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Annual Report 2007

MESH is an Integrated Project in the Sixth Framework Programme. Its main objectives are to extract, compare and combine multimedia content from multiple news sources, automatically create advanced personalised multimedia summaries, syndicate summaries and content based on the extracted semantic information, and provide end users with a personalised "multimedia mesh" news navigation system.

During 2007 MESH has successfully developed:

- A first integrated prototype that allows for semantic search and full text search, video transcoding, summarisation, streaming, manual annotation, usage statistics tracking and platform access control.
- A multimodal analysis infrastructure for multimedia content.
- A hybrid reasoning framework that combines reasoners of different types.
- An Information Retrieval module based on ontology-driven semantic analysis of text, audio and image content.
- A personalisation subsystem which tracks and analyzes both long-term interests and instant preferences to filter and recommend the most relevant news content to the user.

From the beginning, MESH has been following a user-centred development approach. The project adopted validated usage scenarios that have directed the development of MESH modules. After the project's second year, a stable version of the MESH platform includes most multimedia analysis modules, while additional features will be added in the third year following the prioritisation decided through the user validation cycles.

MESH first integrated prototype

The development of the first MESH Prototype has focused on the integration of the basic features in order to provide a functional platform to which all modules will be incrementally added. These first features include semantic search and full text search, video transcoding, summarisation, streaming, manual annotation, usage statistics tracking and platform access control.

With this first prototype, users of the first MESH prototype will be able to log securely into their personal area, upload media items, edit their profile, view usage statistics, sell or offer media items and receive personal notifications. Multilingual querying is also possible, both for full text search and concept-based search; although for the latter search mode the first prototype supports only English as a query language, while the results may be in German, Spanish or English. The search mechanism is currently operating based on keywords or semantic concepts, while the results are sorted according to user interests expressed in a (still manually) described profile. Video news items can be transcoded according to four pre-defined profiles, summarised in real time and viewed through real-time streaming. A manual annotation tool for video items has also been released, although it has not yet been connected to the rest of the platform.

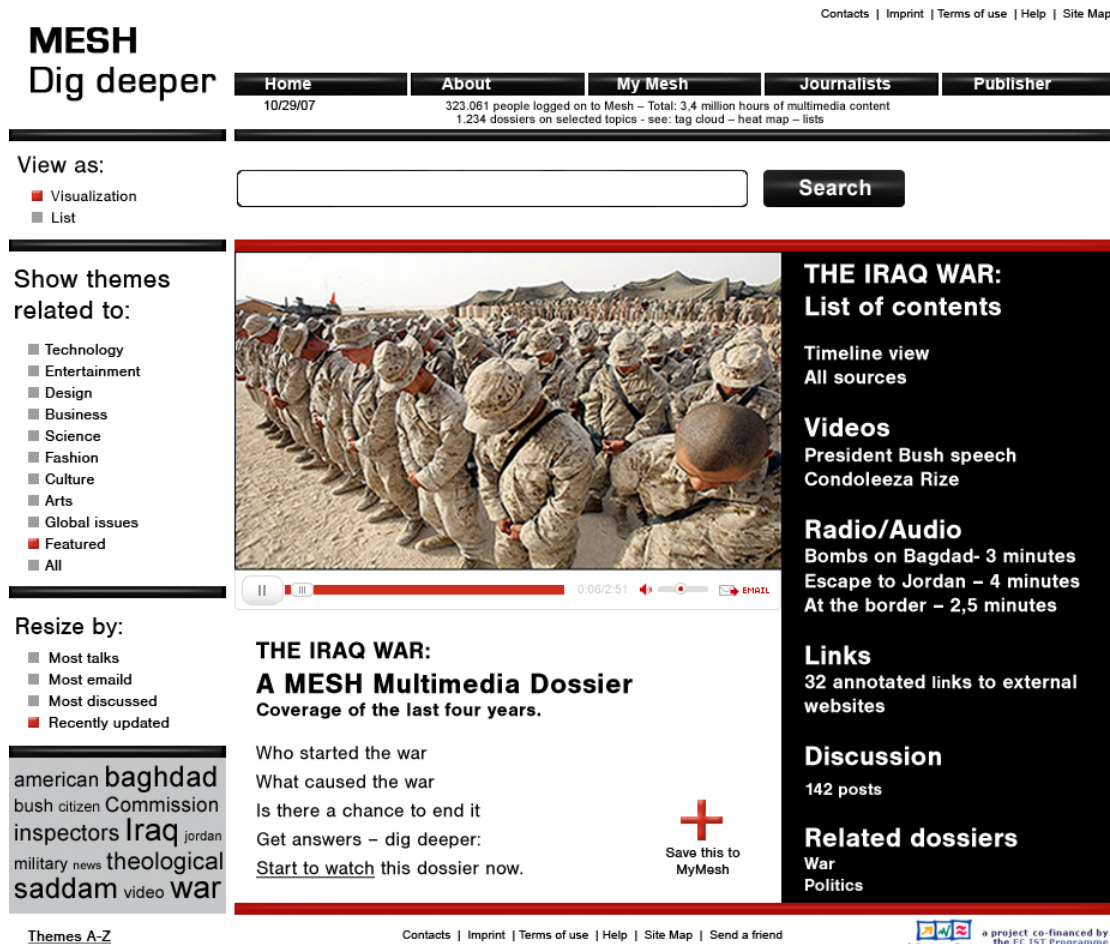


Figure 1 – Example: First draft version of the MESH User Interface

Though not all functionalities are yet in place, a first version of the user interface as it may look in the final MESH system has been designed (shown in figure 1). The final system may not implement all features suggested by the user interface; a prioritisation of the functionalities to deploy will be based on the user validation which is being performed.

The content set that has been made available for the first prototype includes pre-recorded video news broadcast by Deutsche Welle in English, German and Spanish. Although multimedia analysis has not been integrated in the prototype yet, automatic speech recognition has been performed on the content set off-line and the produced speech transcripts have been semantically analysed and indexed according to the MESH ontology.

Multimedia Analysis in MESH

The role of multimedia analysis in MESH is to automatically extract meaningful semantic-level metadata from multimedia content. This represents a key module for achieving the efficient organisation, location, access and presentation of huge and heterogeneous amounts of news multimedia information. To this end, a set of techniques covering the areas of image, video, audio and text analysis has been developed.

Considering image and video analysis, the developed methods treat all parts of the necessary processing chain, starting with temporal and spatial/ spatiotemporal segmentation, continuing with the compact representation of the generated elementary pieces of visual information by means of standardized features, and concluding with their classification to one of the semantic classes of interest that are defined in the MESH Knowledge Structures.

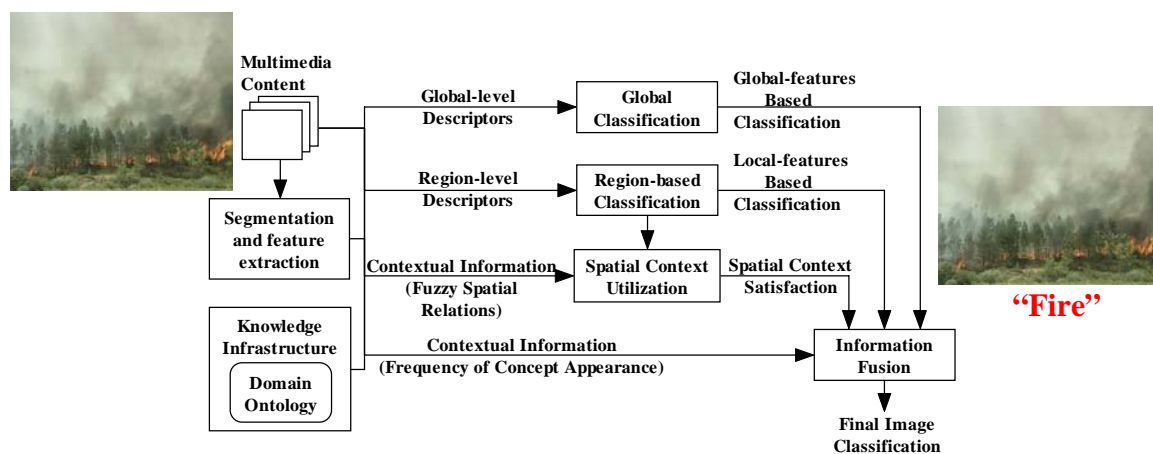


Figure 2 – Visual information analysis in MESH

The developed methods for audio and text analysis support an even richer understanding of the semantics of the multimedia information that extends beyond classification to the capturing of details such as the location of an event and the names of any people involved, to name just a few possibilities. Employed techniques to this end include Automatic Speech Recognition (ASR) from the news soundtrack, which involves a number of processing steps from speech activity detection to speaker adaptation, and specialized linguistic analysis of both the ASR transcripts and any other available textual information.

The above development work on analysis techniques is supported by the MESH Knowledge Structures, which provide the necessary prior knowledge for performing the analysis and represent its results in a structured way, enabling their subsequent combination and further enrichment via reasoning.

Reasoning in the MESH system

In order to make intelligent use of the semantic content acquired through the multimedia analysis of news items, strong reasoning capabilities are required. Reasoning is necessary to detect semantic relationships between related information items, to integrate background knowledge (e.g. which country a location belongs to) and to validate the consistency of the information sets. Reasoning enables the system to bring out information only implicit in the explicitly given information for retrieval and query answering. In the second year of the project's lifetime, a hybrid reasoning framework was developed that allows for combining and integrating reasoners of different types, such as general reasoners based on First-Order Logic or Description Logic with special purpose reasoners that focus on efficient handling of specific types of information. The reasoners all operate on the same OWL knowledge base representing the semantic repository of the MESH system.

The first prototype of the reasoning system combines a general *monotonic rule based reasoner*, a special *identity reasoner* for managing sets of entities referring to the same object and a *temporal reasoner* for managing temporal relationships among the entities, e.g. events. An initial rule set for the application domain was created to derive relationships among news and events from different sources.

Search and ranking of results in MESH

Query processing in MESH features a simple interface, but a complex system processing the query is used to return personalized results. The following diagram shows the subcomponents that process the query and data being transferred between them.

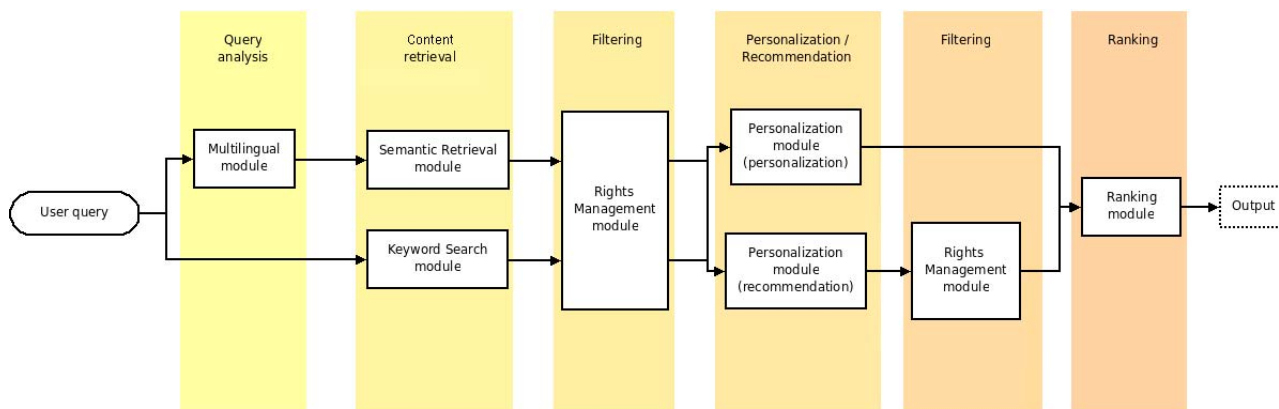


Figure 3: Subcomponents that process a query in MESH

These components are needed to determine which news items or fragments are more important for a specific user in a given situation, and which news should be highlighted or left in the background, depending on the particular context, or which pieces of content best convey a story or meet a specific user request.

A combination of ontology-based search and full text query processing for multiple languages is being developed as novel technology in MESH. A first complete version of the semantic retrieval algorithms has been implemented and delivered as part of the first MESH prototype. Ontology-driven technologies have been introduced in the retrieval model as an enhanced ground for representing and processing the semantics (e.g. the meaning of content, user interests, contextual conditions, etc.) involved in the retrieval process. Ontologies enable finer, very specific search and retrieval tasks in the retrieval system, by supporting the expression of complex semantic queries (e.g. involving conditions between the search terms), finding accurate conceptual answers, and

retrieving the content related to such answers, by exploiting the semantic annotations produced by the corresponding MESH modules.

The integration of multiple criteria for the final ranking of search results (or recommended content) has been also addressed in this period, resulting in the design and implementation of a rank fusion module where advanced dynamic combination strategies are applied, leading to a hybrid retrieval approach. This involves properly balancing several relevance dimensions, based on observable evidence thereof, when automatic choices of content units are to be made by the system. Criteria such as query-based relevance (ontology-based and text-based), user preferences, freshness, popularity, user's situation, and recommendations of other users, are some of the considered criteria in the rank fusion step.

MESH Personalisation architecture

One key aspect of MESH is that news consumers have to be understood (i.e. profiled) so that news items can be matched against the reader's interests and requests.

Thus, a MESH personalisation subsystem has been defined (Figure 4), composed of several major elements, which will track and analyze both long-term interests and instant preferences to filter and recommend the most relevant news content to the user. This architecture drives the technical work on personalisation.

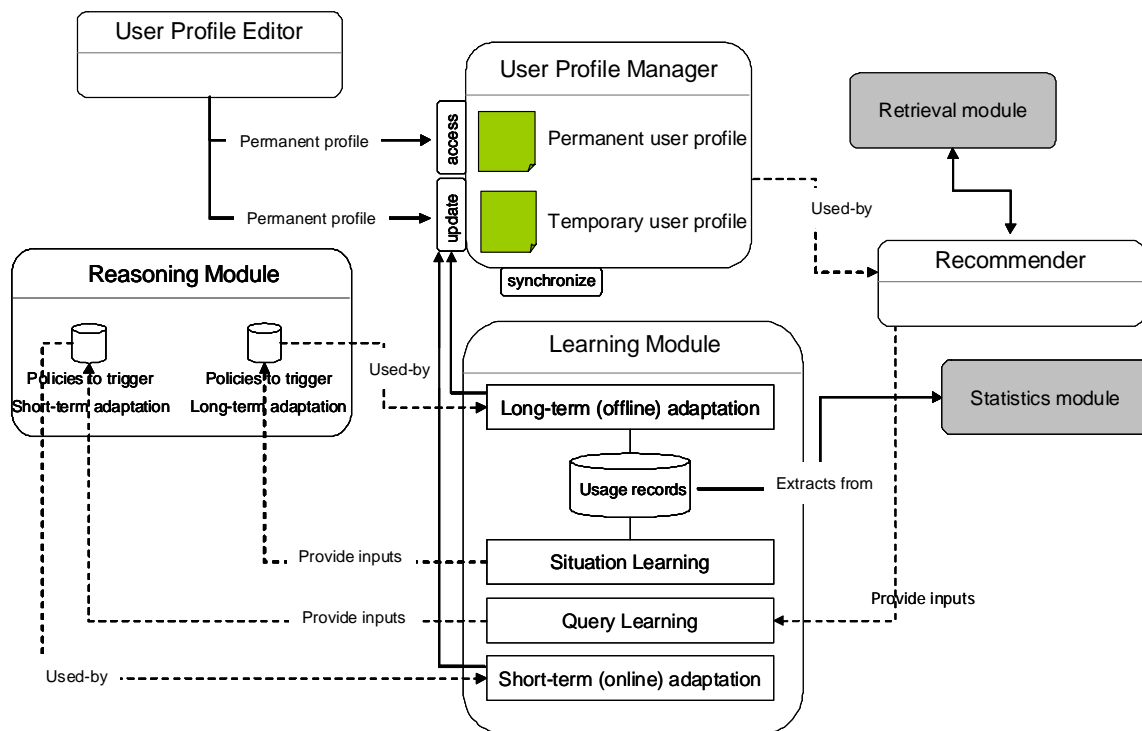


Figure 4 - MESH personalisation architecture

More specifically, the first achievements towards the realization of this architecture include:

- The specification of user preference learning techniques characterised by the analysis of implicit user feedback, and the definition of gradual forgetting functions in tracking user actions. The techniques have been brought to a first implementation and initial experimental work.
- The implementation of a content filtering module, whose main novel aspects are the use of the ontology-based representation of user interests, and a first approach to the contextualisation problem, consisting of a mechanism to filter long-term user preferences according to their semantic relation to the short-term user actions.

- The specification and initial implementation of a collaborative recommender module, based on the detection of implicit communities of interest.
- An analysis of the relevant evaluation methodologies for the ongoing personalisation work in order to support the testing, refinement, and validation of the proposals being developed.

User Involvement, Promotion and Awareness

The MESH consortium continued its efforts to promote the project and its expected results in year 2 by means of a well-established strategy that addresses three target groups:

- General public
- (Media) Industry related
- Academic and EC/Clustering related

Considerable output was generated towards all three main dissemination target groups. Concerning the 'general public' the **MESH** website was regularly fed with project news, updated animated scenarios and short videos introducing the project and its main objectives. In order to raise awareness within a community interested in the latest online search engine developments, Deutsche Welle briefly introduced viral marketing techniques by selecting blogs (e.g. altsearchengines.com, webware.com, techreview.com) relevant to MESH topics and posted the MESH URL in blogs' comments. This constant process also supported the ongoing market survey and analysis of emerging technologies and services.

In terms of dissemination activities aiming at (media) industry related target groups, the full day conference "Wag the long tail", held in Cologne (Germany) on August 17th 2007, was a major event. More than 300 participants gathered under the MESH banner to learn more about how MESH is addressing "the long tail of News" and discuss "tomorrow's multimedia services and tools". The workshop was co-promoted by CHORUS, an IST coordination action on Audiovisual Search, as a result of intensified co-operation with this initiative following the MESH participation in a CHORUS workshop in March and the subsequent joining of CHORUS working groups by MESH partners. In addition to this, MESH was presented at the annual **IFRA Expo 2007** (**IFRA** is the World's leading association for newspaper and media publishing) through the ATC exhibitor space. More dissemination activities and events highlights from MESH year 2 include:

Industry/Media related

- Attendance and distribution of MESH brochures at **CEBIT 2007** in Hanover including project presentation to representatives from IBM.
- Presentation of MESH at the **IFRA Expo 2007**, which took place from 8-11 October 2007 in Vienna, Austria.
- Co-organisation of the **WIAMIS 2007 Industry Session** in Santorini, Greece, in June 2007. Presentation of the MESH project during this session.
- Distribution of brochures and presentation of the MESH project at the Media Forum North-Rhine-Westfalia in closed workshop "Homo digitalis - future media trends" in June 2007.
- Presentation of the MESH project at the Bitkom (German Association for Information Technology, Telecommunications and New Media)-Academy **workshop "Information Overflow - search engines, filters, EPG's"** in August 2007

- Presentation of the MESH project at the Amsterdam-Maastricht Summer University at the [European Journalism Centre in Maastricht during a dedicated session on Innovation Journalism/Innovation Projects](#).
- MESH project presentation at [SAMT2006](#), which took place in Athens and organised a special **media industry day** on 6 December 2006 with wide participation from the news industry.

Academic/Clustering related

- The MESH special session proposal with the title "*Domain-restricted generation of semantic metadata from multimodal sources*" was prepared and submitted to [SAMT 2007](#), together with a number of associated articles. A total of 7 articles coming from MESH partners passed peer review and were part of the special sessions.
- A tutorial on "Annotation for the Semantic Web" was taught at the 4th Annual European Semantic Web Conference 2007 (ESWC 2007) in Innsbruck on 3 June 2007. In the tutorial, MESH was used as an example case.
- MESH was presented in the Practitioner Day of the *ACM International Conference on Image and Video Retrieval* (CIVR 2007), on 11 July 2007.
- A lecture entitled *Human Language Technology for Multimedia Analysis*, including MESH concepts, was given at the Summer School on Multimedia Semantics 2007 15-21 July 2007.

Full and updated list of these activities and papers can be found in a dedicated page in the [MESH website](#), including some material for download.

Future Work

The first MESH functional prototype has been completed in September 2007. This is a stable first version of the MESH platform that includes most multimedia analysis modules. During the third year, additional features will be added following the prioritisation decided through the user validation cycles.

With a considerable number of components in place, MESH can start to measure the performance of the key technologies developed. To this end several suitable test collections have been identified for which various aspects of MESH functionality will be evaluated. These include a MESH specific content set as well as a number of collections that have been developed with international benchmark initiatives.

Work on multimedia analysis will continue with emphasis on the further extension of the MESH knowledge structures and the integration of the individual analysis techniques and related components in a unified framework for multimodal semantic reasoning and cross-media analysis.

Personalisation work will continue by the development of the described personalisation architecture, focusing on: user-friendly methods for user profile acquisition based on an "assisted-browsing" approach, analysis of queries patterns to improve contextual adaptation and social recommendations. A special focus will be done on the validation of these approaches.

Dissemination work will continue with the same vigour as has been done up to date. With the MESH prototype and individual components being refined further, exploitation activities will gain momentum in the period ahead. This includes preparing for the commercialisation of individual products and/or services. Also, the consortium will closely follow market developments that are relevant to the MESH system as a whole and its individual components.

Further Information

The MESH consortium is formed by: **Telefónica I+D, Informatics and Telematics Institute, Athens Technology Center, Motorola, Queen Mary University of London, Institut National de l'Audiovisuel, Noterik, Universiteit Twente, Deutsche Welle, Deutsches Forschungszentrum für Künstliche Intelligenz, Universidad Autónoma de Madrid and DIAS Publishing.**