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Video Shot Detection Techniques Brief Overview

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Abstract— The first step in video processing is temporal segmentation, i.e. shot boundary detection. Camera shot transitions can be either abrupt (e.g. cut) or gradual (e.g. fades, dissolves, wipes).Video segmentation is essential for video structure analysis and content based video management. One of the most challenging domains for shot boundary detection is sports video. Here we present a classification of shot boundary detection algorithms, including those that deal with gradual shot transitions. A current research topic on video includes video abstraction or summarization, video classification, video annotation and content based video retrieval.

Keywords.: Video segmentation, cut detection, gradual transition detection,Shot,frames,Threshold.

I. INTRODUCTION

In the multimedia environment the use of digital data is increasing rapidly, so that tools to handle large volumes of video data are required. Temporal video segmentation is the first step towards automatic annotation of digital video sequences. Its goal is to partition video into a manageable segment. A shot is defined as an unbroken sequence of frames taken from one camera. There are two basic types of shot transitions: abrupt and gradual. A gradual transition means Fade, Wipe, and Dissolve. The simplest method for cut detection is to calculate the absolute sum of pixel differences and compare it against a threshold [2]. The problem with this method is its sensitivity to camera and object movements. A better method is to compare block regions instead of individual pixels. Sensitivity to camera and object movements can be further reduced by comparing histograms of successive images. The idea behind histogram based approaches is that two frames with the same background and the same object (although moving) will have little difference in their histograms. The techniques mentioned so far are single threshold based approaches for cut detection and they are not suitable to detect gradual transitions. A simple and effective two threshold approach for gradual transition detection is the twin comparison method [3].These approaches for video segmentation process uncompressed video, but it is desirable to use methods that can operate directly on the encoded stream.

This paper is organized as follows. Section II describe brief literature survey on shot boundary detection methods. Section III illustrate comparison of shot boundary detection methods. Section IV describes shot change detection techniques. Section V represents classification techniques.

II. LITERATURE SURVEY

Ravi Mishra et al[2014] proposed a paper on a "Comparative study of block matching algorithm and dual tree complex wavelet transform for shot detection in videos". This paper presents a comparison between the two detection methods in terms of various parameters like false rate, hit rate, miss rate tested on a set of different video sequence.

Sowmya R et al [2013] proposed a paper on Analysis and Verification of Video Summarization using Shot Boundary Detection. The analysis is based on Block based Histogram difference and Block based Euclidean distance difference for varying block sizes. Zhe Ming Lu et al [2013**]** present a Fast Video Shot Boundary Detection Based on SVD and Pattern Matching. It is based on segment selection and singular valuedecomposition (SVD). Ravi Mishra et al[2013] proposed a paper on Video shot boundary detection using dual-tree complex wavelet transform, an approach to process encoded video sequences prior to complete decoding. The proposed algorithm first extracts structure features from each video frame by using dual tree complex wavelet transform and then spatial domain structure similarity is computed between adjacent frames. Sandip T et al[2012] proposed a paper on Key frame Based Video Summarization Using Automatic Threshold & Edge Matching Rate. Firstly, the Histogram difference of every frame is calculated, and then the edges of the candidate key frames are extracted by Prewitt operator. Goran J. Zajić et al [2011] proposed a paper on Video shot boundary detection based on multifractal analysis. Low-level features (color and texture features) are extracted from each frame

in video sequence then are concatenated in feature vectors (FVs) and stored in feature matrix. Donate et al[2010] presented Shot Boundary Detection in Videos Using Robust Three-Dimensional Tracking. The proposal is to extract salient features from a video sequence and track them over time in order to estimate shot boundaries within the video. LihongXun et al [2010] proposed a paper on A Novel Shot Detection Algorithm Based on Clustering. This paper present a novel shot boundary detection algorithm based on K-means clustering. Color feature extraction is done first and then the dissimilarity of video frames is defined. The video frames are divided into several different sub-clusters through performing K-means clustering. Jinchang Ren et al [2009] proposed a paper on Shot Boundary Detection in MPEG Videos using Local and Global Indicators operating directly in the compressed domain. Several local indicators are extracted from MPEG macro blocks, and Ada Boost is employed for feature selection and fusion. The selected features are then used in classifying candidate cuts into five sub-spaces via pre-filtering and rule based decision making, then the global indicators of frame similarity between boundary frames of cut candidates are examined using phase correlation of dc images.

III. SHOT BOUNDARY DETECTION METHODS

A lot of research is going on, for automatic content Based Video retrieval. Previous techniques focused on cut detection, and more current work has focused on gradual transitions detection. The major methods for shot boundary detection are pixel differences, statistical differences, histogram comparisons, edge differences, and motion vectors.

A. Pixel Comparison

This is the very primitive way to find the change in scene. Here the two frames are taken as input and the intensity of pixels are calculated. If the intensity of pixels is greater than a certain threshold value, then scene change is declared. There exist some modified algorithms for pixel comparisons. [1] [2] used 3 X 3 averaging filter. They are adjusting the threshold value manually.

But these methods are comparatively slow and setting manually threshold is not the best idea. Some author [5] divided a frame into 12 regions and each region is compared with same region in next frame. But, this method is not suitable for scene having camera and object motion.

B. Transform-Based Difference

It represents compression difference computation using different transformation methods. A discrete Cosine Transformation (DCT) coefficient is example.

C. *Histogram-Based Difference*

It computes the color histogram of each frame and compares it to detect shot boundaries.

D. Edge Based Difference

In this method the edges of successive aligned frames are detected first and then the edge pixels are paired with nearby edge pixels in the other image to find out if any new edges have entered the image or if some old edges have disappeared.

E. Statistical Difference

This method is an expansion of pixel comparison method. [6]
And [8] used this method. Here they divided the frame into
blocks and for each block mean deviation and standard deviation is calculated. This method is not noise tolerant, and it is bit slow as it calculates statistics.

F. Motion Vector

In every image processing application we need to find the vector fields. In vector fields we can see the changes in the image with time. There exists a third dimension but it has a drawback. That is called as aperture problem. The input frame is divided into blocks and motion vectors are extracted from those blocks [9] used this method. It is the transformation of pixel in one frame into other frame. And it is 2-dimensional vector (u, v).

IV. SHOT CHANGE DETECTION METHOD

A. Thresholding

Thresholding means comparing the computed discontinuity value with a constant threshold [4, 10, and 2]. This method only performs well if video content exhibits stationarity with time, and only if the threshold is adjusted by hand.

B. Adaptive Thresholding

The obvious solution to the problems of the simple thresholding is to vary the threshold depending on the average discontinuity within a temporal domain, as in [1, 10].

C. Probabilistic Detection

A rigorous way to detect shot changes is to model the pattern of specific types of shot transitions and perform optimal a posteriori shot change estimation, presupposing specific probability distributions for shots. This is demonstrated in [3,6].

V. SHOT CLASSIFICATION ALGORITHM

A. Spatial Feature Domain

The size of the region from which individual features are extracted plays a great role in the performance of shot change detection. A small region tends to reduce detection invariance with respect to motion, while a large region tends to miss transitions between similar shots.

1) Single frame pixel per feature:

Some algorithms use per feature a single frame pixel. This feature can be color [9], edge strength [4] or other. However, such an approach results in a very large feature vector and is very sensitive to motion.

2) Rectangular block:

To segment each frame into equal-sized blocks, and extract a set of features per block [13, 3, and 6] rectangular method is used. This approach is invariant to small camera and object motion. By computing block motion it is possible to enhance motion invariance, or to use the motion vector itself as a feature.

3) Arbitrarily shaped region:

This is another method in which Feature extraction can also be applied to arbitrarily shaped and sized regions [12]. This exploits the most homogeneous regions, enabling better detection of discontinuities. Object-based feature extraction is also included in this category. The main disadvantage is high computational complexity and instability due to the complexity of the algorithms involved.

4) Whole frame:

The algorithms that extract features from the whole frame at once [2, 9] have the advantage of being very resistant to motion, but have poor performance at detecting the change between two similar shots.

B. Temporal Domain of Continuity Metric

Another important aspect of shot boundary detection algorithms is the temporal window of frames which is used to perform shot change detection. These can be one of the following.

1) Two Frames:

Two frame approaches not work proper when there is large variation in activity among different parts of the video, or when certain shots contain events that cause short-lived discontinuities. To look for a high value of the discontinuity metric between two successive frames is the simplest way to detect discontinuity.[10, 3, 8,7,].

2) N-frame Window:

The most common technique for solving the above problems is to detect the discontinuity by using the features of all frames within a temporal window [1,5]. This is either by computing a dynamic threshold or by computing the discontinuity metric directly on the window.

3) *Interval since last shot change:*

In this method we need to compute one or more statistics from last detected shot change upto current shot. The problem with this approach is variability in shot.[9,10]

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CONCLUSION

The different techniques are discussed to detect a shot boundary depending upon the video contents and the change in that video content. As the key frames needs to be processed for annotation purpose, the important information must not be missed.

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