A Data Model with Multimedia Retrieval

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Abstract. Multi-media data models were developed to facilitate multimedia information retrieval and management in the digital library. Existing multimedia data models fail to meet the need of multimedia digital library. This paper introduces a data model with multimedia information retrieval, and discusses the design goals and methods of the data model by classified and granularity decomposition thinking of multi-modal data. Then describe the modeling methods with multimedia information retrieval.

Keywords: Data model; Digital Library; Multimedia; Retrieval

1 Introduction

Digital libraries, evolved from traditional libraries during the information age, have become important platforms for information retrieval [1]. However, due to the rapid expansion of multimedia data in the collection of digital libraries, such as text documents, images, audio and video data, traditional information retrieval approaches became inadequate to the management of large unstructured data. Firstly, support of interaction with multimedia data is insufficient. Users are usually passive roles only provided with one-way access to multimedia data. Even though multimedia data carry a rich amount of information, difficulty has been acknowledged in systematic management of such unstructured data. Secondly, there are models that associate multimedia data with the keywords for information management and retrieval, where multimedia data are often stored as object attributes with low granularity, which is prone to cause data redundancy and can hardly support content-level information retrieval. Thirdly, distributed structure, considered as one of the optimal solutions for developing search engines [2][3], with advantages in information retrieval from massive data, is also facing a big challenge in the efficient organization and management of multimedia data.

For digital libraries, an effective way of managing multimedia data has to be able to automatically handle the embedded information in its content. In traditional libraries, users can find desired objects from the multimedia archives by using indexing tools like cards. By analogy with that, a structured index can also be established for the content of multimedia data in digital libraries, so that the embedded information can be exposed for retrieval, and unordered multimedia data
can be translated into index-based data which is more suitable for storage and access control with fine granularity [4][5].

Therefore, proper data models are needed for organizing and managing massive multimedia data, which should be able to provide multimedia information retrieval service for digital libraries by means of multi-level semantic data mining. In response to such need, this paper proposes an efficient data model for multimedia content retrieval. Section 2 presents the detail of our data model.

2 Proposed data model

2.1 The goal of the model

The objective of our proposed data model is to allow reasonable abstraction and classification of multimedia data by decomposing each multimedia file into multiple semantic layers with well preserved content information at different levels of granularity. By using our data model, a multimedia information retrieval system can categorize data objects into different granular sets, so as to ensure that each semantic level (including hypermedia links) within the content of multimedia data is accessible to the information retrieval system. Moreover, in order to improve the accuracy and flexibility of information retrieval, our data model offers an interface for manual editing of properties for each data object.

2.2 Data abstraction method

The proposed data model is supposed to be used for multimedia information retrieval services and the modeling target is multimedia data. By using data abstraction in object-oriented methods, different multimedia forms can be modeled by different kinds of basic classes. Each data file is related to a source object and each source object is an instance of a basic class. For a complex multimedia file, the source object can be decomposed into several atomic objects with low granularity. Each atomic object contains partial properties of the source object, and corresponds to a certain part of the source object.

2.3 Object structure

A common data structure for a multimedia object is \(<\text{OBJ}:\{\text{ID}, \text{Type}, \text{T}, \text{Attr}, \text{Method}\}\rangle [6]\), where “ID” is the unique identity of the object, “T” represents time attribute, and “Method” includes operations between object properties, and relations between this object and its original data file or other objects. In our data model, an object is described by a node, as showed in Figure 1, whose data structure includes the following fields:

1) Data fields: include its ID, properties and method functions
2) Predecessor pointer: points to its predecessor node
3) Successor pointer: points to its successor node
4) Branch pointer: points to the list of its atomic objects
5) Media pointer: points to the list of hypermedia in its original data file

![Object node diagram](image1)

Fig. 1. Object node diagram

In the data model, all data classes are nodes of a doubly linked list, as shown in Figure 2. Each node points to a header which points to another doubly linked list formed by the nodes of the same class.

![Two-way linked list class node diagram](image2)

Fig. 2. Two-way linked list class node diagram

Object nodes should be organized by considering the relationship between object properties. Therefore, different organization methods based on different object properties can be employed according to specific applications [6]. In practice, many data objects in a digital library can be connected by timestamp, and the same media data usually have different versions from different time. Based on such observation, the linked list of the object nodes in our data model is organized by time attribute. Thereby achieving efficient management and enabling time-based indexing.

A hierarchical node-object model [7] is eventually created. The top level is a doubly linked list of class nodes; each class node has a pointer pointing to a doubly linked list of its source objects; each source object has a pointer pointing to a doubly linked list of its atomic objects. Based on such data model, hypermedia semantics can be well preserved by using pointers instead of hypermedia links.
3 The Data Model Construction

The data using object-oriented modeling, requires to find the suitable object, and determine the object particle size [8], in the multi-media information retrieval system, one reasonable method for object classification is referred to the media type. Hence, all multi-media data are divided on video, audio, images, text and web pages. Wherein web and video contain plentiful content, and also include various media forms itself. Therefore, web class objects can be re-subdivided particle size into video, audio, images, text; video class objects subdivide particle size into audio, video and subtitles.

4 Conclusion

Multimedia data organization methods and storage structure are the key technology affecting the development of the digital library. This designs a novel data model, and efficiently realizing the organization of multi-media data. The innovation point expresses as:

1) It provides different fine granularity control on the media content, and sharply reduces the information redundancy within the media and among the medias, meanwhile better support the content-based retrieval.

2) It enhances the ability of abstraction and generalization of the model, which can support a variety of media objects, studio, or the performance of the query.

References

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