Chapter 10
Towards a Dynamic Semantic and Complex Relationship Modeling of Multimedia Data

Dawen Jia
Carleton University, Canada

Mengchi Liu
Carleton University, Canada

ABSTRACT

Multimedia data is a challenge for data management. The semantics of traditional alphanumeric data are mostly explicit, unique, and self-contained, but the semantics of multimedia data are usually dynamic, diversiform, and varying from one user's perspective to another's. When dealing with different applications in which multimedia data is involved, great challenges arise. We first introduce a novel data model called Information Networking Model (INM), which can represent the dynamic and complex semantic relationships of the real world. In this chapter, we show how to use INM to capture dynamic and complex semantics relationship of multimedia data. Using INM, we present a multimedia modeling mechanism. The general idea of this novel mechanism is to place the multimedia data in a complex semantic environment based on the real world or application requirements, and then users can make use of both contextual semantics and multimedia metadata to retrieve the precise results they expect.

INTRODUCTION

Multimedia data has become more and more ubiquitous. The application potential of multimedia information retrieval is extensive, particularly in fields as *Art and Culture*, *Medical*, *Personal* and the *Web*. Compared with traditional pure alphanumeric data, multimedia data is inherently different. First, as the name implies, multimedia data refers to media data in a variety of types, such as image, video, audio, text etc. Different types of media have different characteristics. Secondly, the semantics of traditional pure alphanumeric data are usually explicit, unique and self-contained

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but the semantics of media data such as images, videos etc. can vary from one user's perspective to another's. Dealing with alternate applications in which multimedia data is involved presents great challenges.

In past decades, content-based multimedia retrieval is one of the most challenging areas in the multimedia data management field (Datta, Li & Wang, 2005; Petkovic & Jonker, 2003; Sebe, Lew, Zhou, Huang & Bakker, 2003; Yoshitaka, 1999). People focus on key problem called semantic gap (Smeulder, Worring, Santini, Gupta & Jain, 2000). Content-based multimedia retrieval relies on technologies, such as image processing, automatic feature extraction, object recognition and speech recognition, to extract semantic contents of single type of media data automatically. Research of content-based multimedia retrieval focuses on extracting internal structures and semantics of single medium data. (Datta, Joshi, Li & Wang, 2008; Petkovic & Jonker, 2003; Sebe, Lew, Zhou, Huang & Bakker, 2003).

In the database community, researchers have been devoted to presenting, indexing and querying multimedia data. They also improve existing data models, such as the relational model and object-oriented models, to represent temporal and spatial features of multimedia data. Until now, the most popular approaches to modeling multimedia data include: (1) extending the object-oriented data model (e.g. Djeraba, Hadouda & Briand, 1997; Henrich & Robbert,2001 ;Li, Ozsu &Szafron, 1997), (2) extending the object-relational model (Melton & Eisenberg, 2001), (3) MPEG-7 standard for multimedia metadata management (e.g. Doller,Renner &Kosch,2007; Manjunath, Salembier &Sikora, 2002).

The research mentioned above mainly focuses on extracting or modeling semantics and structures in single medium; relatively little progress has been made in modeling the semantic relationships between different types of media and enhancing the data models to manage multimedia data application management.

In this chapter, we first introduce Information Networking Model and discuss how the dynamic features of multimedia data can be modeled with INM. Then we present a novel multimedia data modeling mechanism. The general idea of this mechanism is to place the multimedia data in a complex semantic environment based on the real world or application requirements, and then we can make use of both contextual semantics relationships and multimedia metadata to retrieval the precise results we expect. Our approach has the following features and benefits:

1. It is easy to model the dynamic semantic nature of multimedia data, that is, the same media data in different contextual environment or from different points of view may have totally different explanations. With INM, multiple classifications of multimedia data are naturally supported.
2. It can simplify the design of multimedia application systems since the characteristics of objects, and complex relationships between objects, can be modeled in a simple and intuitive way.
3. A powerful query language has been designed for our model so that we can make use of both contextual semantics and multimedia metadata to form rich semantic query expressions to find the precise results we expect, and a user-friendly navigation can be easily implemented.
4. Compared with the content-based retrieval technique, our approach is complementary for multimedia data management and has the potential to deal with many different applications in which multimedia data involved.
5. Multimedia data can be shared easily so long as we place the multimedia data in the different contextual semantic environment.

Our research in this chapter neither deals with single modal content-based multimedia semantic extraction, nor models the temporal and spatial

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