JUdicial MAnagement by digital libraries Semantics

Annual Report 2010

http://www.jumasproject.eu

JUMAS project, started on February 1st 2008 and ending on January 31st 2011, addresses the need to supply to the users effective tools for managing multimedia libraries, such as criminal trial proceedings. New models and techniques for extracting and representing the embedded semantics derived from multiple data sources will be developed. JUMAS will automate the transcription process and provide effective information retrieval tools on multimedia digital libraries through the collection, enrichment and sharing of multimedia documents annotated with embedded semantics. JUMAS is tailored at managing those situations where courtroom recordings from multiple cameras and audio sources are acquired for then be semantically annotated and consulted by judicial actors. The contribution of the JUMAS project, with respect to the current scenario concerned with the judicial systems, is summarized in Figure 1. The prototype of JUMAS has been validated in 2010 by using Italian and Polish criminal trials.

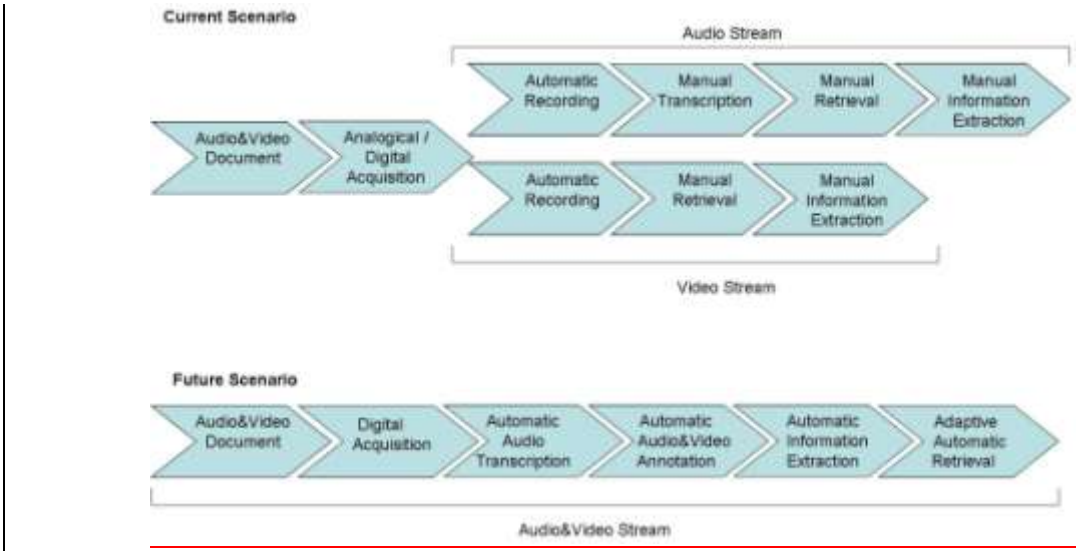

Figure 1:

Summary of Activities

The JUMAS consortium, taking into account the outcomes and the recommendations related the second reporting period, continued its activities upon the results previously achieved.

The main activities in the third project year have been:

1) Acquisition of new multimedia data taking into account the requirements specified for audio and video analysis
2) Refinement of advanced techniques for semantic analysis of multimedia data and semantic information retrieval
3) Integration of the first prototype of the JUMAS system, on the basis of the design developed in WP1 including user requirements and system design
4) Deployment of the second prototype of the JUMAS system, on the basis of first prototype and the user feedback about the first prototype

5) Demonstration of the JUMAS system to several audiences in Italy and Poland
6) Validation of the JUMAS system from a technical point of view, by measuring the research potential of each component
7) Validation of the JUMAS system from an end-user point of view, by measuring the impact of the system on judicial actors both in Italy and in Poland
8) Enhancing of the exploitation strategy by investigating the potential of JUMAS in additional domains.

The main working areas of JUMAS in 2010 have been split as follows:

a) Audio analysis

1. Both language model (LM) and acoustic model (AM) used in the Italian ASR have been improved. Maximum A Posteriori (MAP) adaptation of the LM has been carried out using an approach based on n-gram counts mixing: n-gram counts to combine are derived from a background (out-of-domain) text corpus and an in-domain text corpus formed by proceedings of judicial trials. Similarly, AM adaptation makes use of an in-domain audio corpus formed by audio tracks of judicial trials: the approach used for adaptation is based on the Maximum Likelihood Linear Regression (MLLR) framework. Statistically significant improvements, measured on development and test sets recorded in a courtroom during real judicial trials, have been observed using both LM and AM adaptation.
2. Emotion Recognition. Many different aspects have been faced for providing annotation about emotional states both from a static and dynamic point of view. In particular the previously defined Multi-layer SVMs have been extended in order to include a further discriminative layer of emotions, i.e. between positive and negative affective states

b) **Video analysis**.

1. Video separation into sequences from same viewpoint
   Detection of camera motion is taking place. This is achieved by extracting and evaluating the edge content. When the location of edges changes from frame to frame, it is likely that the camera has moved. Then, the evaluation of the edges leads to determining if camera motion, panning or jumping has occurred. Once camera motion has been detected, the viewpoint is found to form a "comparison feature image".
2. Reflection elimination
   In the case of judicial trials, reflections may appear in courtrooms because of the presence of windows and similar reflective surfaces. The method used is based on the detection of a vanishing point in the video and the extraction of the statistics of the movements of the real moving object and its reflection. This successfully eliminates reflections in various scenarios.
3. Human Behavior Annotation
   Various components of human behavior are captured by the digital video recordings of court trials. In order to analyze this behavior and draw conclusions from it, it is first necessary to extract the human body from the video and then analyze its activity in the scene. The sections that follow describe this process, as well as the data used for it.

c) **Multimedia Information Retrieval**.

1. The information retrieval module has been integrated via JEX into the JUMAS portal. The module indexes video ASR with lattices, portal documents, trial information as well as user generated semantic annotations.

All JEX metadata, primarily coming from Video analysis, is used both for filtering and form ranking. ASR retrieval uses information from speech lattices.

2. Multimedia Summarization and ontological query expansion. The role of domain ontology has been investigated for multimedia summarization purposes. An unsupervised clustering algorithm based on the domain ontology has been studied in order to improve the effectiveness of key-frame based summaries
3. Template Filling for Structured Indexing. Several issues have been addressed for training suitable probabilistic models able to extract structured information from unstructured sources. The main target was to improve the inference potential of Conditional Random Fields by introducing domain constraints both in the training and in the inference phase.
4. Support for Polish and Italian have been added.

d) **System Integration**.
All working areas mentioned above were integrated building up a complex solution to register, maintain and view audio-video and annotations. As a result of work done in year three two main components were developed:

- **Jumas Portal –** which is a web application that allows user to search and browse trials and all related documents. It also enables to watch audio-video content with text annotations related to the recordings. Jumas Portal provides its content as AV stream. Two language version were made - for Polish prototype and for Italian one.
- **Jumas Process Manager (JPM)** – which is a desktop application designed to manage all modules that were subject of integration. With JPM user can upload multimedia to the system and schedule annotation generation with different JUMAS modules.

In 2010 the JUMAS system has be deployed in real environment. The JUMAS portal, joint with the semantic modules, has been validated by the judicial users (Italian and Polish Ministry of Justice)

User Involvement, Promotion and Awareness

The Italian Ministry of Justice and the Circuit Court of Wroclaw (Poland) promoted awareness about JUMAS inside their organisations, with relevant results. Dissemination activities have been performed from a scientific point of view, by presenting the JUMAS system as a novel court management system to knowledge management communities and from a stakeholder prospective, by disseminating the JUMAS experience to national and worldwide law professional. The judicial users expressed a very strong interest in JUMAS activities. An important meeting involving the Italian and Polish Ministry of Justice has been organized in Naples in order to discuss the audio-video acquisition chain and the opportunity to test on field JUMAS potentialities. The project activities and results have been presented on two main events:

- ForumPA – Italy, event for promoting innovative solutions for the public administrator sector
- "Praktyczne problemy transkrypcji e-protokołu" – Poland, conference targeted to Polish law professionals for discussing and evaluating the JUMAS system and novel solutions for the Polish courts.

Exploitation Prospects

The main objective of JUMAS is to support the establishment of processes and procedures that acquire and share the knowledge embedded into a corpus of multimedia documents in order to streamline and enrich the processes of content creation and management. This objective is obtained through innovative techniques both in audio and video processing joined to information retrieval services, improving also the usability, accessibility, scalability and the cost effectiveness.

The JUMAS system will place Europe and European organisations and the FP7 programme in a strong worldwide leadership position greatly contributing to the building of the European Research Area.

The table below tries to summarise approaches and contents of this section of the proposal:

JUMAS Strategic Impact	**Which market is addressed by JUMAS?**	**JUMAS what?**	**JUMAS Who?**
Trans-national judicial process improving	European Judicial Systems	JUMAS collaboration and sharing platform	R&D Actors System Integrators
Content Management	City, Country and National Council European Judicial Systems	JUMAS audio/video/text components	Consultants System Integrator
Workflow Environments	Public Administration	Unified Framework	Consultants System Integrator

The judicial community is one of the largest European information – bound public organization and is experiencing a substantial pressure to improve its information processing activities not only in terms of more secure and performing archiving, retrieval, processing tools but specifically to exploit the semantics hidden in the huge knowledge base of judicial proceedings towards the increasing citizens' expectation of the justice system. JUMAS addresses exactly this need through its technological and organizational objectives and expected results in term of functionalities

Further Information

Project website at www.jumasproject.eu

Contact Information

Project Coordinator: Prof. Hermann Ney ney@cs.rwth-aachen.de

Scientific Director: Prof. Francesco Archetti archetti@milanoricerche.it