements

In order for this retrieval technology to successfully enter the market it has to provide fast and accurate results. These two factors unfortunately are the main drawbacks since content-based search at this stage requires too much computational resources providing rather pure results. More research has to be done towards identification of real world objects, people, set ups etc.

Intellectual Property Rights

IPR in a connected world is the main problem that all news organizations face. It is indeed very tempting to re-use content that does not belong to you since no actual

degradation of the quality occurs during copying and it is difficult for someone to actively guard the content that he makes publicly available. To this end content-based search may provide another measure for safeguarding content since identification of possible IPR infringement can be made possible through global search providers who could match a particular object to anything that is available on the Internet.

18 Conclusions

Implementing visual query engines integrated into digital archives is a high priority. The new challenge for a traditional archive, image provision service, e-retailer, or museum (photographic archives, art museums, etc.) is to make available its content to as many users as possible and in the simplest way with no language barriers. Of course enlarging the number of possible customers involves many risks for the IPR protection: the improper and illegal usage of protected images must be detected more easily (and SCHEMA can also play a role in improving the security by detecting improperly used content).
The visual query engine is supposed to be integrated into the existing database, as the image needs also the cataloguing data for advance searches.
In this context Alinari has executed market studies for the exploitation of SCHEMA and has delivered the draft agreements.

Considering the educational domain, a researcher could find historical images starting from a portrait or a family photo. From the medical domain there is sometimes the need to find the images from the database that have common features to the one under analysis referring some disease. Then in the business domain a graphic studio could be interested to find real images that could be similar to some freehand drawings. Recently defined application cases require integration of technologies, as example the scanned UV image of a painting could be automatically elaborated by a segmentation software and after revealing the image features we could extract the information relating it to a specific thesaurus and comparing the processed image (still during the same direct process) with other images inside the database revealing similarities and key elements. In this report, many such applications have been described, in order to provide examples of possible exploitation open to SCHEMA partners as well as other researchers active in the area.

When considering digital contents such as images or video excerpts, the owners of the content request for strong IPR management systems.
The application cases inside the artificial vision domain are much more than the few described here. The image archive application cases underline the need for the user to be able to insert as input an image (a photo of a real subject or a drawing or even only a distribution of colours) and having as output a set of images retrieved on the basis of the image features. Of course this new approach is not intended to be completely separated from the traditional keyword-based engines, on the contrary the two approaches are supposed to be integrated together.

18.1 Impact

The potential impact of the project in market applications that we explored by meetings during events, fairs, workshops and company visits are:

- **Health- medical**: the doctor can quickly search inside medical data bases looking for radiographies that are similar to one under exam (i.e. find the images from the database that have commune features to the one under analysis referring some disease).
- **Cultural heritage and preservation**: to retrieve all the images belonging to the same album and associate restoration solutions to each image damage.
- **Security**: the retrieval of marked documents preventing their transmission.
- **Monitoring/Alerting**: such as intrusion detection.
- **Question & Answer Interfaces**
- **3G mobile multimedia communications**: retrieving of video and images to be delivered by mobile environments.
- **Entertainment**: visual tools with graphical interaction.
- **IPR Management and protection of knowledge**: reveal watermarks that have been embedded in the digital image.
- **Textile Industry**: manage large repositories of textile patterns.
- **Cinema and Broadcasting**: retrieve all scenes where your favourite actor appears or find out sequences of relevance.
- **Automotive industry**: development of software for object recognition and avoiding to be integrated in automotive environments.
- **Tourism**: create services for retrieving information and maps.
- **Cultural Heritage**: manage digital archive by integrating the visual engine in local systems.
- **Commerce**: code bar reading environments (large distribution).
- **Education**: the application cases to the visual search engines in the educational domain can be adapted to the group of users by means of personalized tools that differ from one university to another:

    - **History-domain application**: the professor requires the students to find images referring historical personages and reporting on the places, events, and chronicle.
    - **Art-domain application**: the professor requires the students to analyse a painting reproduction and to find similarities and correspondences with similar artists.
    - **Science-domain application**: the student preparing an exam on astronomy needs images on eclipses and planets from an image database that has not been catalogued by keywords (rough image database).

As illustrated by the few previous application cases, we foresee a large impact of the visual search engines; almost all domains could improve processes, quality and profits by the usage of advanced tools that support this engine.

During year 2004, Google Inc. has released the Google desktop search engine which indexes all the hard disk of the host: in an astonishing fast search you can retrieve anything on the web as on your personal computer. The market investment into the

search engines is increasing so much that a visual search engine will be more and more important.

18.2 Recommendations for exploitation

It is very difficult to introduce new technology into any market or business environment, since change requires expenditure, and costs must be kept to a minimum. Introduction of just one or two modules from the SCHEMA results into an existing product or service, as some of the above analysis has recommended, would be of significant benefit to the entire SCHEMA Network of Excellence as a showcase of the benefits of the technology. The objective is to demonstrate how easily the technology can be integrated into a workflow process or a system, such that user benefits are rapidy realised, and the costs of development are reliably estimated. Then a trial period would demonstrate the cost savings (e.g. in time), or additional revenue gains (e.g. through increased sales) that the technology has introduced, leading to greater probability of adoption in other products and services.

A second important route for exploitation is adoption of the SCHEMA results in other projects, especially those with a commercial focus such as aceMedia or BUSMAN. Integration into related system which are intended to be commercially exploited by industrial organisations can improve the chances of exploitation of SCHEMA results, albeit via an indirect route.

19 Annex-1: Intellectual Property Rights (IPR) & Third Party Licencing Provision

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INTELLECTUAL PROPERTY RIGHTS DOCUMENT (IPR)

THIRD PARTY LICENCING PROVISION

INTRODUCTION

This document presents the legal framework which is used to establish a commercial trading relationship between the SCHEMA project partners and third party who wish to use SCHEMA software.

In order to simplify the legal basis, the SCHEMA project is legally represented by the (*put here the business aggregating company*). Centre for Research and Technology - Hellas/Informatics and Telematics Institute (CERTH/ITI) is coordinating the project and is also the contact point to the SCHEMA reference system.

The availability of this document allows third parties to have a clear and unambiguous understanding of the key issues when considering participation in, and cooperation with the SCHEMA project :

- How the IPR will be protected
- How SCHEMA will benefit from the exploitation of the reference system

Such a clear legal and commercial framework removes much of the doubt for third party providers, and so makes participation in SCHEMA more attractive.

Background

SCHEMA-(*put here the versions of the system***)**
Among the objectives of SCHEMA is the design of a general architecture for content-based analysis, representation indexing and retrieval. The system can support high level (semantic) descriptors and the integration of visual media indexing and retrieval with other modalities (like text and audio based indexing and retrieval). The most important milestone of this system is the opportunity given to research institutions and organisations to take this system as a test-bed and a common dataset for the evaluation and comparison of different modules and interfaces within CBIR context.

Income Model
The consulting of the SCHEMA educational site is done through the purchase of a licence. The end user is informed about the usage of the reference system at the moment of signing the subscription agreement.

The income model (*to be defined in detail by means of a business plan*) can be defined on different king of licensing:

Server-Llicensing (B2B)
Desktop-Licensing (B2C)

Collaboration Business Model
The business model presented in this document reflects the priorities and objectives of both the SCHEMA project team and of any third party who is considering collaboration with the project.

The business model has the following stages

- Payment negotiation, where the SCHEMA team and the third party reach agreement on the amount of payment due to the third party from the SCHEMA project, for the right to manage and license their content.
- Definition of revenue sharing.

20 Annex-2: MoU- Memorandum of Understanding

Introduction
This document presents the commercial Memorandum of Understanding (MoU) which binds the commercial players in the SCHEMA consortium in the context of the further exploitation of the results of the SCHEMA project.

While the SCHEMA project subject to the current contract is limited to (*put here the limiting conditions or the reference*), the SCHEMA consortium agrees that this is merely a phase in the development of an international, viable and profitable partnership for exploiting the SCHEMA reference system. In order that the commercial and legal aspects of their cooperation in this enterprise be clear from the outset, the consortium have agreed to the MoU outlined in legal terms below.

The objective of the MoU shall be to establish a common understanding among the consortium members, in the case that, on the basis of encouraging results from the project Reference System, they decide to enter into the exploitation phase and to create the SCHEMA Company.

Commercial and University Partners
The SCHEMA consortium is made up of *(put here the number)* commercial players (*Alinari, MPA, BTexac, and other if any*) and *(put here the number)* universities (*ITI, QMUL, DCU, TUT, TUM, I3S, UNIBS, UPC, FUB and other if any*). It has been agreed that this MoU shall bind in particular the commercial players - this reflects the fact that it is these partners, which have the most direct interest in exploitation in the commercial sense.

The university partners participate in this MoU as *(put here the status)* - their signature and involvement in the MoU is not critical in any way, but merely indicates their general endorsement of the approach taken.

In their status of *(put here the status)* they will play an important role in the project as being involved as developers of the SCHEMA Reference System they *(define the role in detail).*

It may be noted that the Consortium Agreement document, however, fully and legally binds all SCHEMA partners.

The SCHEMA company
This MoU envisages the creation of a commercial limited company (the 'SCHEMA Company') as the vehicle for SCHEMA Reference System exploitation on the open market. The company shares shall be held by the participating partners, with the proportion of shares reflecting the investment by the particular partner. This reflects the commercial norm. New players can join the company and purchase shares in the usual way, subject to the agreement of the SCHEMA Steering Group.

The licence provided on the open market by the SCHEMA Company will be essentially those provided at present by the SCHEMA project.

The revenue from the use of and sale of SCHEMA Reference System will accrue to the SCHEMA Company. The amounts of such revenues will of course be influenced by agreements with third party (who).

Exploitation Stages
This MoU governs the exploitation phase of the SCHEMA Reference System that phase where the partners roll out a commercial licence to the market. The exploitation phase may be divided into two stages - the Initial Exploitation stage and the Commercial stage. At the end of the Initial exploitation, rollout will be complete and the legal procedures for the SCHEMA Company will be completed. It is anticipated that this Initial Exploitation phase will have a duration of *(put the number)* years.

The objective of the exploitation phase is to make all the necessary investments and to implement all the technical and organizational steps, in order to roll out the licence through the targeted European countries. This phase requires financial commitment on the part of the partners. In addition to the signatories of the present MoU, the actual exploitation will also benefit from the possible participation of external corporations (such as *put the list*). The finalization of the agreements with the organizations that have expressed their interest for a possible investment into the SCHEMA Company will be part of the work of the exploitation phase.

Following the Initial Exploitation, the MoU shall continue to govern the partners, unless and until replaced by an Exploitation Contract. In the event that such a contract is adopted, it can be expected to be similar to this MoU, but with a greater emphasis on expansion, reseller management and third party content provision.

The remainder of this document presents the MoU in legal terms.

MEMORANDUM OF UNDERSTANDING

§ 1 - Partners

This Memorandum of Understanding (hereinafter referred asMoU) is entered among the participants to the current Reference System of the project SCHEMA, supported by the European Commission in the frame of the IST programme (contract number IST-2001-32795).

The undersigned companies/organisations (hereinafter referred to as Parties):

Participant name - Full Members- Companies	**Address**
Company 1	
Company 2	
Company 3	
Company N	

agree to the terms of this MoU with respect to a possible market deployment process of the SCHEMA services and the creation of and SCHEMA Limited Company (hereinafter referred to as SCHEMA Company) to run the commercial operations rolled out by the exploitation.

The other partners:

Participant name - Full Members- Universities and Institutions	Address
University 1	
University 2	
University N	
Institution 1	
Institution 2	
Institution M	

Endorse this MoU in the role of ……..

§ 2 - SCHEMA Company

The Parties hereby agree that in case of a successful exploitation a jointly-owned limited company, namely the SCHEMA Company, will be established. Shares in the company will be allocated according to level of investment of each participating Party.

All rights to any products or parts of product developed by the company shareholders during the Exploitation Phase of the SCHEMA project shall be assigned to the SCHEMA Company.

The business model proposed by the SCHEMA Business Plan (*put the reference to the BP)* at the end of the Reference System phase and further upgraded along the initial exploitation phase will be the basis for the operations of the SCHEMA Company. This business model and the related prices and fees may evolve in response to market changes in order to maximise the sustainability and profitability of the SCHEMA Company.

§ 3 - Management of the Exploitation Phase

A Steering Committee (SC) will be created at the beginning of the exploitation phase and it shall be in charge of the overall co-ordination and management until the actual commercial operations start.

Each Party shall appoint a member of the SC.

The SC will aim to reach its decisions using consensus. If the SC fails to agree on issues, such issues shall be submitted to the Parties for a final decision. However, the SC can decide by absolute majority that issues can be of such an urgent nature that decisions have to be made immediately. Decisions related to issues of an urgent nature shall be decided by the SC by absolute majority. In the case of parity of votes - in both cases mentioned above - the vote of the Chairman of the SC counts as two (2) votes. In all cases mentioned above, the decision shall immediately be presented to all Parties.

The Chairman of the SC shall be appointed for a period of one year, by the majority of the SC members.

In order to guarantee the necessary continuity between the Reference System and the successive exploitation phase, the first Chairman of the SC, at the beginning of the exploitation phase, will be appointed by the Project Leader of the Reference System phase.

The Chairman of the SC shall convene meetings as often as necessary and in any case at least once every six months.

A Management Group (MG) and a Commercial Group (CG) will be created to advise the SC respectively on technical and marketing issues. Each Party shall appoint a member to the MG and one to the CG. Internal regulations of the Groups will be established by the Groups themselves, on the basis of their needs.

§ 4 - Rights, DRMS and IPR

All Parties shall respect any existing patent, other intellectual property rights or information owned by a Party, the use of which is necessary for the operations of the SCHEMA Company.

Any Party will retain sole ownership of information and data developed prior to entering the exploitation of the SCHEMA services ('background material'). Sole ownership of any modifications, which are made to these data outside the operations covered by the SCHEMA exploitation, shall be retained by the individual Party.

The results of work carried out by any individual Party during the exploitation phase ('foreground material'), such as (but not limited to) marketing data, marketing analysis, and university segmentation research, will remain property of the SCHEMA Consortium and later of the SCHEMA Company. This collective ownership shall persist even if the individual Party withdraws from consortium co-operation

Rights and ownership of the SCHEMA web site (*put here the web address of the site*) will be retained by the SCHEMA Consortium for what regards: project layout, graphics, web site navigation and web site domain ('foreground material'), rights and ownership of the content such as text, photographs. In the event that any content is the subject of an existing legal agreement (e.g. a third party licensing agreement), such agreements shall remain in force and shall not be affected in any way by this MoU. .

Any marketing and dissemination content such as radio interview, video marketing clips, statistical information and market segmentation results supplied to the SCHEMA web site ('foreground material') belongs to the SCHEMA Consortium.

Technical Support of IPR, using the SCHEMA Digital Rights Management System, shall persist. At the current stage, because of its experience and know-how, ITI is acting as DRMS manager and licensing coordinator. When the SCHEMA Company has been established, the management of the DRMS and of the licensing will be appointed by the Steering Committee to the candidate who best suits the role.

§ 5 - Utilisation of Results and Revenues

All revenue accruing from the sale of SCHEMA Reference System license shall accrue to the SCHEMA Company. Additional revenues may also accrue from third party sources (e.g. online advertising). The Parties shall receive dividends from the SCHEMA Company in percentage to the amount of their shares.

These revenues may be affected by agreements between the SCHEMA Company and third parties *(put here which one)*. In the event that such a provider is also a shareholder in the SCHEMA company, this shall in no way affect the division of profits based on shareholding.

The revenues may be affected by agreements between the SCHEMA Company and third party distributors. In the event that such a distributor is also a shareholder in the

SCHEMA Company, this shall in no way affect the division of profits based on shareholding

The amount of such revenues may be affected by the terms under which end user organisations acquire the rights to SCHEMA Reference System. In the event that such an end user organisation is also a shareholder in the SCHEMA company, this shall in no way affect the division of profits based on shareholding.

The amount of such revenues may be affected by advertising revenue paid by third party organisations to products and services on the SCHEMA infrastructure. In the event that such an advertiser organisation is also a shareholder in the SCHEMA company, this shall in no way affect the division of profits based on shareholding.

§ 6 - Confidentiality

Each of the Parties shall be under an obligation of secrecy in relation to third parties regarding any matter related to "SCHEMA".

Each of the Parties shall be obliged to keep confidential any information learnt regarding other parties during the course of the SCHEMA Exploitation Phase or the subsequent operation of the SCHEMA Company.

The obligation of secrecy shall apply irrespective of whether or not the knowledge is regarded as being of commercial importance to the other Party.

§ 7 - Breach During the Exploitation Phase

In the event of a Party failing to perform its obligations in accordance with the SCHEMA Exploitation Contract, and if the breach of the Contract results in a documented loss for another Party (with the exception of indirect loss or costs, including damage to property under product liability), the Party committing the breach shall be under an obligation to indemnify such loss. The maximum amount of such indemnity shall be limited to the share of the Contract of the injured party.

Where the breach is material and the Party committing the breach (the 'breaching party')has not ceased being in breach of the contract within 30 days after the Steering Committee has requested such cessation in writing, the breaching Party must withdraw from the Exploitation Contract.

In such case the breaching Party's ownership rights within the SCHEMA Company, including but not restricted to technical material, rights to patents, names, research results, know-how, industrial property rights and the like, shall fall to the SCHEMA Company. The breaching Party in breach shall not be entitled to claim any compensation. In addition, the breaching party shall not be entitled to use for any purposes any results of the Exploitation phase, from such time onwards.

A Party entering into bankruptcy proceedings shall be considered to be in breach of contract, and the Party shall withdraw from the SCHEMA Exploitation Contract with immediate effect. In such cases the Party's rights within the SCHEMA Company shall fall to the Company, without the said Party's bankrupt estate being entitled to claim compensation from the other Parties for this. If a Party enters into bankruptcy proceedings it is the responsibility of the Party in question to report this immediately to the other Parties of the SCHEMA Consortium.

§ 8 -New Participants

If an external organisation is identified as having the potential to add significant value to the SCHEMA Company, the recruitment of this organisation into the SCHEMA Consortium as a full partner shall be allowable. The shares in the SCHEMA company allocated to such an organisation shall reflect its level of investment in the company. However, all such recruitment must first be endorsed by the Steering Group.

In the event of a failure to reach an agreement on the new participant or the conditions for its joining the project, a Steering Group decision may be made by absolute majority. In the case of parity of votes the vote of the Chairman of the Steering Committee counts as two (2) votes.

This MoU may be amended only by a written agreement of the parties.

Execution of a copy of this MoU delivered by facsimile shall be sufficient to bind the parties.

The Parties hereby agree to the above.

Dated ……...

Signatories

With respect to … *(partner)……*, authority to enter into or modify this MoU is held by Mr./Mrs. …*(signatory person)……* and CEO, ……*...(addr)…….. (town)…..*, (country)…….
Notices to…… *(Partner)…..* shall be provided to …*(signatory person)……* at this address.

Signature: _____

(SIGN pages)

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