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MAGICAL Demonstration: System for Metadata Automated Generation for Instructional Content

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*MAGIC*AL Demonstration: System for Metadata Automated Generation for Instructional Content

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ABSTRACT

The "Tools for Automatic Generation of Learning Object Metadata" project has been underway at IBM Research to address the requirement of developing advanced distributed learning delivery architecture and services for a large US government agency. We have developed a system called MAGIC (*Metadata Automated Generation for Instructional Content*) to assist content authors and course developers in generating metadata for learning objects and information assets to enable wider reuse of these objects across departments and organizations. Using the MAGIC system through a Web-based user interface, content authors review and edit automatically-generated metadata sufficient to register and describe their assets for use and discovery in current and future distributed learning applications complying with the ADL (Advanced Distributed Learning) SCORM (Sharable Content Object Reference Model) standard. Course developers can use the system to assist in the conversion of existing courses to SCORM format or in developing new SCORM courses. The MAGIC system includes software tools to analyze and extract descriptive metadata from instructional videos, training documents, and other information assets. The tools generate some of the most critical SCORM metadata completely automatically. Benefits of MAGIC include easier reuse and repurposing, improved interoperability, and more timely registration of content for use by course developers. In this paper, we describe the system architecture, analysis tools developed, and services supported. A live demonstration of the system illustrating several use cases of the system will be presented at the conference, with a discussion of results from user studies and evaluation of the system.

1. INTRODUCTION

Some of the emerging trends in learning content development are transforming the way distributed learning delivery services are being offered. First, large amounts of changing information are needed to deal with emerging conditions and threats in the world. Second, there is a shift from creating original materials to *rapid transformation and reassembly* from existing materials. Finally, there is a growing need for shared content repositories to enable rapid *discovery and aggregation* of content within and across organizations and for use of *standardized common metadata* (taxonomies, document tagging, video annotation). These trends, for any large organization, translate into a critical need to quickly transform new information into learning content suitable for distributed learning delivery and management. The immediate technical challenge is to quickly adapt information from primary video and document sources to create re-usable learning modules.

The Department of Defense's Advanced Distributed Learning (ADL) initiative defined SCORM (Sharable Content Object Reference Model). SCORM includes a set of data elements called the *learning object metadata* to model and describe the attributes of learning resources. SCORM has since been adopted by various government and industrial organizations. Using SCORM ensures that learning resources can be registered and stored in distributed content repositories and made accessible to a wide range of users, when searched and browsed using a common set of metadata.

We at IBM Research, have developed a system, called MAGIC (*Metadata Automated Generation for Instructional Content*) with funding from a large US government agency, to help the agency's content authors, course developers and contributors with SCORM adoption and to enable more pervasive reuse of high value content contained in multi-agency archives. The project objective was to develop an environment for (semi-)automated generation of standards-based learning objects, in which primary sources such as the Web and file systems can be easily accessed using standard interfaces; rich metadata can be created automatically by identifying segments, generating title, summary, subject category, and keywords as metadata for information assets, and integrating analyses from audiovisual data and text transcript to segment and annotate multimedia resources. We have built a system that addresses all of these goals. A Web-based interface was developed to enable efficient review and correction of generated metadata and content can be published to content repositories by publishing SCORM-compliant metadata and providing Web services.

The live demonstration of our system at the conference will include the following comprehensive use case anticipated in the deployment of MAGIC: A course developer assembling a collection of learning objects on bioterrorism 1) searches for existing learning objects in the MAGIC metadata repository; 2) adds a new document to the repository; 3) reviews and improves the metadata for other course developers; 4) looks for additional multimedia materials related to this topic; and 5) packages this content as a collection for delivery to a SCORM-compliant system. We will also discuss results from user studies conducted with MAGIC and its performance.

MM'06, October 22-28, 2006, California.

2. HIGHLIGHTS OF MAGIC

The MAGIC system (see Figure 1) consists of a Metadata Generation Environment (MGE) and a Metadata Editor (MAGIC Graphical User Interface). A user (an author or course developer) interacts with the system via the Metadata Editor. The user accesses a training document or an instructional video by entering a URL on the Web (WWW), or the name of a local file, or an address in a Content Management System. The Metadata Editor loads the content into the Content Cache where it is optionally annotated by the various analysis and annotation tools. The user can then view the resulting annotated resource in the Metadata Editor to review possible segmentation points. The resource is then processed to create a SCORM metadata record and it is stored in the Metadata DB. The user can view and correct the SCORM record. After generating and correcting metadata for a collection of instructional videos or training documents, the user can request that the Packager create a SCORM-compliant package for export to SCORM-compliant authoring systems, learning management system, or learning content repositories.

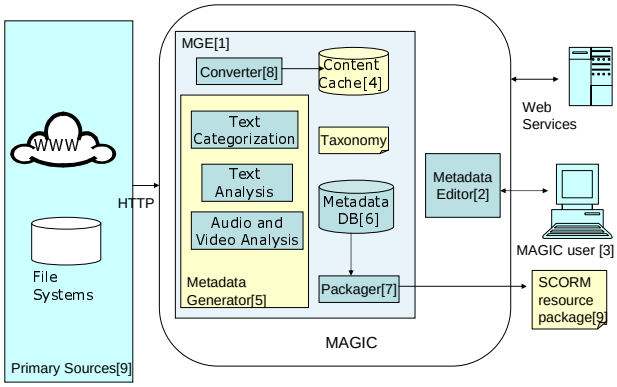

Figure 1. High-level MAGIC system architecture.

The MAGIC Metadata Generation Environment (MGE) consists of a set of text and video processing tools integrated through a common set of application program interfaces. These include the following:

Text Analysis Components for extracting titles and key words including domain-specific technical terms, people names, place names, and organization names, and generating a summary description using shallow natural language processing.

A **Taxonomy and Classification** system, including a high-coverage domain-independent taxonomy (e.g., "Patrol Boats", "Weapons of Mass Destruction") and a text classifier component for automatically and precisely assigning documents to this taxonomy.

Audio and Video Segmentation and Analysis Components for segmenting training videos to recover narrative structure (e.g., instructor speaks, a slide with information is shown, the instructor speaks again) using image and signal processing algorithms [1] and machine learning techniques that operate on visual features extracted from the video track and aural features computed from the audio track. The segments obtained are further annotated with text features extracted from time-stamped closed caption text based on advanced text analysis.

Figure 2 depicts integration of these analysis components as a set of processing modules to generate SCORM attributes. When all the annotations have been computed they are converted to XML for output as SCORM metadata.

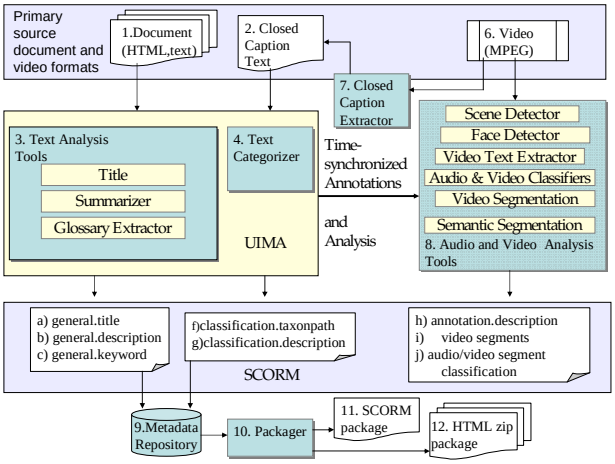

Figure 2. Integration of content analysis tools.

Figure 3 shows a sample video navigation page generated in the MAGIC Metadata Editor, in response to a user search.

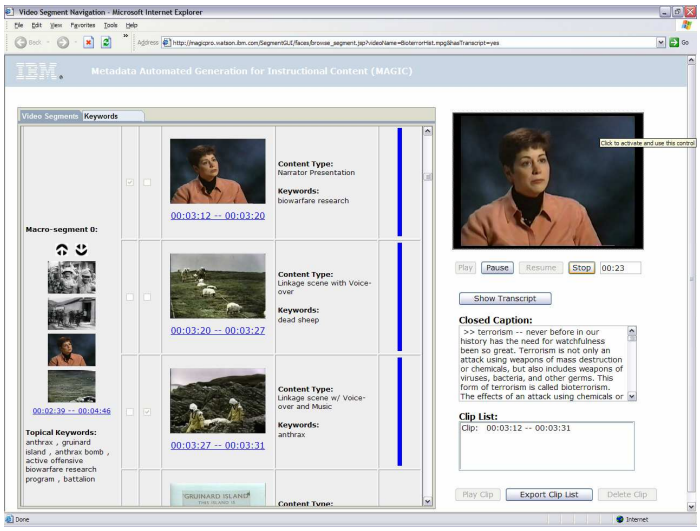

Figure 3. Browsing the results of MAGIC video segmentation.

3. CONCLUSION

The MAGIC demonstration will show how it assists in converting large amounts of existing information content into small self-contained learning objects, by segmenting text and videos into units which are cohesive and topic-specific. By automating content ingestion, analysis, and annotation processes, MAGIC helps achieve substantial time and labor cost savings.

4. REFERENCES

[1] Li, Y., Dorai, C., and Farrell, R. Creating MAGIC: System for Generating Learning Object Metadata, *ACM Multimedia*, November 2005.