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A STUDY ON MULTIMEDIA DATA MINING

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Abstract: Multimedia data mining is the process of identifying interesting patterns from multimedia data like audio, video, image and text which are not accessible by basic queries and associated results. It mines valuable knowledge and high level multimedia information from large database system and it includes pattern discovery, rule extraction and acquiring knowledge from large multimedia database. Multimedia data mining techniques are used to extract knowledge from multimedia database. In this paper, we focuses on various MDM techniques which perform clustering, classification, sequence pattern mining, association rule mining and result visualization. It is a survey paper on the problems and solution of multimedia data mining that involves the basic concepts, various application areas, techniques, and approaches of MDM. By analyzing this large amount of multimedia data to extract useful knowledge is one of the challenges that has opened the opportunity for research in MDM.

Keywords: Multimedia Data Mining, Feature extraction, Knowledge acquisition and visualization.

I.INTRODUCTION

Multimedia data mining is the exploration and analysis of large quantities of data to extract interesting patterns and rules and it is a subfield of data mining which deals with discovered knowledge and relationship among multimedia data or other patterns which are not explicitly stored in multimedia database. The main goals of multimedia data mining are to discover meaningful information from large disordered data and to get knowledge from the information. Multimedia data mining has six basic tasks which includes summarization, association, classification, clustering, trend analysis and deviation analysis. It is a searching process in multimedia data, which performs description based retrieval system that built indices and it performs object retrieval based on image description which includes keywords, caption, size and time of creation and it performs support retrieval based on the image content like color, histogram, texture, shape, object and wavelet transform. MDM performs the following two steps:

- It discovers correct features from multimedia data.
- It selects data mining methods to verify the desired information.

MDM can be easily understood by its purpose and scope. Multimedia data includes image, audio, video, graphical, text, numerical, temporal, relational and categorical data. Audio data comprises of sounds, speech, and music. Video data includes time aligned sequences of images. These data are used to develop a multimedia system. MDM is a number of data sources of different modalities which are processed at the same time. MDM processes the media data alone or it can be combined with other data to identify meaningful patterns for business.Multimedia database is used to retrieve content based image/audio/video and it provides search and effective storage organization. Powerful data mining tools are needed to operate unstructured or semi-structured data and dynamic audio-visual features which are available in multimedia database. To extract multimedia data it needs two or more data types like text and video or text video and audio. MDM reaches great higher complexity from large amount of data like diversity of sensor and time of acquisition. Multimedia data mining is also known as annotation mining.

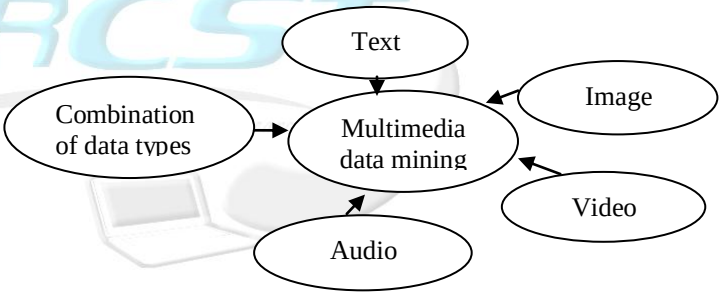

Figure 1: Multimedia data mining

Multimedia and data mining are interdisciplinary and multidisciplinary areas and it has rapid developments in recent years for the applications which make decision because tools are needed to discover hidden information that is embedded within multimedia collections which becomes central point for research.

II.RELATED WORKS

A.BACKGROUND OF MULTIMEDIA DATA MINING

Research in the field of multimedia has been started for integrating various media data into one application where images and text were combined in a document. In the period of research and development process, coordination of audio, video and animation have been done by using a timeline which specify when they must be played. The problems occurred in multimedia data capturing, storing, transmitting and visualizing have been studied where the applications uses the multimedia standards MPEG-4, MPEG-7 and MX have been continued to grow which are adapted and it can transparently handles images, videos, sounds and 3-D objects which are

combined with events, synchronization and scripting languages and it elaborates the content of any multimedia object. Different algorithms are used to distributing multimedia data and database applications. The MDM wraps the following application areas:

- Multimedia data compression and storage
- Delivering media data over networks with good quality of service
- Media data transformation, editing and restoration
- Media data indexing, summarization, search and retrieving multimedia data
- Creates interactive multimedia systems for learning and creative art production
- Creates multimodal user interfaces

B.MULTIMEDIA MINING

1. Processing Text: Unstructured text documents can be depicted as huge feature vectors where each and every feature encodes the presence of a word from the dictionary which is common to all documents. For processing text a naïve Bayesian classifier is used for vectors that are analyzed to categorize documents into:

- By predefined groups
- Type of neural network to group the documents based on its topics
- Trees: structure of documents are stated using HTML tags
- Multi-valued attributes: it is used to filter e-mails.

2. Processing Graphs: in machine learning community processing graphs has become a main role of research. Graph is more communicative than a flat presentation which is the motivation for using graph representation in the area of machine learning. Learning from graph is more powerful than multi-relational learning.

3. Processing Images: a number of approaches are used for feature extraction in pattern recognition. Some of the tasks solved in image processing are texture analysis, line detection, edge detection, segmentation and the region of interest processing. Smoothing, color histograms, contour representations are the tools which are used to solve these tasks. The images are converted into segments which can be represented in relational form.

4. Processing Audio: Audio plays an important role in multimedia applications. Frequently used features of audio processing are band energy, frequency centroid, zero crossing rate, band-width and pitch period. Audio signals are converted into wavelet transformation.

5. Processing Video: automatic segmentation, indexing, content-based retrieval and classification are the basic tasks involved in digital video processing.

Main goals of MDM are dissecting a set of objects, uncovering rules, decision trees, pattern recognition, trend prediction, and dimensionality reduction.

III.DATA MINING VERSUS MULTIMEDIA DATA MINING

Present data mining tools are used to operate on structured data which exists in large relational databases but multimedia databases are having semi-structured data or unstructured data. While comparing data mining with multimedia mining, Multimedia data mining reaches great complexity resulting from:

- Large amount of data
- Heterogeneity of the multimedia data like diversity of sensors, time of acquisition
- Content meaning of multimedia data is subjective

Unstructured data: it is a bit stream. For example, pixel level presentation of images, audio, video and character level presentation for text. To discover semantics from this multimedia data, interpretation is needed. But interpretation of database is difficult for this kind of multimedia data which cannot be broken into smaller logical structures.

IV.ARCHITECTURE OF MULTIMEDIA DATA MINING

MDM architecture includes extracting metadata from unstructured database which is shown in figure 2. The structured database stores the discovered data and it applies data mining tools on the database.

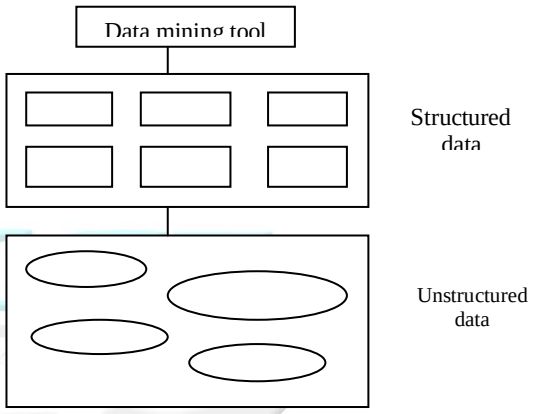

Figure 2: Converting Unstructured data to structured data for Mining

Data collection is a starting point of a learning system and it gives the quality of raw data that determines overall performance. The goal of data pre-processing is to extract main features from raw data and it includes data cleansing, normalization, transformation, feature selection and etc. Detailed procedure depends on problem's domain and the nature of raw data. In some applications, prior knowledge is extremely valuable.

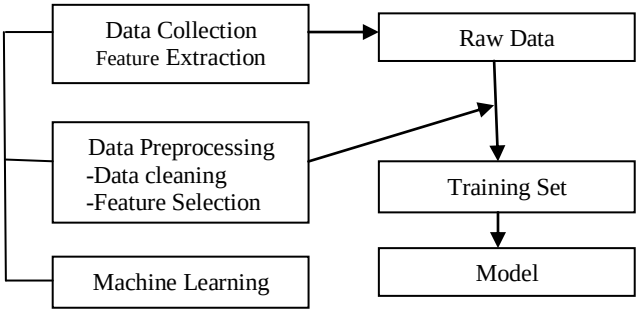

Figure 3: Multimedia Mining process

For every multimedia system, domain experts will conduct these stages. Learning model has to be selected to learn from training dataset. Multimedia processes are iterative. To

improve the results, the analyst has to go back and forth between main tasks. Some of the main tasks in data mining are:

A. Domain Understanding: it needs learning how the results of data mining are used in order to collect all relevant prior knowledge before mining.

B. Data Selection: it requires the user to select a subset of data fields for data mining.

C. Learning and Pre-processing: combining data from various sources and making choices about coding some data fields is the task of this stage. It provides input to the pattern discovery. In MDM preprocessing stage is of significant importance given to the unstructured multimedia data.

D. Discovering Patterns: it is the heart of entire data mining process. The hidden information and trends in the data are uncovered in this stage. A pattern discovery stage includes association, classification, clustering, time series analysis and visualization of data.

E.Interpretations: Main purpose of this stage is to estimate the quality of discovery and its value to decide whether the previous stage must be revisited or not.

F.Reporting and using discovered knowledge: it is final stage of data mining. It is used to generate new actions and services based on the discovered knowledge.

The proposed scheme attains the following goals:

- Discussion about the existing data pre-processing techniques for multimedia data in MDM system.
- It identifies specific problems occurred while multimedia data mining from feature extraction, data transformation, data visualization processes
- Discussion about the current approaches to solve the identified problems and its limitations.
- It identifies open issues in MDM area.

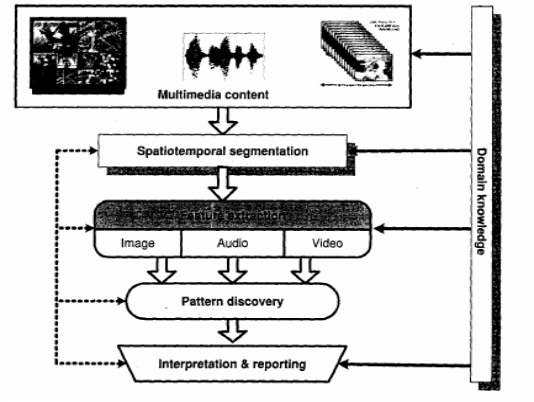

Figure 4: Architecture of Multimedia data mining

V.ISSUES IN MULTIMEDIA DATA MINING

Before developing multimedia data mining into conventional and trusted discipline, many issues have been addressed. Those issues are relevant to the multimedia data mining approaches that are applied. Major issues on MDM include content based retrieval, generalization and multidimensional analysis, prediction analysis and mining associations between multimedia data. MDM requires content based retrieval which is a challenging problem because multimedia data requires detailed interpretation from pixel values. The main objective of multi-dimensional analysis is to get insight into the meaning of databases. This approach makes screening for a particular subset of data and it has an able to define analytical evaluations. Because the multimedia data is physically stored in multi-dimensional way, so the speed of these operations is quicker and consistent than in other database structures. Feature Fusion: the features discovered from multimedia data is an important issue. It focuses on how the features are integrated for mining and other application areas. Multimedia analysis is performed separately and it gets the final decision on input data results that brought together at a later stage. This method is known as decision-level fusion and it is a simple method where we lose valuable knowledge about the multimedia objects that is present in the data.

VI.APPROACHES OF MULTIMEDIA DATA MINING

Combination of storage and searching techniques with standard data mining methods are needed for multimedia database mining. Other approaches include construction of multimedia data cubes, the extraction of several features from multimedia data based on pattern searching.

A. Multimedia data cube: visual content facilitates multiple dimensional analyses of multimedia data. Multimedia miner has been developed that includes the construction of a multimedia data cube and it facilitates multiple dimensional analyses of data. Multimedia data contains summarization, comparison, classification, association and grouping of images and video databases.

B. Feature extraction IT takes the data from multimedia to discover pattern and to derive valuable knowledge from large database which consists images, audio and video.

C. Similarity based pattern searching: similarity search is very difficult task in both multimedia data retrieval and data mining. It will be described as identifying for a group of related objects to a given query object.

D. Database approach: it considers multimedia data as structured. The features are extracted either by manually or by semi-automatically. The attributes on unstructured data, requires a high level of abstraction.

VII.TECHNIQUES OF MULTIMEDIA DATA MINING

A.MDM Process Using Classification Rules

It mainly focuses on extracting the semantic structures. Here, we apply the classification rule techniques to achieve data mining process because it induces entirely accurate rules. Some of the examples are,

- Hidden Markov Model

- Detecting soccer goal shots using decision tree.

B.MDM Process Using Clustering

Categorizing the objects into groups whose members are having the same characteristics in some way is known as Clustering. Clustering is one of the unsupervised learning data mining method. The problem in unsupervised learning is to grouping a huge amount of unlabeled multimedia files into meaningful clusters based on the multimedia content without having apriori knowledge. Examples of this work are,

- Unsupervised neural networks and self-organizing maps
- Incremental clustering at a range of resolutions using Haar Wavelet transforms and K-means as clustering algorithms

C.MDM Process Using Association rules

Association rule learning is a well researched method for extracting relationships among variables in large databases. There are various types of associations are available. Those are association among image content and non image content features. Recent work areas are:

- Image classification technique using multi-level association rules that depends on image objects
- Multiple relational extension to the FP-tree algorithm to achieve association rule mining process effectively

D.MDM through Statistical Modeling

A group of annoted images are used to make a model for joint distribution of probabilities which makes link between features and keywords. Example for this work is

- A simple co-occurrence model to create links between words and partitioned image regions

VIII.FEATURES AND STANDARDS FOR MULTIMEDIA DATA MINING

Color, edges, texture and shape are the image attributes that are used to discover features for various image objects. Feature extraction will be performed based on these attributes at the global or local level. Color histograms are used to characterize the spatial distribution of color in an image. Likewise, the shape of a segmented region can be represented as a feature vector of Fourier descriptors which is used to collect global shape properties of segmented region or it can be represented by using salient segments which is used to provide localized descriptions. Generally, global descriptors are easy to calculate and it is easy to provide a compact representation and it has less prone to segmentation errors. Local descriptors are used to generate more detailed representation and it can yield useful results.

IX.APPLICATIONS OF MUTIMEDIA DATA MINING

A.IN DIGITAL LIBRARIES

Preservation of digital data and retrieval of those data are performed in digital library. But there is a need to change various formats of information like text, audio, video and images to accomplish this purpose. Data mining techniques are popular while converting the multimedia into the libraries data.

B.FOR TRAFFIC VIDEO SEQUENCES

It provides an approach for daily traffic monitoring operations to extract important but without having prior knowledge the analysis and mining of traffic video sequences like vehicle identification, queue temporal relations of vehicle while intersection.

C.FOR AUTOMATED EVENT ANALYSIS OF SUSPICIOUS MOVEMENTS

Surveillance system is used to monitor the actions of employees and visitors. Mostly it has been used in many multi-national companies, government organizations, banks and shopping malls.

D.IN MEDICAL ANALYSIS

Data mining techniques are used to classify the medical images.

E.MEDIA PRODUCTION AND BROADCASTING

Explosion of radio stations and TV channels makes broadcasting companies to search for efficient methods for monitoring their contents.

F.CUSTOMER INSIGHT

This application includes gathering and summarizing of information on customers opinions, services, complaints, preferences and the level of customer satisfaction of products. Nowadays, so many organizations are having call centers or help desks which get telephone calls from the customers. The audio data provides an input for data mining to achieve the following goals:

- Topic detection
- Resource assignment
- Evaluation of quality of services

G.SURVEILLANCE

It consists of gathering, analyzing and summarizing the audio, video about specific area like forests, agricultural areas, buildings, highways, malls, workshops, stores, homes, offices etc and it is associated with security, intelligence and law enforcement. Some of the goals of surveillance are:

- Objector event recognition
- Summarization
- Monitoring

H.INTELLIGENT CONTENT SERVICE

It is a semantically smart content-centric group of software services which improves the association among the information workers and computing systems by using the content and understanding the end users requests for information. MDM techniques are used to achieve the following goals:

- Indexing web media
- Advanced media search
- Progress web-based services

I.KNOWLEDGE MANAGEMENT

Most of the organizations think their files and documents as an important asset. They spend more money to maintain and provide access to their documents to employees. The text files may contain drawing of designs, images, audio, video recording of meetings for training.

XI.CONCLUSION

The key idea behind this paper is to provide review of multimedia data mining that is active and raising area of research. Most of the recent applications are developed on traffic monitoring and video surveillance to increase homeland security. In future, we look forward on MDM applications to grow particularly in areas of medicine and entertainment. Most of the MDM applications use data mining algorithms to change as more and more multimedia data are searched and accessed through peers. Many of the recent MDM applications explore the result of multimedia techniques on multimedia database to discover the multimedia components and it increases the multimedia database platform. MDM techniques are used to improve the indexing and extracting of multimedia information in large databases.

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