

METIS: a Flexible Database Foundation for Unified Media Management

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ABSTRACT

Current multimedia database systems largely focus on specific media types and/or application domains. This paper gives a sketch of METIS, a database solution for the *unified* management of any kind of digital media, characterized by profound *customizability* for domain or application needs. The system core is based on an expressive data model that can be adapted to any scheme for media management, description, and classification desired, and can accommodate arbitrary query operators, similarity measures, and/or feature extraction algorithms. METIS is based on a persistence abstraction layer allowing the exchange of storage back-ends and includes a customizable web front-end for media management. Thereby, METIS establishes a common database foundation for a wide spectrum of *multimedia* applications.

Categories and Subject Descriptors

H.2.4 [Database Management]: Systems; H.3.7 [Information Storage and Retrieval]: Digital Libraries; H.5.1 [Information Interfaces and Representation]: Multimedia Information Systems

General Terms

Management, Design.

Keywords

Multimedia database systems, unified media management.

1. INTRODUCTION

Multimedia database systems often restrict themselves to the management of media of one particular type, such as images (e.g., [1]), to one particular application domain, such as news (e.g., [3]), or even both (e.g., [1]). Consequently,

these systems establish isolated silos of multimedia content [2]; truly *multimedia* database systems that support a wide range of media types and applications are still rare [4].

This paper gives an overview of METIS, a Java-based multimedia database solution for the management of arbitrary kinds of media – basic as well as composite. METIS is characterized by extensive customizability at all levels of the system: from the storage back-end to the system core to the visualization front-end. In this manner, METIS provides a unified media management foundation that can be flexibly adapted to a broad range of user applications.

2. SYSTEM OVERVIEW

Data Model: As illustrated by Figure 1, all basic media in METIS are uniformly represented as *single media objects*, which are abstract, logical representations of actual media. Concrete media files are attached to a single media object through an arbitrary number of *media instances*. Media instances are in turn connected to the actual media data via so-called *media locators*, allowing the system to uniformly address media in file systems, web servers, and databases.

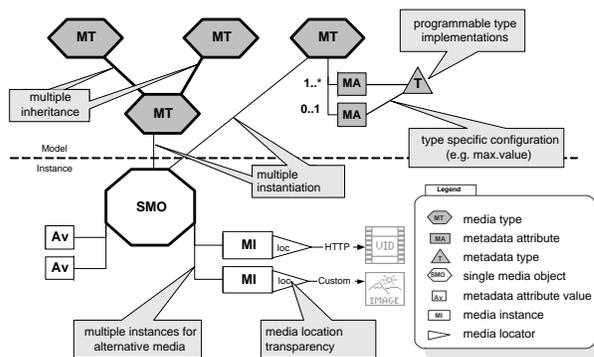


Figure 1: The METIS core data model overview

Media objects may be classified in hierarchical, freely definable categories, known as *media types*. High-level metadata as well as low-level features of media objects can further be described by configurable, typed *metadata attributes*. METIS offers a framework that enables the integration of arbitrary type implementations by means of dynamically loaded Java classes. Finally, media objects can be inter-

related by means of *associations*, arbitrary binary directed relationships between media objects.

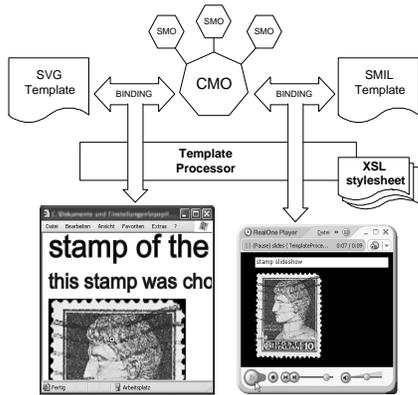


Figure 2: Complex Media Objects and Templates

Multimedia documents in METIS are represented as *complex media objects*, which are containers of single media objects. In order to remain open to as many document format standards as possible (including those yet to be defined), we chose not to develop yet another internal model for the spatial-temporal relationships between the media objects in a document; instead we apply the concept of *templates*.

A template is an XML document in a chosen multimedia document format, enriched by *placeholders* for the media content supplied by the complex media objects employing the template. When a presentation of a complex media object is requested, a format-specific XSLT stylesheet replaces these placeholders at runtime with format-compliant references to the respective media objects bound to them. This process is illustrated in Figure 2.

As a complex media object can be bound to more than one template, it is possible to define the content of a complex media object independent of presentation style and format, and then choose the template best suited to the needs and restrictions of the presentation channel at runtime.

Query Processor: For media retrieval, the METIS core provides a query language supporting the selection of media objects according to their types, metadata attribute values, and participation in associations, as shown in Figure 3.

METIS also provides a framework for the integration of arbitrary plug-in *functions* as dynamically loaded Java classes, usable as comparison operators within queries or for the automatic extraction of metadata attribute values.

Persistence and Visualization: METIS makes use of a *persistence abstraction layer*: all persistent METIS objects extend a common class that demands the implementation of store, update, and delete functions for each of its subclasses. One can easily react to individual storage requirements of an application and integrate a new storage back-end. We have already implemented a simple XML file-based and an SQL92-compliant relational back-end.

METIS includes a web-based media management front-end realized using a *rendering pipeline* based on the Apache Cocoon framework, offering many options for adaptation to application needs. The concepts of eXtensible Server Pages (XSP) and Cocoon sitemaps permit a clean separation of the

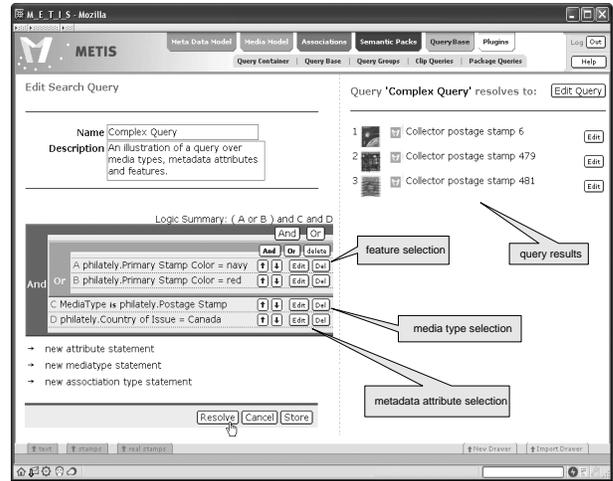


Figure 3: The METIS query processor

front-end’s content, style, and logic, and an easy integration of METIS with legacy web-applications.

Semantic Packs: The generic nature and customizability of METIS introduce a high level of complexity to the administration of the data model. In order to provide premodelled, easily deployable domain-specific customizations, METIS introduces the concept of *semantic packs* – containers of semantically related METIS objects (everything from metadata types to functions to templates). Semantic packs can make use of objects from other semantic packs. Physically, semantic packs are Java archives (JAR), which makes them easy to transport, install, and administrate.

Through this mechanism, third parties can develop semantic packs with METIS customizations for their domain of expertise, as well as for existing metadata standards.

3. CONCLUSION

We are applying METIS in several projects; for example, as a foundation for a news media database, which integrates a commercial audio logger for the automatic classification of news broadcasts, and an MP3 music jukebox, which integrates music processing algorithms for song classification and retrieval. The experience that we have gained so far from these projects indicates that the METIS approach – a customizable multimedia database foundation for a wide variety of media types and applications – is very promising.

4. REFERENCES

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