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TEXTURE SEGMENTATION BASED VIDEO SHOT DETECTION AND SUMMARIZATION

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ABSTRACT

Aim of the paper is to experiment video shot boundary detection using region based segmentation methods and texture based segmentations for short videos and perform a comparative study for the best approach for shot detection based on quality parameter analysis at different levels of implementation. As a preliminary work, the experiments carried out on five different video sequences which capture adequately the visual content of the shot. The results are analyzed and verified using alternative methods for each algorithm like four correlation coefficients are used to find the best suited for shot detection and also the best alpha value is considered from a range of values for calculating adaptive threshold value for detecting shot boundary. The clustering methods are used for key frame extraction and video summarization. The results and analysis shows that summarization provides sufficient information about visual content of the shot. The proposed approach is best suited for detecting abrupt cuts in the scene.

Keywords: *video shot detection, region based segmentation, Texture feature extraction, correlation coefficient, adaptive threshold, Quality parameter, key frame extraction*.

I. INTRODUCTION

A video is divided as frames, shots, or scenes and a sequence of interrelated successive frames considered contiguously representing a continuous action with space and time is known shot. A scene can be defined as the collection of one or more shots which focuses on an object or objects of concern. The continuous image sequence in a shot generally has reliable content whereas scene is a more semantic notion, essentially an information unit. Video shots are measured as the primitives for higher level content analysis, indexing, categorization, summarization and many more. Numerous types of transitions or boundaries exist among video shots. These shots are majorly categorized as cut, fade, dissolve and wipe. Despite innumerable proposed approaches and techniques so far proposed, robust algorithms for detecting different types of video shot boundaries have not been found.

Here we proposed a new experimental approach for detecting video shot based on the combination of Region based segmentation and texture based segmentation. The video shots are detected using these segmentation methods, analyzed the results for the best suited method for shot detection. This method mainly detects abrupt cuts in which the image intensity or color is abruptly changed. The frames which contain meaningful information about the content of the video are called as key frames. The researchers have attempted to exploit various features for the extraction of key frames in videos. In this paper, we used clustering methods for extracting key frames and summarization. The results are compared based on the performance.

The paper is structured as follows. Section II gives a review of the existing techniques, while Section III explains about the proposed methodology; Section IV provides explanation of our Video Shot Detection Algorithm. Section V deals with approaches to Key Frame Extraction and summarization. Section VI demonstrates the results and analysis and finally conclusion is presented in Section VII.

II. REVIEW OF THE EXISTING TECHNIQUES

Key frame extraction is an important and prime phase in video retrieval and used in content-based retrieval and video browsing applications. Near the beginning, techniques focused on detecting cuts, and recent works are focused on identifying slow changes. The discussion about various methods adopted for detecting shot boundaries can be found in [1]. Pixel difference is the earliest and easiest method for detecting whether two frames are significantly differences based on the pixel count change in terms of values greater than selected threshold. The pixel count of first and second is compared with second threshold to determine for the second and third frame when shot boundary is detected. The major drawback of this approach is responsive to camera motion. The expansion of pixel difference is Statistical methods [2] in which image is divided into various regions and evaluating simple statistical measures for the pixels in chosen regions. The advantage of this method is, its tolerance to noise, camera and object motion, but less efficient because of increased time complexity for evaluating statistical parameters and usually produces many false positives. Another most commonly used method is Histogram differences is evaluated between consecutive frames and used to detect change in sequence or shot boundaries and simplest approach is to compute color histograms of gray level for the two consecutive frames and check for the bin-wise difference between the two histograms, if it is above the threshold then shot boundary is assumed. To reduce the amount of processing needed, comparison of nonadjacent frames and finer level comparison are made to detect possible breaks. Histogram difference approach is shows reduced sensitive towards motion but major drawback is that if two images having exactly the same histograms with extremely different content can have same threshold value for shot detection then the detection will be false. Edge tracking [4] or the edge change ratio (ECR) [3] method used for detecting shot attempts to compare the definite content of two consecutive frames. The amounts of entering edges enter and exiting edges between the two successive frames was computed. Shot boundaries are detected by considering a large edge change percentages. The researchers determined that this approach is more precise at identifying cuts than histogram difference approaches and minimal sensitive to motion than chromatic scaling. Motion Vectors [5] like block matching, region-based pixel difference, MPEG compressed video sequences are used for shot detection and results shown are much accurate but selecting appropriate vectors are very critical for image processing purposes.

III. PROPOSED METHODOLOGY

The main criteria in shot boundary detection are to find the difference between the successive frames which is sensitive to the correlation (similarity or dissimilarity measure) between the frames and value of adaptive threshold. Considering these two factors, implementation is carried out in four phases. The first phase is to find the best region based segmentation method. Second phase is to selecting the best feature from the feature vector of texture feature extraction method like GLCM which shows best performance for the selected region based segmentation method. Third phase is to apply the selected feature based segmentation for video shot detection, analyze the results by varying the alpha value of adaptive threshold and varying the methods for measuring similarity or dissimilarity between the successive frames. Finally, adopt different clustering methods for key frame extraction and summarization. The overall design steps are as shown in figure 1.

Here a new approach to video shot change detection has been proposed. The implementation of first two phases is carried out for images (as each frame is an image) to reduce the programming complexity. The phase I analysis shows that Region Growing Segmentation method is the best method as it has less computation time and highest match to the segmentation quality metric[17]. In phase II shows the results of GLCM Texture Feature Extraction method indicates that Variance feature is the best feature as it shows highest match to the Texture Feature quality metric [18]. Phase II, since Roughness consumes more time, which is not suitable for videos. So, Contrast feature which consumes less time and stands in second position according to the Quality metrics is declared as the best feature which can be further used for segmentation and shot detection.

IV. VIDEO SHOT DETECTION ALGORITHM

The implementation steps are as shown in figure 1. The initial assumptions made for the implementations are

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- ✓ Texture feature based segmentation is used to extract the useful information from each frame
- ✓ Alpha value for calculating adaptive threshold
- ✓ The correlation coefficient is used to find the similarity between the successive frames.

V. KEY FRAME EXTRACTION AND VIDEO SUMMARIZATION

The key frames are chosen from each shot for indexing videos. Each PCCn value is compared with the, i.e. if PCCn >Th then there is a shot change detected. The interested good key frames are selected based on their visual and semantical significance. In this work, Fuzzy C Means Clustering Mechanism is adopted for Video Summarization. The basic idea is to produce the video summary based on clustering similar key frames or shots and then presenting some degree of frames per cluster. The selecting similar frames based on their color distribution, luminance and motion vector is significant in frames clustering. In addition, it is also required to find different criteria that can be employed to measure the similarity and or dissimilarity. Our implementation is based on the extraction of color features from video frames and Fuzzy C Means Clustering (unsupervised classification) for selection of representative frame.

VI. EXPERIMENTAL RESULTS AND ANALYSIS

A. Background

The experiment is done as collection of modules like selecting the best Region based Segmentation method as the initial stage. Second module of the work is selecting best feature among other features for each texture feature extraction method, here GLCM [6] and Tamura method [16]. Finally, selected best texture feature for each method is used as segmentation criteria for region based segmentation method to segment each frame of the input video. For Alpha variation (ranging from 2.0 to 6.0) experiments, four video sequences are considered and for correlation coefficient variations, ten video sequences of different scenarios are considered. The different correlation coefficient methods are Cross Correlation (CC), Normalized Area based Correlation (NACM) Method, Pearson's Correlation Coefficient (PCC) and Spearman's Correlation Coefficient (SCC).

B. Video Shot Detection

Video Shot Detection (VSD) algorithm is implemented with two assumptions, Alpha (= 4.0) for setting adaptive threshold value and Correlation Coefficient (initially Pearson's Correlation Coefficient) method. As VSD depends on two parameters and assumption will not give the best results. So the extensive results are generated and analyzes by keeping one value as constant and other as variable. The detailed results and corresponding analysis is as shown in Figure 1.

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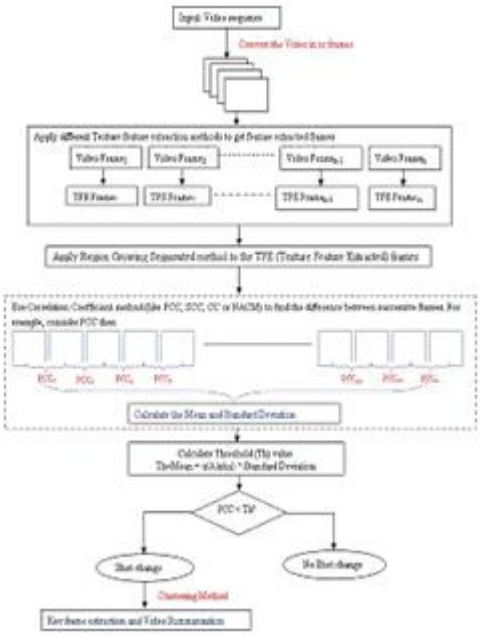

Figure 1: Block diagram for Video Shot Detection and summarization

Table 1: Shot Detected by p roposed Texture based Region Growin Segmentation algorithm

Input Videos	Total no. of fram es	Actual shots	GLCM Texture Features (shot detected)		Tamura Texture Features (shot detected)	
			PCC	NACM	PCC	NACM
Cut1.avi	390	4	4	4	4	4
Cartoon.avi	407	4	11	11	4	4
Cut2.avi	635	4	8	8	3	3
Cut3.avi	610	6	11	11	13	4
Hurricane Force.avi	2311	8	8	7	19	19

a2-25.avi	623	13	15	15	16	16
movie1-43.avi	1293	4	19	19	13	15
news-40.avi	1012	5	10	10	6	6
park-24.avi	617	4	9	9	4	4
sports-28.avi	719	13	23	10	4	4
Entertainment. avi	2895	88	50	55	46	48

Input Videos	GLCM Features (shot detected) Texture		Tamura Features (shot detected) Texture	
	PCC	NACM	PCC	NACM
Recall	93.17	93.33	85.8	82.2
Precision	43.39	47.22	74.1	79
F-measure	59.26	62.71	79.52	80.57

Table 2: comparison of the Quality parameter of Shot Detection algorithms for proposed Texture based Region Growing Segmentation algorithm using GLCM and Tamura as Texture Feature Extraction methods

Texture Feature based Region growing Segmentation Method used for Shot detection
To detect shots, the sum of absolute difference of the pixels of 2 consecutive frames in the sequence is considered. When the sum is superior than a particular threshold, the shot is detected. The threshold T used is adaptive threshold and is given by: T = mean + (ȝ * standard deviation) where ȝ is the experimental constant value. Here only the detection of sudden change is considered. The detailed results of VSD using GLCM and Tamura Texture feature based region growing segmentation are tabulated in table 1 and the outcomes of the VSD performance analysis are as shown in table 2.

C. Video summarization
The video summarization is helpful for getting brief summary of the video, independent of video length. For this experiment fuzzy c means method is used for grouping the frames and extracting key frame among each group.

VII. CONCLUSION

In this paper, a new approach for VSD has been proposed as preliminary experiment for short videos; extensive results are generated and analyzed. The quality measure and time complexity measure is done at three levels, first

to choose the best region based segmentation, next to select the best texture feature suited for VSD and finally for VSD for accuracy in detecting the exact shot change. The results shows that Region growing method is the best region based segmentation method, Variance feature for GLCM and Contrast feature for Tamura is the best suited texture feature for VSD and NACM correlation coefficient method will show the better similarity measure between the successive frames in comparison to PCC, CC and SCC. The proposed method is to study the behavior of various image processing algorithms for video shot detection and key frame extraction method.

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