Research Paper
Impact Factor: 4.164
Refereed Journal

IJMDRR
E- ISSN –2395-1885
ISSN -2395-1877

SEMANTIC MINING KNOWLEDGE FOR MULTIMEDIA DATABASE

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Abstract
Multimedia data base is a collection of inter related multimedia data to popular research domain which helps to take out interesting knowledge from MMDB stores data sets in the form of text, images, graphics, speech, audio, video, and combination of several types of data sets. A multimedia database is a database that includes one or more primary media file types such as .txt (documents), .jpg (images), .swf (videos),.mp3 (audio) etc .In general, multimedia data are categorized into unstructured and semi-structured data. These data are stored in multimedia databases and multimedia mining is used to find useful information from large multimedia database system by using various multimedia techniques and powerful tools. In this paper provides the basic concepts of multimedia mining and its characteristics of MMDM. Multimedia mining architectures for structured and unstructured data, requirements of MMDB, research issues in multimedia mining, data mining models, design goal of MMDB used for multimedia mining and applications are also discussed in this paper. It helps the researchers to get the knowledge about how to do their research in the field of multimedia mining.

Keywords: Data Mining, Multimedia Mining, Content, Architectures, Application.

1. Introduction

Multimedia data mining is used for extracting interesting information for multimedia data sets, such as audio, video, images, graphics, speech, text and combination of several types of data set which are all converted from different formats into digital media. Multimedia mining is a subfield of data mining which is used to find interesting information of implicit knowledge from multimedia databases. Multimedia data are classified into five types; they are (i) text data, (ii) Image data (iii) audio data (iv) video data and (v) electronic and digital ink Text data can be used in web browsers, messages like MMS and SMS. Image data can be used in art work and pictures with text still images taken by a digital camera. Audio data contains sound, MP3 songs, speech and music. Video data include time aligned series of frames, MPEG videos from desktops, cell phones, video cameras .Electronic and digital ink its sequence of time aligned 2D or 3D coordinates of stylus, a light pen, data glove sensors, graphical, similar devices are stored in a multimedia database and use to develop a multimedia system.

Ever since 1960s the research in the field of multimedia has initiated for combining different multimedia data into one application when text and images were combined in a document. During the research and development process of video synchronization of audio and animation was completed using a timeline to specify when they should be played.

The difficulties of multimedia data capture, storage, transmission and presentation have been explored in the middle of 1990s where the multimedia standards MPEG-4, X3D, MPEG-7 and MX have continued to grow. These are reformed and clearly handled sound, images, videos, and 3-D (three-dimension) objects that combined by events, synchronization, scripting languages which describe the content of any multimedia object.

Multimedia database system includes a multimedia database management system (MMDBMS) which handles and provides foundation for storing, manipulating and retrieving multimedia data from multimedia database Multimedia data consists of structured data and unstructured data such as audio, video, graphs, images and text media.

2. Types of Multimedia Database In MM

There are two types of multimedia database & they are follows,

Linked Multimedia Databases in MM

Multimedia database can be organized s a database of metadata(data about data).this meta data links to the actual data such as graphics ,image,animation,audio,vedio,sound etc.These data may be stored on hard disc,CD-ROM,DVD or online. In this database, multimedia elements organized as image, audio/MP3, video, etc.Advantages of these types of database is that the size of database will be small because elements are not embedded in the database, but only linked it.

Embedded Multimedia Databases in MM

Embedded multimedia 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 reduced the access time. However the size of database is large.

Contents of MMDB in MM
A Multimedia Database (MMDB) host one or more multimedia data types. They types are broadly classified into three classes.

Static media: Time independent, constant, non interactive, (e.g.) images & graphics (object).
Dynamic media: Time dependent, moving, interactive, (e.g.) audio, video & animation.
Dimensional media: 3D game and computer aided drafting programs, (e.g.) virtual reality, 9-D Movies.

3. Categories of Multimedia Data Mining
The multimedia data mining is classified into two broad categories as static media 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). Multimedia mining refers to analysis of large amount of multimedia information in order to extract patterns based on their statistical relationships. Figure 1 shows the categories of multimedia data mining.

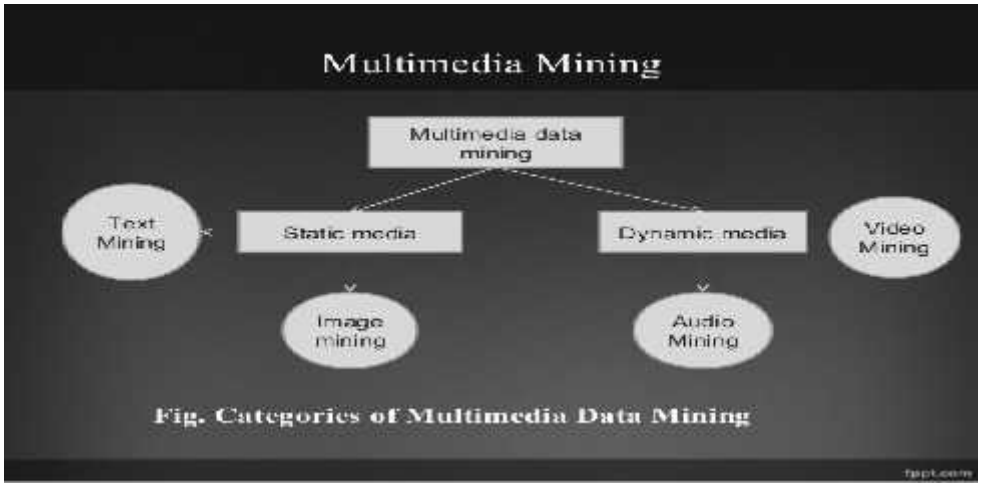


Fig. Categories of Multimedia Data Mining

Text mining
Text Mining also referred as text data mining and it is used to find meaningful information from the unstructured texts that are from various sources. Text is the foremost general medium for the proper exchange of information [3]. Text Mining is to evaluate huge amount of usual language text and it detects exact patterns to find useful information.
Image mining
Image mining systems can discover meaningful information or image patterns from a huge collection of images. Image mining determines how low level pixel representation consists of a raw image or image sequence can be handled to recognize high-level spatial objects and relationship .It includes digital image processing, image understanding, database, AI and so on.

Video Mining
Video mining is unsubstantiated to find the interesting patterns from large amount of video data; multimedia data is video data such as text, image, and metadata, visual and audio. The processing are indexing, automatic segmentation, content-based retrieval, classification and detecting triggers. It is commonly used in various applications like security and surveillance, entertainment, medicine, sports and education programs 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. Band energy, frequency centroid, zero crossing rate, pitch period and band-width are often used features for audio processing [2]. It is generally used in the field of automatic speech recognition, where the analysis efforts to find any speech within the audio

4. Applications of Multimedia Mining
There are different kinds of applications of multimedia data mining, some of which are as follows:

Digital Library: The group of digital data are stored and maintained in digital library, which is important to convert different formats of digital data into text, images, video, audio, etc.

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

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

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

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

Surveillance system: It consists of collecting, analyzing, summarizing audio, video or audio visual information about specific areas like government organizations, multi-national companies, shopping malls, banks, forest, 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.

Other applications of Multimedia include,
World Wide Web, Video Conferencing, Video-on-Demand, Interactive TV, Home shopping, games, Virtual Reality, Digital Video Editing & Production systems, Multimedia Database Systems.

5. Design Goal of MMDB

1. Manage different types of input, output, and storage devices
2. Handle a variety of data compression and storage formats
3. Support different computing plat forms and operating systems
4. Integrate different data model-(R database, OO database)
5. Offer a variety of user friendly query systems suited to different kinds of media.
6. Handle different kinds of indices
7. Provide transparent view of geographically distributed data
8. Synchronize different media types while presenting to user

6. Requirements of Multimedia Database In MM
Integration: Data items do not need to duplicate for different programs invocations.
Data independence: separate the database and the management from the application programs
Concurrency control: Allows concurrent transactions
Persistence: data objects can be saved and reused by different transactions and program invocations
Privacy: Access and authorization control

7. Multimedia Data Mining Process
It shows present architecture which includes the types of multimedia mining process [19]. Data Collection is the initial stage of the learning system; Pre-processing is to extract significant features from raw data, it includes data cleaning, transformation, normalization, feature extraction, etc. Learning can be direct, if informative types can be recognized at pre-processing stage. Complete process depends extremely on the nature of raw data and difficulty’s field. The product of pre-processing is the training set. Specified training set, a learning model has to be selected to learn from it and make multimedia model is more constant.

Fig: Multimedia Mining Process

Converting Un-structured data to structured data

Data resides in fixed field within a record or file is called structured data and these data are stored in sequential form. Structured data has been easily entered, stored, queried and analyzed. Unstructured data is bit stream, for example pixel representation for an image, audio, video and character representation for text. These sorts of files may have an internal structure, they are still considered "unstructured" because the data they contain does not fit neatly in a database. For example, image and video of different objects has some similarity - each represents an interpretation of a building - but then without clear structure.

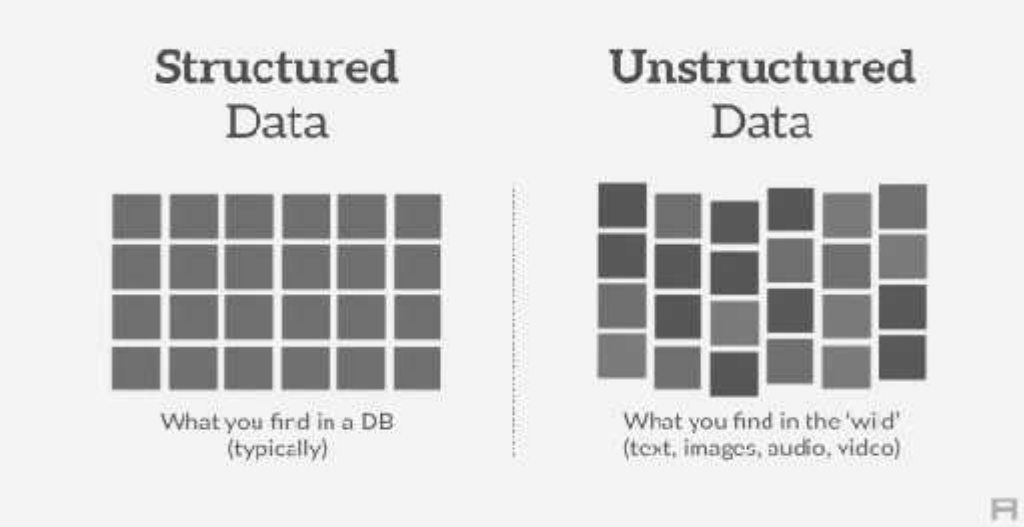
Structured data

Structured data first depends on creating a data model – a model of the types of business data that will be recorded and how they will be stored, processed and accessed. This includes defining what fields of data will be stored and how that data will be stored: data type (numeric, currency, alphabetic, name, date, address) and any restrictions on the data input (number of characters; restricted to certain terms such as Mr., Ms. or Dr.; M or F).

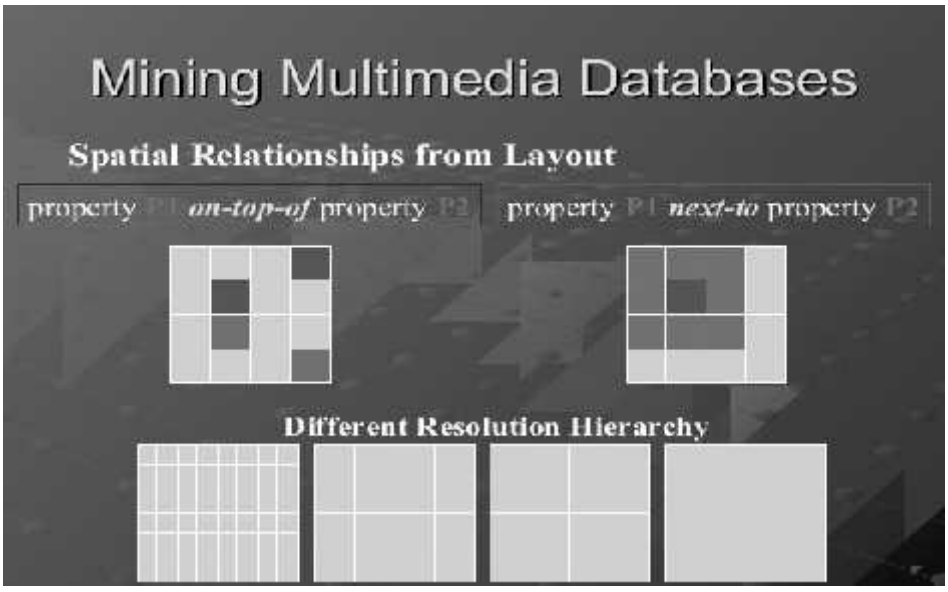
Unstructured data

Unstructured data is simply a bit stream. Examples include pixel level representation for images, video, and audio, and character level representation for text. Substantial processing and interpretation are required to extract semantics from unstructured data. This kind of data is not broken down into smaller logical structures and is not typically interpreted by the database

Fig: Unstructured Data to Structured Data Conversion



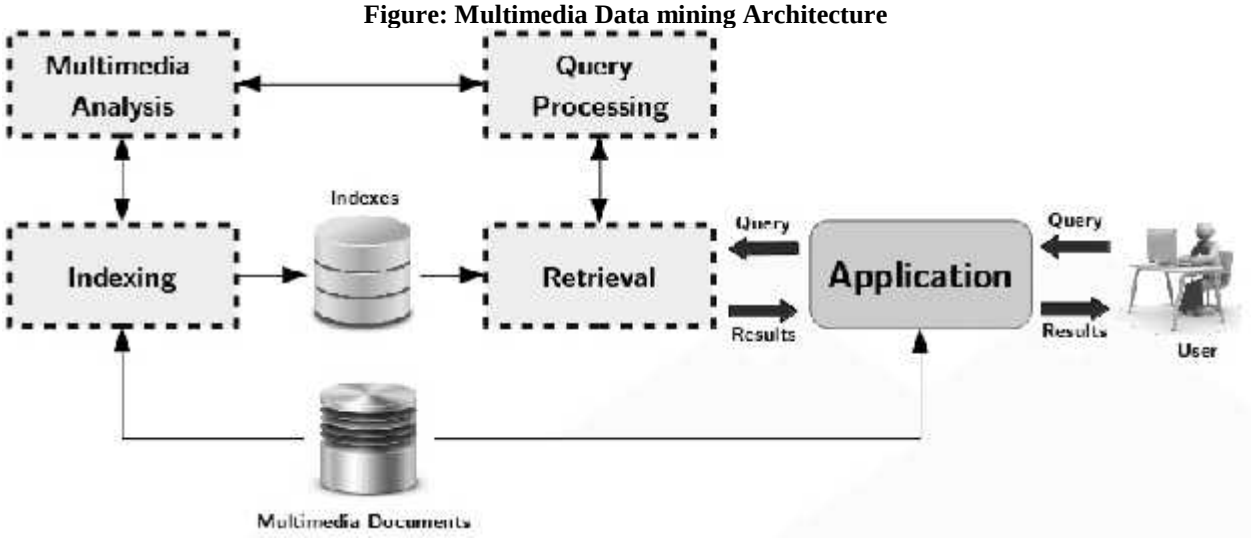
Current data mining tool operate on structured data, which resides in huge volume of relational database while data in multimedia databases are semi-structured or un-structured. Hence, the semi-structured or unstructured multimedia data is converted into structured one, and then the current data mining tools are used to extract the knowledge. A difference between unstructured data and structured data mining is the sequence or time element. The architecture of converting unstructured data to structured data and it is used for extracting information from unstructured database is shown in Fig. Then data mining tools are applied to the stored structured databases.



8. Architectures for Multimedia Database Data Mining

Multimedia mining architecture is given in Figure 4. The architecture has several components. Important components are (1) Input (2) Multimedia Content (3) Spatiotemporal Segmentation (4) Feature Extraction (5) Finding the similar Patterns and (6) Evaluation of Results.

Figure: Multimedia Data mining Architecture



1. Input stage comprises which multimedia database is used for finding the patterns and to perform data mining process.
2. Multimedia Content is the data selection stage which requires the user to select the databases, subset of fields or data to be used 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 pre-processing 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. Such representation of choices is required because certain fields could include data at various levels and not considered for finding the similar pattern stage. In MDM the preprocessing stage is significant since the unstructured nature of multimedia records.
5. Finding the similar pattern 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 of finding similar pattern stage 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 prior stage must be revisited or not. This stage consists of reporting and makes use of the extracted knowledge to produce new actions or products and services or marketing strategies.

9. Models for Multimedia Mining

The models which are used to perform multimedia data are very important in mining. Commonly four different multimedia mining models have been used. These are classification, association rule, clustering and statistical modeling.

Classification

Classification is a technique for multimedia data analysis, can learn from every property of a specified set of multimedia. It is divided into a predefined class label, so as to achieve the purpose of classification. Classification is the process of constructing data into categories for its better effective and efficient use, it creates a function that well-planned data item into one of many predefined classes, by inputting a training data set and building a model of the class attribute based on the rest of the attributes. Decision tree classification has a perceptive nature that the users conceptual model without loss of exactness. Hidden Markov Model used for classifying the multimedia data such as images and video as indoor-outdoor games.

Association Rule

Association Rule is one of the most important data mining technique which helps to find relations between data items in huge databases. There are two different types of associations in multimedia mining: association between image content and non-image content features [1]. Mining the frequently occurring patterns between different images becomes mining the repeated patterns in a set of transactions. Multi-relational association rule mining is used to display the multiple reports for the same image. In image classification also multiple level association rule techniques are used.

Clustering
Cluster analysis divides the data objects into multiple groups or clusters. Cluster analysis combines all objects based on their groups. Clustering algorithms can be divided into several methods they are hierarchical methods, density-based methods, grid-based methods, and model- based methods, k-means algorithm and graph based model [3]. In multimedia mining, clustering technique can be applied to group similar images, objects, sounds, videos and texts.

Statistical Modeling
Statistical mining models are used to regulate the statistical validity of test parameters and have been used to test hypothesis, undertake correlation studies and transform and make data for further analysis. This is used to establish links between words and partitioned image regions to form a simple co-occurrence model [9].

10. Research Issues in Multimedia Mining
Before multimedia data mining develops into a conventional, mature and trusted discipline, many pending issues have to be addressed. These issues pertain to the multimedia data mining approaches applied and their limitations. Major Issues in multimedia data mining include content based retrieval and similarity search, generalization and multidimensional analysis, classification and prediction analysis, and mining associations in multimedia data. Multimedia data mining needs content-based retrieval and similarity search integrated with mining methods. Content based retrieval in multimedia is a challenging problem since multimedia data needs detailed interpretation from pixel values. The objective of multidimensional analysis is to gain an insight into the meaning contained in databases. The multidimensional approach makes navigating the database easier, screening for a particular subset of data, or asking for data in a particular way, and being able to define analytical calculations. Because Major Issues in multimedia data mining contains content based retrieval, similarity search, dimensional analysis, classification, prediction analysis and mining associations in multimedia data the data is physically stored in a multi-dimensional structure, the speed of these operations is much quicker and more consistent than in other database structures.

Content Based Retrieval and Similarity Search

1. Content based retrieval in multimedia is a stimulating problem since multimedia data is required for detailed analysis from pixel values. We considered two main families of multimedia retrieval systems i.e. similarity search in multimedia data.
2. Description-based retrieval system created indices and make object retrieval, based on image descriptions, for example keywords, captions, size, and time of creation.
3. Content-based retrieval system supports retrieval on the image content, for example color histogram, texture, shape, objects and wavelet transforms.
4. Use of content-based retrieval system: Visual features to index images and promotes object retrieval based on feature similarity; it is very desirable in various applications. These applications which include diagnosis, weather prediction, TV production and internet search engines for pictures and e-commerce.

Multidimensional Analysis
In order to perform multidimensional analysis of large multimedia databases, multimedia data cubes may be designed and constructed in a method similar to that for traditional data cubes from relational data. A multimedia data cube can have additional-dimensions and measures for multimedia data, such as color, texture, and shape. A multimedia data cube has several dimensions. Examples are: size of the image or video in bytes; width and height of the frames, creating two dimensions, date on which image or video was created or last modified, format type of the image or video, frame sequence duration in seconds, Internet domain of pages referencing the image or video, the keywords like a color dimension and edge orientation dimension.

Multimedia data mining system prototype is called Multimedia Miner which is the extension of DBMiner system handles multimedia data. The Image Excavator component of Multimedia Miner uses image contextual information, like HTML tags in Web pages, to derive keywords .By navigating on-line directory structures, like Yahoo! directory, it is possible to build hierarchies of keywords mapped on the directories in which the image was found.

Classification and Prediction Analysis
Classification and predictive analysis has been used for mining multimedia data particularly in scientific analysis like astronomy, seismology, and geo-scientific analysis. Decision tree classification is an important data mining method in reported image data mining applications. For example, consider the sky images which has been carefully classified by astronomers as the training set, it can create models for the recognition of galaxies, stars and further stellar objects, based on properties like magnitudes, areas, intensity, image moments and orientation. The image data are frequently in large volumes and needs substantial processing power, for example, parallel and distributed processing. Image data mining classification and clustering are carefully connected to image analysis and scientific data mining and hence many image analysis techniques and scientific data analysis methods could be applied to image data mining.

Mining Associations in Multimedia Data

Association rules involving multimedia objects have been mined in image and video databases. Three categories can be observed

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

The associations between multimedia objects, we can treat every image as a transaction and find commonly occurring patterns among different images. First, an image contains multiple objects, each with various features such as color, shape, texture, keyword and spatial locations, so that there can be a huge number of possible associations. Second, a picture containing multiple repeated objects is an essential feature in image analysis, recurrence of the similar objects should not be ignored in association analysis. Third, to find the associations between the spatial relationships and multimedia images and this can be used for discovering object associations and correlations

8. Conclusion

Multimedia mining is one of the important and challenging research domains in the field of computer science. Most of the researchers are interested to do their research work in the field of multimedia mining. Many challenging research problems are available in multimedia mining. These problems can be solved by developing new algorithms, concepts and techniques for extracting hidden knowledge from the multimedia data bases. This paper discussed the multimedia mining basic concepts, essential characteristics, architectures, models and applications. Emerging and open research issues in multimedia mining also described in this paper. Future work includes improving the feature extraction step to obtain more representative features, efficient frequent pattern searching method for the multi-stream, extracting complex events in different types of video domains, unique efficient mining algorithms for mining knowledge from video data and newer rule types may be necessary to facilitate new data analysis. In the coming years, we expect the MDM applications to grow especially in areas of entertainment and medicine. Almost all of the MDM efforts hitherto have been with the centralized data mining algorithms; however, this is expected to change as more and more multimedia content is searched and accessed through peers. The MDM is an active and growing area of research.

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