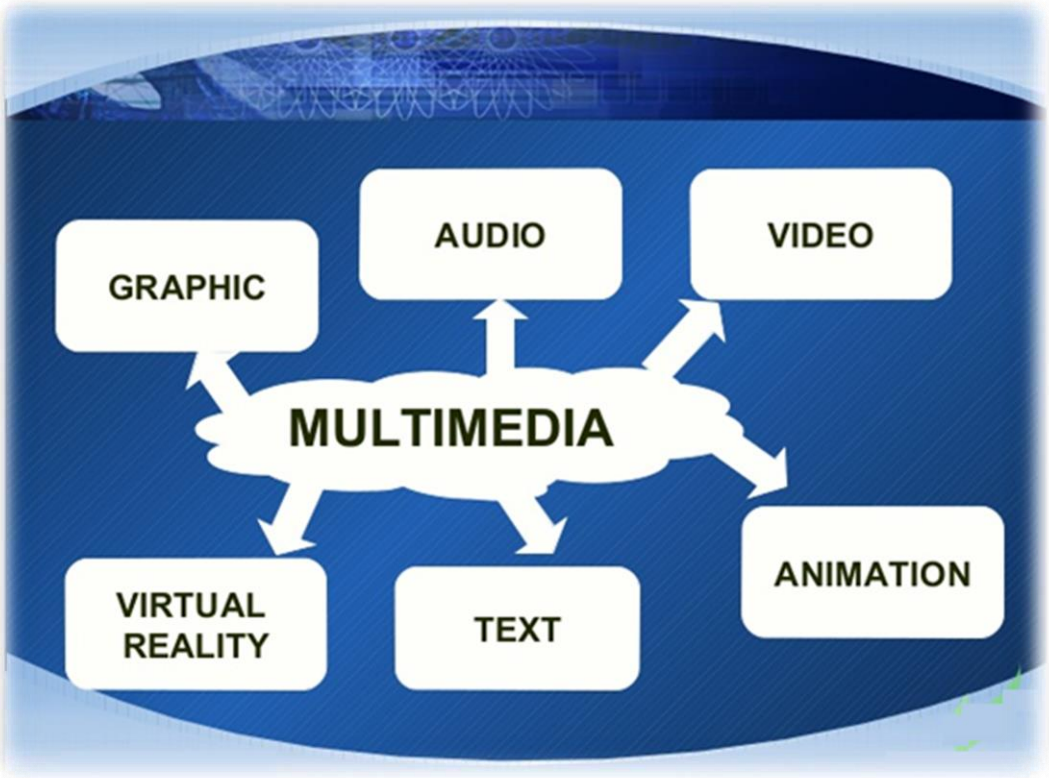

Tikrit University

Computer Science Dept.

Master Degree

Lecture 4

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- **Multimedia database** is the collection of interrelated multimedia data that includes text, graphics (sketches, drawings), images, animations, video, audio etc. and have vast amounts of multisource multimedia data. The framework that manages different types of multimedia data which can be stored, delivered and utilized in different ways is known as multimedia database management system. Multimedia data management involves managing multimedia databases using a multimedia database management system (MDBMS). MDBMS includes features such as data modeling, query language, indexing, and retrieval. One of the advantages of MDBMS is that it enables efficient storage and retrieval of multimedia data. Challenge of MDBMS is that it requires a significant amount of computing resources. There are three classes of the multimedia database which includes static media, dynamic media and dimensional media.

    - **Static media:** This is designed for static media objects. These media objects are not time-dependent and their content doesn't change. For example, an advertisement in a newspaper or magazine is static, because it remains as printed. It will be the same every time we view it. Static media can also refer to those parts of your website that rarely change. It may include landing pages, homepages and white papers.

    - **Dynamic media:** This is used for storing dynamic forms of media content that are time-dependent which is constantly updated and is interactive. It appears on websites, online forums and social media feed. A website is considered dynamic when it is frequently updated or changed. Dynamic media can facilitate interaction between users and a business or product. Social networking websites like Facebook and Twitter all use dynamic media to gain feedback from their users so they can improve their experience and make them spend more time on their applications and websites.

    - **Dimensional media:** These multimedia datasets are primarily used in Computer-Aided Drafting (CAD) programs and operate on 3D multimedia data. They encompass various formats used by image and video editing applications.

- Content of Multimedia Database Management System:

    1. **Media data:** It is the actual data which represents an object.

    2. **Media format data:** The information such as resolution, sampling rate, encoding system, etc.

    3. **Media keyword data:** Media keyword data are the keyword description related to the generation of data. This data is also known as content descriptive data. Examples of content descriptive data are place, time, date of recording.

    4. **Media feature data:** Media feature data contains data which is content dependent such as kind of texture, distribution of, and the different shapes present in the data.

- Types of multimedia applications based on data management characteristic are:

1. **Repository applications:** A Large amount of multimedia data as well as meta-data (Media format date, Media keyword data, Media feature data) that is stored for retrieval purpose, e.g., Repository of satellite images, engineering drawings, radiology scanned pictures.

2. **Presentation applications:** They involve delivery of multimedia data subject to temporal constraint. Optimal viewing or listening requires DBMS to deliver data at certain rate offering the quality of service above a certain threshold. Example: Annotating of video and audio data, real-time editing analysis.

3. **Collaborative work using multimedia information:** It involves executing a complex task by merging drawings, changing notifications. Example: Intelligent healthcare network.

- Challenges in Multimedia Databases, some of which are presented in Figure 1:

1. **Modelling –** Working in this area can improve database versus information retrieval techniques thus, documents constitute a specialized area and deserve special consideration.

2. **Design –** The conceptual, logical and physical design of multimedia databases has not yet been addressed fully as performance and tuning issues at each level are far more complex as they consist of a variety of formats like JPEG, GIF, PNG, MPEG which is not easy to convert from one form to another.

3. **Storage –** Storage of multimedia database on any standard disk presents the problem of representation, compression, mapping to device hierarchies, archiving and buffering during input-output operation. In DBMS, a" BLOB" (Binary Large Object) facility allows untyped bitmaps to be stored and retrieved.

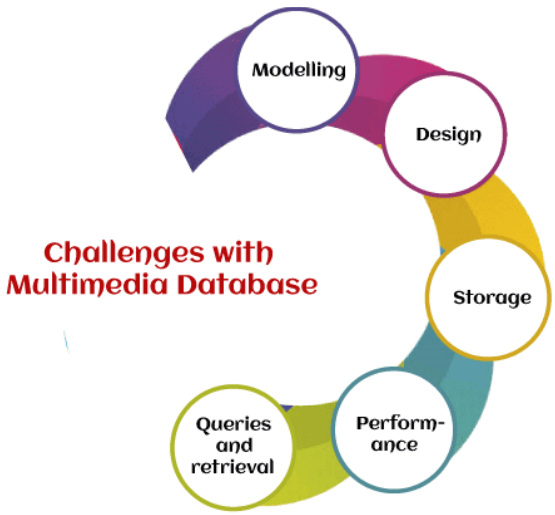

Figure 1: Multimedia Database Problems

4. **Performance** – For an application involving video playback or audio-video synchronization, physical limitations dominate. The use of parallel processing may alleviate some problems but such techniques are not yet fully developed. Apart from this multimedia database consume a lot of processing time as well as bandwidth.

5. **Queries and retrieval** –For multimedia data like images, video, audio accessing data through query opens up many issues like efficient query formulation, query execution and optimization which need to be worked upon.

- Areas where multimedia database is applied are:

    1. **Documents and record management:** Industries and businesses that keep detailed records and variety of documents. Example: Insurance claim record.

    2. **Knowledge dissemination:** Multimedia database is a very effective tool for knowledge dissemination in terms of providing several resources. Example: Electronic books.

    3. **Education and training:** Computer-aided learning materials can be designed using multimedia sources which are nowadays very popular sources of learning. Example: Digital libraries.

    4. **Marketing**: advertising, retailing, entertainment and travel. Example: a virtual tour of cities.

    5. **Real-time control and monitoring:** Coupled with active database technology, multimedia presentation of information can be very effective means for monitoring and controlling complex tasks Example: Manufacturing operation control.

- **Data mining**, which is defined as the process of extracting previously unknown knowledge, and detecting intersecting patterns from a massive set of data, has been very active research.

- **Multimedia mining** is a subfield of data mining that is used to find interesting information of implicit knowledge from multimedia databases. Mining multimedia data requires two or more data types, such as text and video or text video and audio. Multimedia data mining is an interdisciplinary field that integrates image processing and understanding, computer vision, data mining, and pattern recognition. Multimedia data mining discovers interesting patterns from multimedia databases that store and manage large collections of multimedia objects, including image data, video data, audio data, sequence data and hypertext data containing text, text markups, and linkages**. Multimedia data cubes** contain additional dimensions and measures for multimedia information. Multimedia data mining is classified into two broad categories: static and dynamic media. ***Static media*** contains text (digital library, creating SMS and MMS) and images (photos and medical images). ***Dynamic media*** contains Audio (music and MP3 sounds) and Video (movies). **Figure 2** shows the categories of multimedia data mining.

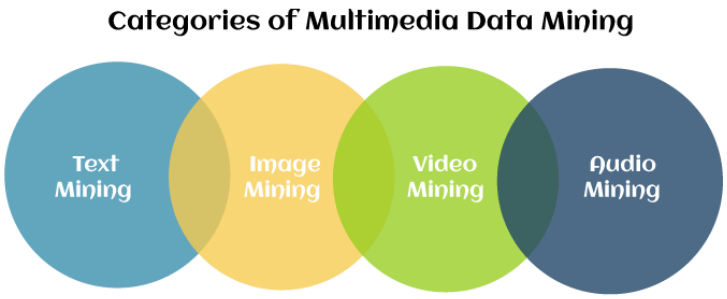

Figure 2 Categories of multimedia Data Mining

1. Text Mining

Text is the foremost general medium for the proper exchange of information. Text Mining evaluates a huge amount of usual language text and detects exact patterns to find useful information. Text Mining also referred to as text data mining, is used to find meaningful information from unstructured texts from various sources.

2. Image Mining

Image mining deals with the extraction of image patterns from a large collection of images. Clearly, image mining is different from low-level computer vision and image processing techniques because the focus of image mining is in extraction of patterns from large collection of images, whereas the focus of computer vision and image processing techniques is in understanding and/or extracting specific features from a single image. While there seems to be some overlaps between image mining and content-based retrieval (both are dealing with large collection of images), image mining goes beyond the problem of retrieving relevant images. In image mining, the goal is the discovery of image patterns that are significant in a given collection of images**.**

3. Video Mining

Video mining is unsubstantiated to find interesting patterns from many video data; multimedia data is video data such as text, image, metadata, visuals and audio. It is commonly used in security and surveillance, entertainment, medicine, sports and education programs.

4. Audio Mining

Audio mining plays an important role in multimedia applications, is a technique by which the content of an audio signal can be automatically searched, analyzed and rotten with wavelet transformation. It is generally used in automatic speech recognition, where the analysis efforts to find any speech within the audio. Band energy, frequency centroid, zero-crossing rate, pitch period and bandwidth are often used for audio processing.

- Applications of Multimedia Data Mining

1. **Digital Library:** The collection of digital data is stored and maintained in a digital library, which is essential to convert different digital data formats into text, images, video, audio, etc.

2. **Traffic Video Sequences:** To determine important but previously unidentified knowledge from the traffic video sequences, detailed analysis and mining are to be performed based on vehicle identification, traffic flow, and queue temporal relations of the vehicle at an intersection. This provides an economic approach for regular traffic monitoring processes.

3. **Medical Analysis:** Multimedia mining is primarily used in the medical field, particularly for analyzing medical images. Various data mining techniques are used for image classification. Examples, Automatic 3D delineation of highly aggressive brain tumors, Automatic localization and identification of vertebrae in 3D CT scans, MRI Scans, ECG and X-Ray.

4. **Customer Perception:** It contains details about customers' opinions, products or services, customers complaints, customers preferences, and the level of customer satisfaction with products or services, which are collected together. The audio data serve as topic detection, resource assignment and evaluation of the quality of services. Many companies have call centers that receive telephone calls from customers.

5. **Media Making and Broadcasting:** Radio stations and TV channels create broadcasting companies, and multimedia mining can be applied to monitor their content to search for more efficient approaches and improve their quality.

6. **Surveillance system:** It consists of collecting, analyzing, summarizing audio, video information about specific areas like government organizations, multi-national companies, shopping malls, banks, forests, agricultural areas and, highways etc. The main use of this technology in the field of security; hence it can be utilized by military, police and private companies since they provide security services.

- **Architecture for Multimedia Data Mining**

Multimedia mining architecture is given in **Figure 3**. The architecture has several components. Important components are Input, Multimedia Content, Spatiotemporal Segmentation, Feature Extraction, Finding similar Patterns, and Evaluation of Results.

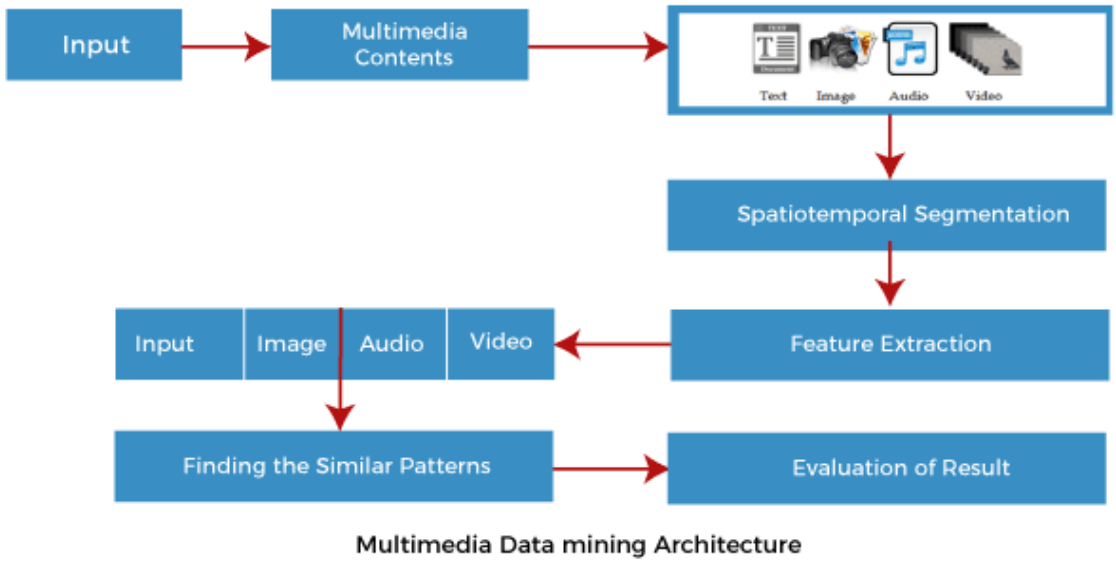

Figure 3: Multimedia Data Mining System Architecture

1. **The input** stage comprises a multimedia database used to find the patterns and perform the data mining.

2. **Multimedia Content** is the data selection stage that requires the user to select the databases, subset of fields, or data for data mining.

3. **Spatio-temporal segmentation** is nothing but moving objects in image sequences in the videos, and it is useful for object segmentation.

4. **Feature extraction** is the preprocessing step that involves integrating data from various sources and making choices regarding characterizing or coding certain data fields to serve when inputs to the pattern-finding stage.

5. **Finding a similar pattern** this stage is the heart of the whole data mining process. The hidden patterns and trends in the data are basically uncovered in this stage. Some approaches to finding similar pattern stages contain association, classification, clustering, regression, time-series analysis and visualization.

6. **Evaluation of Results** is a data mining process used to evaluate the results, and this is important to determine whether the prior stage must be revisited or not. This stage consists of reporting and using the extracted knowledge to produce new actions, products, services, or marketing strategies.

- **Issues in Multimedia Data Mining**

1. Content-based retrieval and Similarity search

Content-based retrieval in multimedia is a stimulating problem since multimedia data is required for detailed analysis from pixel values. Basically, two main families of multimedia retrieval systems considered, i.e. similarity search in multimedia data.

- **Description-based retrieval system** creates indices and object retrieval based on image descriptions, such as keywords, captions, size, and creation time.
- **Content-based retrieval system** supports image content retrieval, for example, color histogram, texture, shape, objects, and wavelet transform.

2. Multidimensional Analysis

To perform multidimensional analysis of large multimedia databases, multimedia data cubes may be designed and constructed similarly to traditional data cubes from relational data. A multimedia data cube has several dimensions. For example, the size of the image or video in bytes; the width and height of the frames, creating two dimensions, the date on which image or video was created or last modified, the format type of the image or video, frame sequence duration in seconds. A multimedia data cube can have additional dimensions and measures for multimedia data, such as color, texture, and shape.

3. Classification and Prediction Analysis

Classification and predictive analysis have been used for mining multimedia data, particularly in scientific analysis like astronomy, seismology, and geoscientific analysis. Decision tree classification is an important method for reported image data mining applications. For example, consider the sky images, which astronomers have carefully classified as the training set. It can create models for recognizing galaxies, stars and further stellar objects based on properties like magnitudes, areas, intensity, image moments and orientation.

4. Mining Associations in Multimedia

Data Association rules involving multimedia objects have been mined in image and video databases. Basically, an image contains multiple objects, each with various features such as color, shape, texture, keyword, and spatial locations, so that many possible associations can be made such as:

- Associations between image content and non-image content features
- Associations among image contents that are not related to spatial relationships
- Associations among image contents related to spatial relationships