

CoCoMA: Content and Context Aware Multimedia Content Retrieval, Delivery and Presentation

Stavros Christodoulakis¹, Chrisa Tsinaraki¹, Christian Breiteneder², Horst Eidenberger², Doris Divotkey², Susanne Boll³, Ansgar Scherp³, Elisa Bertino⁴, Andrea Perego⁴

Keywords: [H.2.4 Systems] Multimedia Databases, [H.5.1 Multimedia Information Systems] Video, [H.3.7 Digital Libraries] User issues, [H.3.3 Information Search and Retrieval] Information Filtering, Relevance Feedback, [H.5.1 Multimedia Information Systems] Video.

Introduction

The increasing availability of high-speed wired and wireless networks as well as the development of a new generation of powerful (mobile) end-user devices like PDAs or cell phones leads to new ways of multimedia resource consumption. At the same time, new standards like MPEG-7/21 have become available, allowing us the enrichment of media content with semantic content annotations, which in turn facilitates new forms of multimedia experience, like search on specific topics or semantic-based content selection, filtering, and retrieval. *CoCoMA (Content and Context Aware Multimedia Content Retrieval, Delivery and Presentation)* focuses on the *integration of content and context-based multimedia retrieval from digital libraries with the personalized delivery and consumption* of the retrieved multimedia data. We aim at providing users of digital library systems with a solution for intelligent personalized retrieval from large media collections where media transport and presentation of the retrieval results are based on adaptation according to the user preferences.

The major objectives of CoCoMA are listed below:

1. *Support for Semantic User Preferences in the MPEG-7 Multimedia Description Scheme.* User preferences can be encapsulated in the MPEG-7 MDS *UserPreferences* descriptor. As the MPEG-7 MDS user preferences, although structured, do not allow taking semantic entities into account, the MPEG-7 MDS user profiles will be enriched, in order to allow for the expression of semantic user preferences.
2. *Personalization of the content (or semantic)-based flow and duration of the presentation, with respect to the interests and skills of the end-users.* Multiple execution flows, with possibly different duration, for the same multimedia presentation will be provided, by specifying (MPEG-7) semantic relationships among multimedia objects and the relevant portions of each object. This information will then be used to dynamically generate a personalized ‘view’ of the multimedia presentation satisfying the end user’s preferences.
3. *Audiovisual content adaptation based on the user’s individual context, specific background, interests, and knowledge, as well as the heterogeneous infrastructure of end-user devices.* The multimedia content will be selected based on the user profile, adapted to the user’s context and assembled into a multimedia composition. Multi-channel multimedia presentation generation will also be provided so that all the different users can get and use the retrieved content in their individual device configuration.
4. *Novel interaction paradigms during retrieval.* Novel interaction paradigms will be introduced that make use of user preference information, employ semantically enriched versions of the low-level MPEG-7 descriptors, and introduce novel distance measures for similarity modeling. Furthermore, we will make use of relevance feedback cycles to improve content adaptation iteratively.

Architecture

The CoCoMA architecture, which has already been agreed among the task members, will utilize and extend the components listed below:

- The MM4U framework [12][4], developed by OFFIS, which is a generic and modular framework that supports multimedia content personalization applications. The framework components are generic and support the steps for composing and delivering semantically rich, personalized multimedia content.
- The VizIR framework for content-based multimedia retrieval [5][6][7][8][9], developed by TUV, allows for content-based metadata extraction and modeling, media annotation (e.g. the entire MPEG-7 MDS), query formulation and refinement, media access and user interface design. In addition, tools for media and media metadata visualization have been developed, which are used in the VizIR user interface framework.
- The KoMMA [18] framework, developed by Klagenfurt University, provides an open, extensible, and intelligent adaptation framework for multimedia data which can be used to build powerful multimedia adaptation servers or proxies. The framework makes use of MPEG-7 and MPEG-21 metadata and features a Prolog unit which is responsible for the adaptation decision taking process.

¹ Laboratory of Distributed Multimedia Information Systems & Applications, Tech. University of Crete (TUC/MUSIC), Chania, Greece, {stavros, chrisa}@ced.tuc.gr.

² Technical University of Vienna (TUV), Vienna, Austria, {breiteneder, eidenberger, doris.divotkey}@ims.tuwien.ac.at.

³ Oldenburg Research and Development Institute for Information Technology Tools and Systems (OFFIS), Germany, {boll, scherp}@offis.de.

⁴ University of Milano (UNIMI), Milan, Italy, {bertino, perego}@dico.unimi.it.

- The multimedia authoring system developed by UNIMI [1][2][3], which supports constraints for personalizing the presentation of multimedia objects according to users' preferences and skill levels. The execution flow is built dynamically on the basis of the semantic correlations existing among multimedia objects. Personalization features are provided concerning, both duration requirements and/or preferences, and the end user's device and network connectivity.
- The DS-MIRF framework developed by TUC/MUSIC [10][11][13][14][15][16][17]. It allows for the interoperability of OWL with the complete MPEG-7 MDS so that domain ontologies described in OWL can be transparently integrated with MPEG-7 metadata. Thus, applications that recognize and use the MPEG-7 MDS constructs to make use of domain ontologies, resulting in more effective user retrieval and interaction with the audiovisual material.

The above components will be integrated in a uniform architecture and extended in order to allow the utilization of semantic metadata from the MPEG-7 MDS user profiles, and the combination of the filtering and search preferences of the end-users with their summary preferences, in order to support the dynamic generation and delivery of personalized summaries. In addition, relevance feedback cycles will be used to improve content adaptation iteratively and multiple execution flows, with possibly different duration, for the same multimedia presentation will be provided. With the architecture we achieve an integrated support for content and context aware from the retrieval in digital libraries to the delivery and consumption of the retrieved multimedia data.

References

- [1] Bertino E., Ferrari E., Perego A., Santi D., "Constraint-based Techniques for Personalized Multimedia Presentation Authoring". In Proc. of the DELOS AVIVDiLib'05 Workshop, Cortona, Italy, May 2005, pp. 91-94, 2005.
- [2] Bertino E., Ferrari E., Stolf M., "MPGS: An interactive tool for the specification and generation of multimedia presentations". In IEEE Trans. on Knowledge and Data Engineering, 12(1):102-125, 2000.
- [3] Bertino E., Ferrari E., Perego A., Santi D., "A Constraint-based Approach for the Authoring of Multi-topic Multimedia Presentations". In Proc. of the IEEE ICME'05, Amsterdam, The Netherlands, July 2005.
- [4] Boll S., "MM4U - A framework for creating personalised multimedia content". In the Proc. of International Conference on Distributed Multimedia Systems (DMS' 2003), Miami, Florida, USA, September 2003.
- [5] Eidenberger H., Breiteneder C., "VizIR – A Framework for Visual Information Retrieval". In Journal of Visual Languages and Computing (2003) 14 443-469.
- [6] Eidenberger H., "Media Handling for Visual Information Retrieval in VizIR". In SPIE volume 5150, 1078-1088 (2003).
- [7] Eidenberger, H., "A Video Browsing Application based on visual MPEG-7 Descriptors and Self-Organising Maps". In International Journal of Fuzzy Systems, vol. 6, no. 3, pp. 124-137, 2004.
- [8] Eidenberger, H., "Statistical analysis of MPEG-7 image descriptions". In ACM Multimedia Systems Journal, Springer, vol. 10, no. 2, 2004.
- [9] Eidenberger, H., Divotkey, R., "A Data Management Layer for Visual Information Retrieval". In Proc. of ACM SIGKDD Multimedia Data Mining Workshop, pp. 48-51, Seattle, USA, 22.8.2004.
- [10] Kazasis, F.G., Moumoutzis, N., Pappas, N., Karanastasi, A., Christodoulakis, S., "Designing Ubiquitous Personalized TV-Anytime Services". In Proc. of UMICS, Velden, Austria, June 2003.
- [11] Pappas N., Kazasis F., Moumoutzis N., Tsinaraki C., Christodoulakis S., "Personalized and Ubiquitous Information Services for TV Programs". In Proc. of the DELOS Workshop on Multimedia Contents in Digital Libraries, Chania, Crete, June 2003.
- [12] Scherp A., Boll S., "MM4U - A framework for creating personalised multimedia content". In: Managing Multimedia Semantics. Surya Nepal, Uma Srinivasan (Hrsg.). Idea Group, Inc., 2005.
- [13] Tsinaraki C., Fatourou E., Christodoulakis S., "An Ontology-Driven Framework for the Management of Semantic Metadata describing Audiovisual Information". In Proc. of CAiSE 2003, Velden, Austria, pp. 340-356, June 2003.
- [14] Tsinaraki C., Papadomanolakis S., Christodoulakis S., "Towards a two - layered Video Metadata Model". In Proc. of the DEXA Workshop - DLib, 2001, Munich, Germany, pp. 937-941
- [15] Tsinaraki C., Polydoros P., Christodoulakis S., "Integration of OWL ontologies in MPEG-7 and TVAnytime compliant Semantic Indexing". In Proc. of CAiSE 2004, Riga, Latvia, pp. 398-413, June 2004.
- [16] Tsinaraki C., Polydoros P., Christodoulakis S., "Interoperability support for Ontology-based Video Retrieval Applications". In Proc. of CIVR 2004, Dublin, Ireland, pp. 582-591, July 2004.
- [17] Tsinaraki C., Polydoros P., Kazasis F., Christodoulakis S., "Ontology-based Semantic Indexing for MPEG-7 and TV-Anytime Audiovisual Content". In Special issue of the Multimedia Tools and Application Journal on Video Segmentation for Semantic Annotation and Transcoding, August 2005 (to appear).
- [18] Leopold K., Jannach D., Hellwagner H., "A Knowledge and Component Based Multimedia Adaptation Framework". In Proc. of the IEEE Sixth International Symposium on Multimedia Software Engineering (MSE), December 2004.