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Video Mining using Query by Example

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***Abstract*— When technology advances and data explodes, development takes place. As the industry grasps every opportunity to shift its strategy towards satisfying the consumer, the consumer's demand further increases. Today, people have advanced from using black and white text, to the more effective and appealing realm of multimedia. With this, the consumer demand has evolved from text-based retrieval to content-based retrieval. In this paper, Video Mining is carried out using content-based retrieval. The content-based Video Mining system aims to effectively retrieve videos using the Query by Example approach wherein search is made based on a query video. The system has two components – a video feature repository and a Match-Retrieve module. On accepting a query video, it is first segmented and its color, audio and meta-data features extracted. These features are used to perform the required video mining based on similarity to the contents of the video feature repository.**

***Keywords:*-- Content Based Video Mining (CBVM), Video segmentation, repository, feature extraction, retrieval**

I. INTRODUCTION

Multimedia is a rich media referring to content that is an aggregation of different content forms such as text, audio, image, animation, video or interactive content forms. 90% of information transmitted to brain is visual and processed faster than text. People respond better to visual information, hence the need for Video Mining as an important research area. The Content Based Video Mining System is an approach in which videos are retrieved from the database based on their visual content.

The Video Mining system has 2 main components- A) Video Feature Repository wherein video segmentation, feature extraction and feature storage takes place and B) Matching and Retrieval module where comparison is made.

In the Video Feature Repository task, the first step is to acquire a Video, and perform segmentation in order to extract frames. Given a Video, we first divide it video into frames. Frames are still images which if put together and played continuously create a video. After segmenting the video into frames, only a subset of the frames is used for further analysis. This subset comprises of frames that are representative of all the frames of the video. They provide an accurate and compact summary of the entire video content. Once these frames are selected, their features are extracted. Features are classified in two levels - Low Level features and High Level features. Low Level features are extracted directly from objects such as color, texture, shape, motion, etc. High Level features are semantic features and are viewed based on human perception. Once extracted, these features are stored in a feature vector. The feature vector is then stored in the database.

When a query video clip is given as input, the task is to find a similar video from the database. Thus the query video is segmented and its features extracted. The extracted features of the query video clip are compared with features of stored videos to measure similarity. If there is a similarity, the matched videos are retrieved and presented to the user

The target of this paper is to design a Content Based Mining system. Given a query video clip, the exact matched video or similar videos will be retrieved and its performance will be evaluated.

II RELATED WORK

With the boom of the Multimedia Industry, a lot of Researchers are pursuing this domain. Research on Image and Video processing and Pattern Recognition has come a long way. Several methods of video retrieval based on various features have been developed by Researchers. Video Retrieval can be done based on low level features like color, texture and statistical features as a Time Based activity[2]. Extraction of static features from video and its comparison with database video frames[3,4].Video Retrieval using SIFT features. The Object is extracted and SIFT is applied to retrieve features representing the video[8].Many have used features such as color, shape , texture, motion , intensity for Retrieval. The system can also be designed based on content as well as metadata.The

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Query by Image (&video) content (QBIC) system developed at IBM Alamaden Research and Centre uses example sketches, drawing and selected colors and texture pattern for retrieval from both Image and Video Databases. In addition the Video Retrieval system also uses camera and motion features.
Applications where CBVM can be applied are enormous and diverse, such as Scientific Database management, picture archiving and Communication systems, Law enforcement and criminal investigation, geographic information system and video on demand system.

III THE VIDEO MINING SYSTEM

"If a picture is worth a thousand words, a moving picture is worth a million". Hence Video Media is flourishing and so is Video Retrieval. Retrieval has been a challenging task based on the various types of Queries used. Video Retrieval can be done using various approaches such as;

- Query by Sketch: Users draw sketches which act as a representation of the query video
- Query by Objects: Objects in the videos marks as identifiers of similar videos
- Query by keyword: User uses normal text words i.e. keywords as a description
- Query by Natural Language: Semantic word similarity is used to retrieve relevant videos.

In this paper, Query by Example is used i.e. an example video is used as the reference to search for related videos. The Input Query is in the form of video clip which is an example video clip. Features are extracted to create feature vector and this is then used to find similar videos in the video feature repository. The features that are extracted act as representatives for the video significantly determine the performance of the system.

Algorithm
Step 1: Acquire the video
Step 2: Perform video segmentation i.e. divide the video into frames.
Step 3: Analyze the video for feature extraction
a. Extract the video color, find RGB component and calculate mean for each of the frames
b. Separate the audio from the video and extract the frequency of the audio signal.
c. Extract the metadata related to the video file.
Step 4 : Store the extracted features of the video in a File.
Step 5: Acquire the Query video.
Step 6 : Repeat steps 2-4 and store the features as a Query file.
Step 7: Compare the Query File with the existing Feature Files to find a match.
Step 8: If match is found, the matched content file video is given as output. Else "No match found" is displayed.

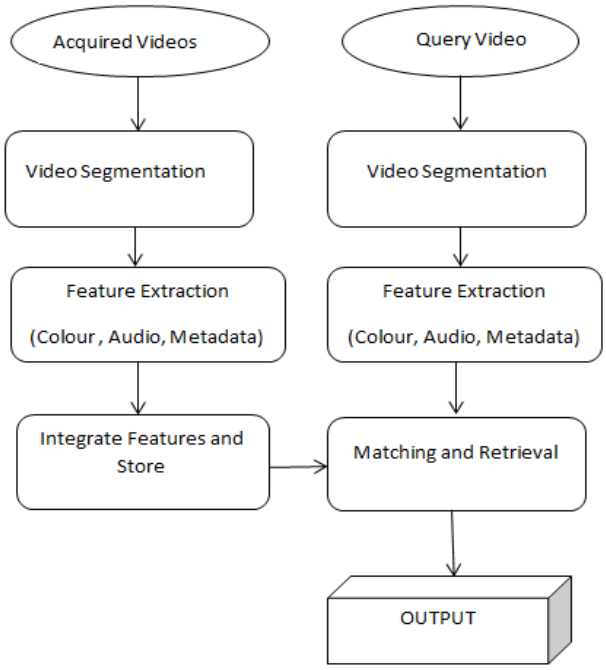

Fig.1 Video Mining Architecture

3.1 Video Feature Repository

The Video feature Repository is the first phase which will accept the video and perform the required processing on the clip. The processing steps are:

Video Segmentation

Video segmentation is a way of dividing a Video clip into meaningful segments. It is a crucial step in Video Processing. Any Video analysis starts with Video segmentation which partitions video into spatial, temporal or spatio-temporal regions. The Multimedia service performs temporal segmentation of video into slots or group of pictures, namely frames. Subsequent changes in frame content can also help in motion detection. Change in location or orientation of an object in consecutive or subsequent frames tracks motion of an object. Based on the utility of the application segmentation method is selected.

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Effective video segmentation requires proper feature selection and appropriate distance measure.

IV. FEATURE EXTRACTION

Color as a feature

The human visual system uses color features to sense the environment, recognize objects and convey information. Given a video clip which is made of frames, Each frame image conveys information on color which helps in analysis. There are various color models such as RGB, CMY, YIQ but the one used here is RGBA. These are represented using Color Histogram which is an estimate of the probability of occurrence of color intensities. RGB model represents a frame image as a constituent of 3 independent image planes, Red, Green & Blue. The image is traversed for RGB components along with another component called alpha, which is an extension of RGB color values with an alpha channel which specifies the opacity of the object. Histogram is plotted using RGB which is widely used in computer vision. While RGB takes a value between 0 -255 , Alpha takes a value between 0(fully transparent) to 1.0 (Fully opaque). The standard deviation of the RGBA component is calculated and thus forms the color feature. The standard deviation is represented as the feature.

Fig. 2 RGB Feature histogram for Parking.mpg

Audio as a Feature

An audio is sound within acoustic range available to humans. It has an acoustic audio frequency which produces acoustic sounds. Feature Extraction here involves Extracting the audio signal from video and then analysing the signal. There are 2 feature extraction techniques classified as Temporal Analysis and Spectral Analysis techniques. Temporal Analysis uses audio signals waveform while Spectral Analysis utilizes spectral representation of audio segment for analysis. It has different features such as pitch, timbral, rhythm ,etc.The signal can be analysed using Fast Fourier Transforn(FFT).The spectrum content of an audio signal can be generated and viewed. The audio is extracted from video clip and the signal is given as Input to FFT algorithm and the FFT of signal is calculated. The mean and standard deviation of the audio signal is calculated and stored in database along with the FFT as a part of audio features.

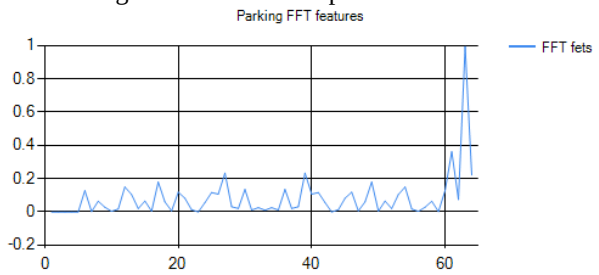

Fig. 3 Frequency Representation for Parking .mpg audio signal

Metadata as a Feature

Metadata is data about data. Metadata about video contains information related to video clip. It may contain technical related contents which are normally understandable by a non-technical user. It may include duration, Format , Bit rate, length , width and so on about the video. Such Embedded information stays with the file until the file is altered or edited. Using this as a feature will form an identification scheme for the video. This feature for every clip can be extracted and stored in database which further improves the accuracy by locating a similar video in database.

Feature Storage

As the video size increases, the no of features retrieved will increase. Since features increase, the size of database will definitely increase. The usefulness of database is dependent on the time taken to retrieve the videos and type of video retrieved. Thus care has to be taken that the size and search of features does not slow down the application. Hence feature vectors can be stored in File and indexed. Every Video RGB, audio FFT feature and metadata of the file is extracted and stored as a separate file for that particular video. To further enhance the speed of retrieval the retrieved values are stored as a vector representation i.e. Feature Vector.

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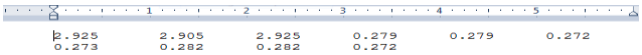

Fig.4 Feature Vector for Parking.mpg

3.2 Matching and Retrieval

We first accept the query Video clip. The clip is termed as query video. The Query video is then processed to identify features, a procedure similar to processing done on stored videos. When a query video clip comes as input, the extracted features of query clip is stored as a query text file. This query text file containing recently extracted features is compared with every other file in database to check if there is any file existing with similar features. The features extracted are compared with the stored features to find a match. It proves that a similar video is already stored in database. If a match is found, the Video is retrieved.

IV ANALYSIS

For implementing a successful Video Mining system the content feature Vectors are important. The stored features of video in query are compared with the features of video in database. At the end of search a doubt still arises "Have I retrieved all the relevant videos, Or am I missing on some?" The answer to this lies in Recall and Precision. The Performance of CBVM system can be evaluated based on these two parameters.
Recall is the ratio of no. of relevant records retrieved to the total no. of relevant records in the database.

Recall = No of relevant videos retrieved
Total no of relevant videos in database
Precision is ratio of no. of relevant records returned to the total no of irrelevant and relevant records retrieved.
Precision = No. of relevant Videos retrieved
Total no of retrieved videos
The above measures are expressed in percentage and gives the performance of the system
5 Output

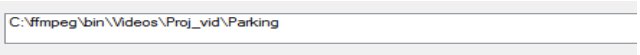

Fig.5 Retrieved Video Matching the Query Video

VI RESULTS

The Query Video Features were matched against every other video features in the database.If the Features were same , it was a signal that similar video is present and hence the video along with its path is retrieved and given to the user.If after performing a search for the matching video the query video fails to find a match , a message stating that the video is not present is displayed.Overall the contents of the Query video are analysed to find a matching video in the database using the Query by Example approach.

VI CONCLUSION

This paper presents a Content Based Video Mining System. The system takes a query video clip and searches the database Repository to find similar videos. The features targeted are colour, audio and metadata. The match is done using an algorithm which gives the best result. Each feature adds to the accuracy of the results. If only colour is used as a feature, all videos with similar RGB values are retrieved, even if the videos have different scenes. Considering only audio as a feature, all videos with the same background music will be retrieved even if the shots differ. With only metadata , a non technical person dealing with the system would find the information inaccessible and complex. Besides this, if detailed metadata extraction is carried out, the amount of information retrieved will increase exponentially with increase in number of videos, thus leading to an increase in access time. In this paper, each feature is considered as an individual characteristic and only basic metadata is retrieved, resulting in a high recall rate but low precision value, The strength of this system is that if a video is stored in the database, the user needs no knowledge about the text description nor the technical terms used to describe the video, in order to retrieve it. Any non-technical user can search for related videos using the system. This is what makes this system efficient and reliable.

Research related to Multimedia always has new challenges to overcome. Results could be improved further by extracting more high level features from the video such as human recognizable objects and events as well. The retrieval can also be done using frames which are a summary of the video rather than using the entire video clip. These approaches would make the retrieval more interesting and challenging.

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