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REVIEW ON WEB MULTIMEDIA MINING AND KNOWLEDGE DISCOVERY

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ABSTRACT

Web Multimedia data mining (WMDM) can be defined as the process of finding interesting patterns from media data such as audio, video, image and text that are not ordinarily accessible by basic queries and associated results. MDM is the mining of knowledge and high level multimedia information from large multimedia database system. MDM refers to pattern discovery, rule extraction and knowledge acquisition from multimedia database. To extract knowledge from multimedia database multimedia techniques are used. We compare MDM techniques with the state of the art data mining techniques involving clustering, classification, sequence pattern mining, association rule mining and visualization. This paper is a review on Web multimedia mining (WMM) and Knowledge discovery it elaborates basic concepts, application at various areas, techniques, approaches and other useful areas which need to be work for WMM. Analyzing this huge amount of multimedia data to discover useful knowledge is a challenging problem which has opened the opportunity for research in WMM and knowledge discovery.

KEYWORDS: *Multimedia Mining, Feature Extraction, Knowledge discovery*

I. INTRODUCTION

The recent abundance of digital information available electronically has made the organization of texture information into an important task. Web multimedia content mining is burgeoning new technology for discovering knowledge from web multimedia based on complementary resources.

1.1 Web Multimedia Mining

Knowledge Discovery from Data (KDD) was introduced at the beginning of nineties. Taking into account the polymorphism of multimedia data, multimedia data mining was recently proposed as a new topic of research [1].

The World Wide Web serves as huge, widely distributed global information service centre for news, advertisements, consumer information, financial management, education, government, e-commerce and many other information services. The size of web is in order of hundreds of terabytes and still growing rapidly. The properties of web: the huge, diverse, and dynamic and thus raises the scalability, multimedia data and temporal issues respectively. At the extreme knowledge discovery, i.e., identification of novel information through inference mechanisms consider as web mining [2]. Historically, the conception of discovering useful patterns in data has been given a variety of names like data mining, knowledge extraction, Information discovery, Information harvesting, data archaeology, and data pattern processing.

The Web Mining is about to discovery of knowledge in all its forms, everywhere on the web. It is the process of discovering potentially useful and previously unknown information or knowledge from the web data. Three distinct categories based on [3], are: the application of data mining techniques to extract and prepare knowledge from Web content (include text, image and video), structure (hyperlinks between documents), and usage (logs of web sites). Web content mining describes the discovery of useful information from web contents data/documents. The web content consists of several types of data such as textual, image, audio, metadata and hyper links. The web multimedia contents analysis has been facing lots of research challenges due to the multimedia mining and knowledge discovery deals with non structured information.

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Multimedia mining is more than just an extension of data mining, as it is an interdisciplinary endeavour that draws upon expertise in computer vision, multimedia processing, multimedia retrieval, data mining, machine learning, database and artificial intelligence.

Similar to Etzioni, who first invented the term web mining which is concerned with extracting knowledge from web multimedia data, suggest decomposing web multimedia mining into following subtasks:

1. Resource finding: the task of retrieving intended web multimedia data contents documents/text, images and videos.
2. Information selection and pre-processing: automatically selecting and pre-processing specific information from received Web multimedia.
3. Generalization: automatically discovers general patterns at individual Web video across multiple video.
4. Analysis: validation and/or interpretation of mined pattern with the indexing the video.

Basic approach for WMM is to separate different media channels (Figure 1). The classical knowledge discovery scheme is modified by introducing two additional steps: the extraction of various media (spatial, temporal, audio, text….) at the beginning of the process in order to highlight various streams of data, and eventually the aggregation of specialized knowledge obtained from each stream. Video have many characteristics that can extracted for mining.

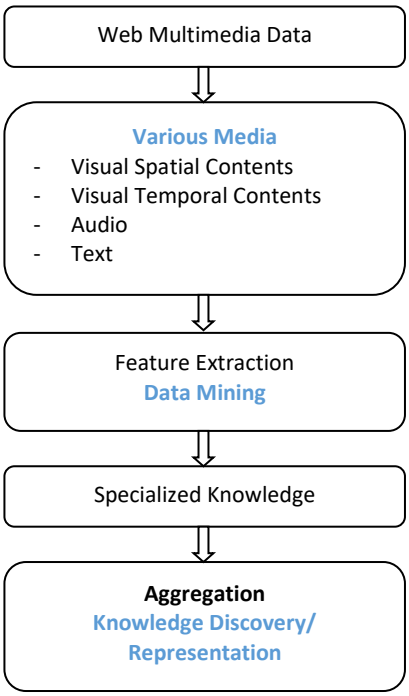

Figure 1: Multimedia Data Mining: An Approach

- **Visual Spatial Content**- A representative image a Key-frame can be easily extracted from video stream. From this image several features can be extracted. The color feature of this image is typically represented by histograms.
- **Visual Temporal Content**- Another characteristic of video is temporal aspects the camera motions
- **Audio Content**- Audio streams are synchronized in video number of basic characteristic can be extracted for video mining based on audio contents.
- **Textual Content**- The text can bring out very useful information.

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II. RELATED WORK

2.1 Multimedia Data mining Architecture

Multimedia Data mining architecture follows the seven steps that are: Domain understanding stage, Data selection, Cleaning and Preprocessing, Pattern-Discovery, Interpretation, Reporting and putting.

2.2 Domain Understanding Stage

Domain understand stage requires learning how the results of data mining will be used so as to gather all relevant prior knowledge often leads to discovery of irrelevant or meaningless patterns .e.g. Cricket, it is very important to have a good knowledge and understanding of the game to detect interesting strokes used by batsman

2.3 Data Selection

The data selection stage requires the user to target a database or select a subset of fields or data records to be used for data mining. The proper domain understanding at this stage helps in the identification of useful data. This is the most time consuming stage of the entire data mining process for business applications. For multimedia data mining this stage is not an issues because data are not in relational form and there are no subsets of fields to choose form.

2.4 Cleaning and Preprocessing

In pre-processing stage involves integrating data from different sources and making choices about representing or coding certain data fields that serve as inputs to the pattern discovery stage.

The preprocessing stage is of considerable importance in multimedia data mining, given the unstructured nature of multimedia data.

2.5 Pattern-Discovery

The pattern discovery stage is the heart of entire data mining process. It is the stage where the hidden patterns and trends in the data are actually uncovered. There are several approaches to the pattern discovery stage these include association, clustering, regression, time series analysis and visualization. Each of these approaches can be implemented through one of several coating methodologies, such as statistical data analysis, machine learning, neural networks and pattern recognition.

2.6 Interpretation

The interpretation stage of the data mining process is used to evaluate the quality of discovery and its value to determine whether previous stage should be revised or not. Proper domain understanding is crucial at this stage to put a value on discovered patterns.

2.7 Reporting and putting

The final stage of the data mining process consists of reporting and putting to use the discovered knowledge to generate new actions or products and services or marketing strategies as the case may be.

Architecture captures all above stages of data mining in the context of multimedia data. Figure shows the whole architecture of multimedia data mining. The broken arrows on the left indicate that the process is iterative. The arrows emanating from the domain knowledge block on the right indicate domain knowledge guides in certain stages of the mining process.

The spatiotempororal segmentation step is necessary because of the unstructured nature of the data. This step breaks multimedia data into parts that can be characterizes in terms of certain attributes or features.

In conjunction with the feature extraction step, this step serves the function similar to that of pre-processing step in typical data mining process. In image data mining the spatiotemporal step simply involves image segmentation. Both region and edge-based image segmentation methods have been used at this stage in different applications [4].

III. UNSTRUCTURED VERSUS STRUCTURED DATA

Various architectures are being examined to design and develop a multimedia data mining system. Data in multimedia databases are semi structured or unstructured. Unstructured data is simply a bit stream. Examples include pixel level representation for images, video, and audio, and character level representation for text. The architecture to convert unstructured data to structured data for mining is illustrated in Fig. 2: Extract data or metadata from the unstructured database. Store the extracted data in a structured database and apply data mining tools on the structured database [5]. A difference between multimedia mining and structured data mining is the sequence or time element.

Multimedia often captures an entity changing over time. Video and audio are clearly ordered, and even text has little meaning without sequence. Time series mining analyses the change to one or more values over time. Multimedia is more complex - as the sequence progresses, the concept being represented may change as well.

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This is obvious with video, where a camera may slate or objects in the scene may move. Understanding and representing changes in the mining process is necessary to mine multimedia data [6].

Multimedia is harder to fit into typical data mining models. Image and video of different entities have some similarity - each represents a view of a building - but without clear structure such as "these are pictures of the front of buildings" it is difficult to relate multimedia mining to traditional data mining. Multimedia generally gives a lot of data on each entity, but not the same data for each entity.

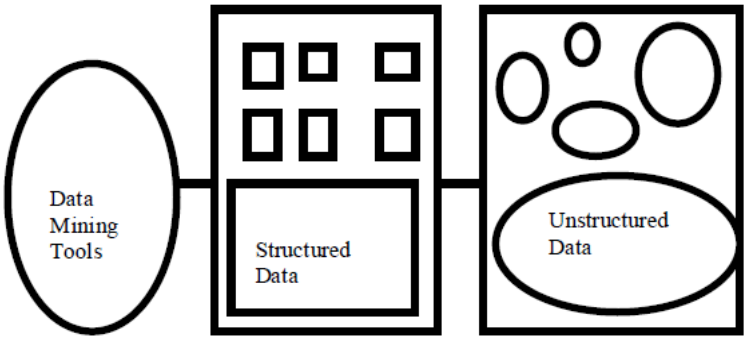

Fig. 2: Converting Unstructured to Structured Data for Mining

IV. MULTIMEDIA DATA MINING

In this section we discuss the issues involved in mining and extracting useful information from multimedia databases.

A. Processing Text:

The Unstructured text documents can be represented as “bag-of-words” such as huge feature vectors, where each feature encodes the presence or absence of a word from the dictionary common to all documents a naive Bayesian classifier is used for such vectors to be analyzed to classify documents into

- Extract data and/or metadata from the unstructured databases possibly by using tagging techniques, store the extracted data in structured databases, and apply data mining tools to the structured databases.
- Integrate data mining techniques with information retrieval tools so that appropriate data mining tools can be developed for unstructured databases.
- Multi-valued attributes, which corresponds to some parts of the document instead of single term for filtering e-mails this approach was used.

B. Processing Images:

Image categorization classifies images into semantic databases that are manually pre-categorized. In the same semantic databases, images may have large variations with dissimilar visual descriptions (e.g. images of persons, images of industries etc.). In addition images from different semantic databases might share a common background (some flowers and sunset have similar colors). Three types of feature vectors for image description: 1) pixel level features, 2) region level features, and 3) tile level features. Pixel level features store spectral and textural information about each pixel of the image [7]. Therefore, one could say that image mining deals with making associations between different images from large image databases. The challenge, then, is to determine what type of mining outcome is most suitable. One can mine for associations between images, cluster images, classify images, as well as detect unusual patterns.

C. Processing Audio:

Audio data play an important role in multimedia applications. Music information has two main branches: symbolic and audio information. Attack, duration, volume, velocity and instrument type of every single note are available information. Therefore, it is possible to easily access statistical measures such as tempo and mean key for each music item. Some of the most frequently used features for audio classification are:

- Total Energy: The temporal energy of an audio frame is defined by the rms of the audio signal magnitude within each frame.

- Zero Crossing Rate (ZCR): ZCR is also a commonly used temporal feature. ZCR counts the number of times that an audio signal crosses its zero axis.
- Frequency Centroid (FC): It indicates the weighted average of all frequency components of a frame.
- Bandwidth (BW): Bandwidth is the weighted average of the squared differences between each frequency component and its frequency centroid.
- Pitch Period: It is a feature that measures the fundamental frequency of an audio signal [8].

D. Processing Video:

In video mining, there are three types of videos: a) the produced (e.g. movies, news videos, and dramas), b) the raw (e.g. traffic videos, surveillance videos etc), and c) the medical video (e.g. ultra sound videos including echocardiogram).

Higher-level information from video includes:

- detecting trigger events (e.g. any vehicles entering a particular area, people exiting or entering a particular building)
- determining typical and anomalous patterns of activity, generating person-centric or object centric views of an activity
- classifying activities into named categories (e.g. walking, riding a bicycle),
- clustering and determining interactions between entities [9].

V. MULTIMEDIA DATA MINING TECHNIQUES AND ALGORITHMS

The algorithm and techniques employed to perform multimedia data mining are most important. Data mining techniques are numerous. Many of these techniques may also be applied for multimedia data mining. Within the supervised framework, three data mining methods have been used. These are classification, association and statistical modeling. Within the unsupervised learning, clustering is another data mining methodology used.

5.1 Multimedia Data Mining Process Using Classification Rules

In this approach, we concentrate on discovering the semantic structures. We choose to use the classification rule approaches to perform data mining process because this approach only induce absolutely accurate rules. An early example of this is the work of Yu and Wolf [10], who used one dimensional Hidden-Markov Model for classifying images and video as indoor-outdoor games[11].

A recent work in this area is due to Shu-Ching Chen et al. presented a new multimedia data mining framework for the detection of soccer goal shots by using combined multimodal (audio/visual) features and classification rules using Decision Tree[12].

5.2 Multimedia Data Mining Process Using Clustering

Clustering is a process of organizing objects into groups whose members are similar in some way. It is one of the data mining techniques is an unsupervised learning. In unsupervised classification, the problem is to group a given collection of unlabeled multimedia files into meaningful clusters according to the multimedia content without a priori knowledge. A recent work in this area is due to Lei wang et al.[10], who introduced a clustering method based on unsupervised neural nets and self-organizing maps. Another recent work in this area is due to Jessica Lin et al. have presented an approach to perform incremental clustering at variuos resolutions, using the Haar wavelet transform using k-means as clustering algorithm.

5.3 Multimedia Data Mining Process Using Association Rules

Association rule learning is a popular and well researched method for discovering interesting relations between variables in large databases. There are different types of associations: association between image content and non image content features. An early example of applying association rule mining for image annotation is provided by the work of Ordonez and Omiecinski [13], who consider segmented images to compute the co-occurances of regions that are deemed similar[11]. Another recent work in this area is due to Tseng et al.[14], who proposed a new image classification method by using multiple-level association rules based on the image objects. Another recent work in this area is due to Ankur M. Teredesai et al.[15], who presented a multirelational extension to the FP-tree algorithm to accomplish the association rule mining task effectively. The motivation for using multi-relational association rule mining for multimedia data mining is to exhibit the potential accorded by multiple descriptions for the same image (such as multiple people labeling the same image differently).

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VI. APPLICATIONS OF MDM

There are various applications [16] [17] of MDM some of which are as follows:

A. In Digital Libraries: The retrieval collection storage and preservation of digital data is performed in the digital library. To fulfill this purpose, there is a need to convert different formats of information such as text, images, video, audio, etc. While conversion of the multimedia files into the libraries data mining techniques are popular.

B. For Traffic Video Sequences: To discover important but previously unknown knowledge the analysis and mining of traffic video sequences such as vehicle identification, traffic flow, queue temporal relations of the vehicle at intersection, provides an economic approach for daily traffic monitoring operations.

C. For Automated event analysis of suspicious movements: Surveillance system to monitor movements of employees, visitors and machines are used in many government organizations, multi-nationals companies, shopping malls, banks. Which has an ultimate objective to detect suspicious person based on their movements to maintain security and avoid any casualty?

D. In medical analysis: Application of Data Mining techniques for Medical Image Classification is used.

E. Media Production and Broadcasting: Proliferation of radio stations and TV channels makes broadcasting companies to search for more efficient approaches For creating programs and monitoring their content.
F. Customer Insight: It includes collecting and summarizing information about customer‘s opinions, products or services, customers‘complains, customer‘s preferences, and the level of customer‘s satisfaction of products or services. Many companies have help desks or call centers that accept telephone calls from the customers. The audio data serve as an input for data mining to pursue the following goals:
Topic detection Resource assignment Evaluation of quality of service.

G. Surveillance: Surveillance consists of collecting, analyzing, and summarizing audio, video, or audiovisual information about a particular area, such as battlefields, forests, agricultural areas, highways, parking lots, buildings, workshops, malls, retail stores, offices, homes, etc. [17]. Which is associated with intelligence, security, and law enforcement and the major uses of this technology are military, police, and private companies that provide security services.

There are several goals of surveillance data mining:

1. Objector event detection/recognition
2. Summarization
3. Monitoring

H. Intelligent Content Service: The Intelligent Content Service (ICS) is ―a semantically smart content-centric set of software services that enhance the relationship between information workers and computing systems by making sense of content, recognizing context, and understanding the end user‘s requests for information‖ The MDM techniques can help to achieve the following goals:
Indexing Web media and using advanced media search
Advanced Web-based services

I. Knowledge Management: Many companies consider their archives of documents as a valuable asset. They spend a lot of money to maintain and provide access to their archives to employees. Besides text documents, these archives can contain drawings of designs, photos and other images, audio and video recording of meetings and multimedia data for training.

VII. CONCLUSIONS

In this paper, we have reviewed and analyzed the multimedia data mining process with different tasks and also we describe well known techniques for multimedia mining. In text mining there are two open problems: polysemy, synonymy. Polysemy refers to the fact that a word can have multiple meanings. Distinguishing between different meanings of a word (called word sense disambiguation) is not easy, often requiring the context in which the word appears. Synonymy means that different words can have the same or similar meaning. In audio and video mining, a fundamental open problem also remains: The combination of information across multiple media (combining video and audio information into one comprehensive score). In image mining an open problem remains: the combination of different types of image data. Documents from an OCR library and a video library need to be presented in a single ranked list.

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