A COMPREHENSIVE REVIEW ON MULTIMEDIA DATABASE AND THEIR APPLICATIONS

Sumangali K, Harsha Kalsi
Department of Information Technology, School of Information Technology and Engineering, VIT University, Vellore – 632 014, Tamilnadu, India.
Email: ksumangali@vit.ac.in

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Abstract

Everyone deals with multimedia at every walk of lives. We work with multimedia and are surrounded by multimedia. Due to the advancement of modern computer and information technology, multimedia systems play more and more impact on our lives. Therefore, it is more challenging fact how to organize and structure these huge multimedia information so that we can get information easily at any point of time. To do so, multimedia database is a tool required to manage and maintain huge multimedia objects. Multimedia objects consist of texts, graphics, animations, video, sounds, music etc. Multimedia applications often address file management interfaces at different levels of abstraction such as hypertext application, audio editor, audio-video distribution service depending on the real strength of multimedia database and its structure. The main objective of this paper is to provide a brief review on multimedia database and their applications.

Keywords: Data retrieval, modeling, multimedia database, query language.

1. Introduction

Multimedia database is a kind of database like any other databases containing multimedia collections. Multimedia is defined as the combination of more than one media, they may be of two types – static and dynamic media. Text, graphics, and images are categorized as static media; on the other hand, objects like animation, music, audio, speech, video are categorized as dynamic media. Graphic images may consist of cliparts, photographs, logos, and custom drawings. Sound consists of voice narration, speech, music etc. Video data encompasses sound as well as photos. To manage these data multimedia database management system is essential. Multimedia database management system can be defined as a software system that manages a collection of multimedia data and provides access to users to query and
retrieve multimedia objects. Generally, multimedia database contains text, image, animation, video, audio, movie sound etc. But, all data are stored in the database in binary form. We organize the paper as follows. In section 2, we provide data types supported for multimedia database, and the types of multimedia database. In section 3, describes the characteristics and prerequisites. Next, in section 4, we present the structure and architecture in a detailed manner, also applications are discussed. Finally, we conclude this article with possible extensions and scope.

2. Data types and Types of Multimedia Database

2.1 Data types

In addition to the standard numeric, date and text data types, there are a number of data types that are regarded as the basic building blocks of MM applications. These data types, which are elements of more complex MM objects, are:

Text - different fonts and to produce special effects such as colour and fill.

Audio - various audio file formats include Microsoft WAV (wave) and MIDI, which is a more compact representation of sound. Still images - pixels can be 0 or 1 ('white' or 'black') or hi-res colour images with 8, 16 or 24 bits per pixel.

Digital video - usually stored as a sequence of frames. For realistic playback, the transmission, compression, and decompression of digitized continuous frames requires transfer rates of 30 frames per second. If audio is required as well, the audio and video must be interleaved so that the sequences can be timed properly. Microsoft's AVI format can synchronize playback of audio and video.

Graphical objects - such as 2- and 3-dimensional images.

2.2 Types of Multimedia Database

There are generally two types of multimedia databases: Linked Multimedia Databases and Embedded Multimedia Databases

A. Linked multimedia databases

Multimedia database can be organized as a database of metadata. This metadata links to the actual data such as graphic, image, animation, audio, sound etc. These data may store on Hard Disc, CD-ROM, DVD or Online. In this database, multimedia elements are organized as image, audio/MP3, video etc. In this multimedia database system, all data may be stored either on off-line i.e. CD-ROM, Hard Disc, DVD etc. or on Online. One great advantage of this type of database is that the size of database will be small due to the reason that multimedia elements are not embedded in the database, but only linked to it.
Figure 1: Architecture of Linked MDBMS.

B. Embedded multimedia database

Embedded Multimedia Database implies that the database itself contains the multimedia objects as in the binary form in the database. The main advantage of such kind of database is that retrieval of data will be faster because of the reduced data access time. However, the size of the database will be very large.

3. Characteristics and Prerequisites of MDBMS

3.1 Characteristics of MDBMS: A MDBMS (Multimedia Database Management System) can be characterized based on its objectives at the time of handling multimedia objects:

- Corresponding storage media
- Comprehensive search methods
- Device and format independent interface
- Simultaneous data access
- Management of large amount of data
- Relational consistency of Data Management
- Long Transaction

The design of a multimedia database management system is unlikely to follow in the footsteps of the design of a traditional database management systems due to the following characteristics of multimedia objects:

Multimedia are complex and therefore less completely captured in a MBDMS; Multimedia objects are audiovisual in nature; Multimedia objects are context dependence; Queries looking for multimedia objects are fuzzy in nature.

3.2 Prerequisites for MDBMS

A. Synchronization

Multimedia data refers to the simultaneous use of data in different media forms, including images audio, texts and numerical data. Many multimedia applications such as recordings and playback of motion video, video conferencing and
slide presentations require continuous presentations of media data streams. Such synchronization requirements are specified by either spatial or temporal relationship among multiple data streams. For example, a motion video and its caption must be synchronized spatially at the appropriate position in a movie, and in a slide presentation, a sequence of images and speech fragmentation must be temporally combined and presented to compose unified and meaningful data streams. Current database systems are not equipped to represent the entire multimedia data-flow. There are generally two main types of synchronization: Intra-synchronization and Inter-synchronization. Intra-synchronization: In order to represent the original data stream to users, synchronization constraints among media objects must be specified and maintained. Such synchronization is called Intra-synchronization. Inter-synchronization: If the data stream is composed of media objects from different media streams, additional complications may arise with the timing relationships. Such media data streams may not be merged prior to storage in a database. Thus, the synchronization of multiple media data streams is known as Inter-synchronization, which becomes an essential prerequisite to any successful multimedia database application. For this reason, synchronization is one the important factors that should be taken into consideration in order to provide multimedia applications. Time dimension: Multimedia data stream consists of a set of data upon which some time constraints are imposed. The time constraints may specify discrete, continuous, step-wise constant time flow relationship among the data. For example, some multimedia streams such as audio and video are continuous in nature, in that they flow across time; other data stream such as slide presentation and animations have discrete or stepwise constraints. Therefore, multimedia streams may not have convenient boundaries for data presentation.

4. Structure and Architecture of multimedia database

Multimedia database structure can best be explained with the following components:

4.1 Data analysis

In data analysis, data can be stored in the database in either unformatted (unstructured) form or formatted (structured) form. Unstructured data are presented in a unit where the content cannot be retrieved by accessing any structured details. Structured data are stored in variables, fields or attributes with corresponding values. Multimedia data can be stored in database as raw, registering and descriptive data types. Raw data are generally represented by the pixels in the form of a bytes and bits. For example, in image can be represented in pixels and to get the image it is essential to know the size of the image.
4.2 Data modelling

Data model deals with the multimedia objects, which has already been explained in the previous section. Data model concentrates on conceptual design of the multimedia database in order to execute certain operations like, media object selection, insertion, querying and retrieval etc. Time-based multimedia like video, audio and animation involve notions of data flow, timing, temporal composition and synchronization. These notions are quite different from conventional data like textual data flow. One of the gravest problems of multimedia database system is the description of the structure of time constraint media for querying, updating, retrieval and presentation.

4.3 Data storage

Multimedia data objects are stored in the database. These are of types- non-continuous media such as static media like text, and images; and continuous media such as dynamic media. Continuous media data has the real time property while non-continuous data has not. Therefore, storage mechanism will be different for these types of data. Most of the continuous media data are stored using separate storage server to meet the real time constraint requirements. Non-continuous data are stored in the database with meta-information about the files. In general, data can be stored either in Hard Disc, CD-ROM, DVD or Online.

A storage server that stores a large number of long multimedia documents must manage huge volume of storage systems that will be constructed in hierarchical fashion using storage device of various types as described earlier.

4.4 Data retrieval

The ultimate objective of any multimedia database is how to access multimedia information effectively. With respect to access, multimedia objects can be classified into two-- active and passive objects. The objects, which participate in the retrieval process, are called active objects. Similarly, the objects, which are not participating in the retrieval process are called passive objects. In a really multimedia database environment all objects should be active objects.

4.5 Query language

In order to retrieve multimedia data from database system, query language is provided to fulfill this purpose. In a DBMS process, user queries are processed by defining a query language as part of DBMS. It is an un-separated part of DBMS. A multimedia query language must have ability to handle complex, spatial, and temporal relationships. A powerful query language should have to deal with keywords, index to keywords and contents of multimedia objects. Traditional DBMS
deals with exact match query. Generally, there are two types of queries used in databases. They are well-defined query and fuzzy query. In a well-defined query, the user must know what they are intended to search. The second one is called fuzzy where the properties of query objects are ambiguous. In such a situation, multimedia data queries can be divided into the sub-groups like keyword querying, semantic querying, and visual querying. Keyword querying is still popular because of its simplicity. Semantic query is the most difficult query method in terms of its indexing and pattern matching. Visual querying is used in QBIC (Query By Image Context) through icon leading to content search in the domain of image.

**Architecture of a MMDB application**

![MMDB application architecture](image)

Since existing relational and OO databases comprise the basic requirements of any database, it is natural that many multimedia and imaging DB applications are constructed within such existing systems. In order to support such applications, many DBMS vendors offer facilities suitable for MM. These include:

- long bit and byte strings
- BLOBs
- paths or references of images where the actual image stored elsewhere, such as on an optical storage subsystem. The reasons for this are that document imaging systems need on-line, near-line and off-line storage of images, including archiving. This may be achieved by the use of optical jukeboxes but most commercial DBMSs do not directly support optical storage subsystems (Informix Online/optical is an exception).
Content retrieval capabilities—Information retrieval and document imaging systems require searching the content of documents. This ability can be generalized to still images, audio and video.

**Examples of MM systems based on Relational DBs**

InterBase: This relational database system has built in support for BLOBs. A Blob is an object that cannot easily be stored in a database as one of the standard datatypes. You can use a Blob to store large amounts of data of various types, including: Bitmapped images, Sounds, Video segments, Text. Rather than storing Blob data directly in the Blob field of a table record, InterBase stores a Blob ID there. A Blob ID is a unique numeric value that references Blob data. The Blob data is stored elsewhere in the database, in a series of Blob segments, units of Blob data read and written in chunks. Blob segments can be of varying length. The length of an individual segment is specified when it is written. Segments are handy when working with data that is too large for one application memory buffer. But it is not necessary to use multiple segments; you can put all your Blob data in a single segment.

When an application creates a Blob, it must write data to it a segment at a time. When an application reads a Blob, it reads a segment at a time.

Sybase SQL server: Sybase SQL server allows users to declare columns as TEXT and IMAGE data types which can be very large (2GB). Sybase has an enhanced version of SQL called Transact SQL which allows some manipulation of the TEXT and IMAGE data types such as finding the first occurrence of a particular "pattern" in the column. The column values of TEXT/IMAGE contain pointers to the first page of the MM column and these pages are stored separately from the tables for the database. The pages on which the object is stored form a linked list.

XDP from Plexus: This is an imaging database engine based on the INFORMIX Turbo relational DBMS. Unlike Sybase, this system does support hierarchical storage subsystems and manages magnetic discs, optical discs, and optical jukeboxes with on-line, near-line and off-line facilities. Records and the images associated with them are stored in different locations but both image/text structures and records can be manipulated and updated consistently in the same transaction.

XDP provides support for BYTES and TEXT data types. A special family can be assigned to each IMAGE and TEXT column in a Table with a different storage extent or family for that table records. Example: CREATE TABLE Pages(Number Integer, PageImage IMAGE IN Image Family)IN Compound Document Family). XDP supports
hierarchical storage system, managing magnet disks, optical disks, optical jukeboxes with online, near-line (stored in the optical jukeboxes but not mounted)

4. Conclusion

In this paper we have presented a brief overview on the fundamentals related to multimedia database to fulfill the thirst of the beginner towards this topic of interest. The basic terms and relevant prerequisites are recalled and provided the examples. Finally we discussed the applications of multimedia database.

References


Corresponding Author:
Sumangali K*,
Email: ksumangali@vit.ac.in