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Contents

List of Figures

List of Tables

Preface

The objective of this book is to provide a survey of different models and to cover state of the art techniques for multimedia presentations, multimedia database searching, and multimedia browsing. Therefore, the readers can have an understanding of the issues and challenges of multimedia information systems. As more information sources become available in multimedia systems, the development of the abstract models for video, audio, text, and image data becomes very important. The pros and cons of the different models for multimedia information designs are discussed in this book. In addition, this book will cover most of the recent works that were published on the prestigious Journals and Conferences such as IEEE Transactions on Knowledge and Data Engineering, ACM Multimedia System Journal, Communications of the ACM, IEEE Computer, IEEE Multimedia, ACM SIGMOD and so on.

This book is aimed at the general readers who are interested in the issues, challenges, and ideas underlying the current practice of multimedia presentation, multimedia database searching, and multimedia browsing in multimedia information systems. It will also be of interest to university researchers, scientists, industry professionals, software engineers, graduate students, and undergraduate students who need to be become acquainted with this new multimedia technology, and to all those who wish to gain a detailed technical understanding of what multimedia information systems involve.

This book is organized in the way that makes the ideas accessible to the readers who are interested in grasping the basics, as well as to those who would like more technical depth.

The first chapter introduces multimedia information applications, the need for the development of the multimedia database management systems (MDBMSs), and the important issues and challenges of multimedia systems. With the increasing complexity of real world multimedia applications, multimedia systems require the management and delivery of extremely large bodies of data at very high rates and may require the delivery with real-time constraints. The applications expected to benefit enormously from multimedia technologies and multimedia information systems include remote collaboration via video teleconferencing, improved simulation methodologies for all disciplines of science and engineering, and better human-computer interfaces.

Also, a multimedia system should be able to accommodate the heterogeneity that may exist among the data. Hence, a new design of an MDBMS is required to handle the temporal and spatial requirements, and the rich semantics of multimedia data such as text, image, audio, and video. The purpose of the design and development of an MDBMS is to efficiently organize, store, manage, and retrieve multimedia information from the underlying multimedia databases. In other words, an MDBMS should have the ability to model the varieties of multimedia data in terms of their structure, behavior and function.

The issues and challenges discussed in this chapter include:

- formal semantic modeling techniques
- indexing and searching methods
- synchronization and integration modeling
- formal query languages
- data placement schemas
- architecture and operating system support
- distributed database management
- multimedia query support, retrieval, and browsing

The second chapter discusses the temporal relations, the spatial relations, the spatio-temporal relations, and several semantic models for multimedia information systems. As more information sources become available in multimedia systems, the development of abstract semantic models for multimedia information becomes very important. An abstract semantic model should be rich enough to provide a friendly

interface of multimedia presentation synchronization schedules to the users and should be a good programming data structure for implementation to control multimedia playback. In other words, the models must be devised able to support the specification of temporal constraints for multimedia data and the satisfaction of these constraints must be at runtime. The use of a model that can represent the temporal constraints on multimedia data makes it easier for the satisfaction of these constraints at presentation time.

The semantic models can be classified into the following categories:

- timeline models
- time-interval based models
- graphic models
- petri-net models
- object-oriented models
- language-based models
- augmented transition network (ATN) models

Several existing models in each category are introduced in this chapter. Some models are primary aimed at synchronization aspects of the multimedia data while others are more concerned with the browsing aspects of the objects. The former models can easily render themselves to an ultimate specification of the database schema. Some models such as based on graphs and Petri-nets have the additional advantage of pictorially illustrating synchronization semantics and are suitable for visual orchestration of multimedia presentations.

The third chapter introduces the issues for multimedia database searching. Multimedia database searching requires semantic modeling and knowledge representation of the multimedia data. Two criteria are considered to classify the existing approaches of modeling multimedia data, especially video data. These two criteria are level of abstraction and granularity of data processing. Based on these two criteria, several classes of approaches employed in modeling video data are compared in this chapter.

Some important issues are discussed here. They include:

- image segmentation and image segmentation techniques

- video segmentation and video parsing
- motion detection and tracking approaches
- iconic-based grouping and browsing approaches
- object recognition approaches
- knowledge-based event modeling approaches
- content-based retrieval

The fourth chapter discusses the issues for multimedia browsing and introduces several existing multimedia browsing systems. Cataloging and indexing of video is a critical step to enable intelligent navigation, search, browsing, and viewing of digital video. While the importance of a seamless integration of querying, searching, browsing, and exploration of data in a digital library collection is recognized, this chapter focuses on the challenges associated with video browsing. An increasing number of digital library systems allow users to access not only textual or pictorial documents, but also video data. Digital library applications based on huge amount of digital video data must be able to satisfy complex semantic information needs and require efficient browsing and searching mechanisms to extract relevant information. In most cases, users have to browse through parts of the video collection to get the information they want, which address the contents and the meaning of the video documents. Hence, a browsing system has to provide the support for this kind of information-intensive work.

The browsing systems introduces in this chapter include:

- a client/server architecture-based browsing system
- the VideoQ browsing system
- the CueVideo browsing system
- the Informedia browsing system
- the augmented transition network (ATN) browsing system

In addition, the importance of key frame selection algorithms is also included, and some of the key frame selection algorithms are discussed in this chapter.

Two case studies are given in the fourth and the fifth chapters. The fourth chapter introduces the augmented transition network (ATN) model

and the fifth chapter introduces the object composition Petri net (OCPN) model. These two models are proposed by the authors of this book. The ATN model has the capabilities to model multimedia presentations, multimedia database searching, and multimedia browsing. Also, the temporal, spatial, or spatio-temporal relations of various media streams and semantic objects can be captured by the proposed ATN model. On the other hand, the OCPN model is based on the logic of temporal intervals and Timed Petri Nets to store, retrieve, and communicate between multimedia objects. These two models are discussed in details in these two chapters.

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