METADATA FOR DIGITAL MEDIA: INTRODUCTION TO THE SPECIAL ISSUE

This special issue on metadata for digital media addresses a problem which is quite crucial for the understanding and the development of systems which have to deal with digital media (such as voice, image, and audio), and multimedia data. Some of the issues that need attention are:

- the management of large amounts of data,
- information resource discovery, and
- sharing and integration of structured, semi-structured and unstructured data.

One of the key problems to be solved to share information is the development of metadata, that is, the data about data. While the issue of metadata has received a fair share of attention in conjunction with structured and text data, most of the current practices in the context of digital media and multimedia data management are ad-hoc.

Metadata assumes more importance when managing digital media and multimedia data, than when managing traditional structured data. Some of the reasons include:

- inability to do exact match in many cases,
- inability to do content based search in some cases with large data sets that are hard to analyze,
- when content based search is possible, they cannot be done very frequently (e.g., for every query) for performance reasons and because of application- and modality-specific search criteria, and
- greater role of derived data, interpreted data, context, and semantics when dealing with audio-visual data

This special issue consists of seven papers contributed by researchers and practitioners who are experts in this field and who are experienced in using one or more types of digital or multimedia data. The contributors present their views on metadata issues by answering the following questions we presented them with:

- What are the characteristics of the data type considered, e.g., text, image, voice, video?
- What are typical examples of metadata, e.g., abstractions from raw video data?
- What is the content, the reference terms, the ontology of the metadata?
- What are the strategies used for manually and/or automatically generating/extracting and maintaining metadata?
- How is metadata structured, what kind of language is used to describe the structure, what is the relationship between data and metadata (e.g., size), how is metadata stored and organized?
- How does metadata facilitate information discovery and retrieval?

The first paper on *Metadata for Multimedia Documents* by Klemens Böhm and Thomas Rakow provides a classification of metadata in the context of multimedia data. The paper focuses the organization of metadata, the role of standards, and the usage of metadata for the processing of multimedia documents. We believe that this classification may be a good start when considering metadata issues for any digital media or a multimedia management system. The discussion of how the nature of multimedia documents leads to new ways of exploiting metadata is also noteworthy.

The paper by Ramesh Jain and Arun Hampapur, *Metadata in Video Databases*, characterizes video metadata and its usage for content based processing. Through an analysis of applications and nature of queries, it leads to a rather comprehensive set of features (metadata items) that are included in their data model for representing video.

Using metadata in order to provide associative search of images for a set of user-given keywords is reported in the paper by Y.Kiyoki, T.Kitagawa, and T.Hayama, entitled *A Meta-database System for Semantic Image Search by a Mathematical Model of Meaning*. The metadata used do not depend on the characteristics of the media, but use keywords that are associated with images based on user's impression. The use of various existing ontologies is interesting.

Jean Anderson and Michael Stonebraker present in their paper *SEQUOIA 2000 Metadata Schema for Satellite Images* a metadata schema developed for the management of satellite images. Noteworthy aspects of this paper include (relatively) detailed discussion of the medium characteristics and typical metadata associated with the images, and the advocacy of the usage of emerging standards for modeling this type of data with an ability to extend them as needed, and a scheme for the storage for the metadata.

Using Metadata for the Intelligent Browsing of Structured Media Objects, by W.Grosky, F.Fotouhi, and I.Sethi discusses a data model for modeling metadata, its indexing, and the definition of higher abstractions. Image and video objects are used as surrogates for real world objects. It's interesting to see how metadata can influence the way of navigating/browsing through data.

An information retrieval system that allows to search for speech documents simultaneously with text documents is presented in the paper *Metadata for Integrating Speech Documents in a Text Retrieval System* by U.Glavitsch, P.Schaeuble and M. Wechsler. It presents arguments for the use of "best-match retrieval" as opposed to "exact-match retrieval" and an approach which is based on the automatic generation of metadata to support such retrieval. It also discusses metadata organization by means of a new controlled indexing vocabulary, and its use that provides about the same retrieval effectiveness as a conventional Boolean retrieval system. A noteworthy result presented in this paper is that the same vocabulary works well for both text and speech retrieval.

The paper by F.Cehn, M.Hearst, J.Kupiec, J.Pedersen, and L.Wilox entitled *Metadata for Mixed-media Access* discusses a new information access paradigm which allows formulating queries in different media types than the media type of the data queried. The media considered in the paper are speech, images of text, and full-length text. It is very interesting to see how the combination of different media types can be used for accessing information and how metadata is automatically generated and used for supporting data access.

Our observation is that much of the work on metadata in the past has been media- and application-specific, and there has been generally a lack of synergy between specialized research. For example, approaches to metadata for managing geospatial images has been quite different than that for managing medical images. Our motivation for organizing this special issue has been to derive a broad overview of current approaches and the progress in developing, managing, and using metadata for different types of digital media data such as image, voice, and video. Our goal is to foster the synergy, and help form a basis for (future) techniques for the integration and the sharing of multimedia digital data.

We believe that the authors, within the strict time and space limitations we imposed on them, have given us excellent material discussing four main questions we had posed to them about a variety of media types: which metadata, why, how is metadata structured/stored, and how is metadata used? One issue that we would like to see addressed in more detail in future is that of semantics. A brief yet interesting introduction to this issue appears in R. Jain's introduction to the second issue of IEEE MultiMedia "Semantics in Multimedia Systems" (1(2), Summer 1994) with the following interesting definition of semantics: "*The process of abstraction from sensory data to alphanumeric, or any other highly symbolic form is the process of systematically introducing semantics.*" A complementary perspective is to view the semantics as representing the meaning and use of data, with emphasis on the issues of contexts, ontologies, and their mappings to more representational issues (features, modalities, etc.). We believe that (both content-based and descriptive) metadata provide the right tool for managing higher complexity as the focus of research in database community moves from structured data to unstructured data associated with digital media.

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