International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)

Volume 3, Issue 11, November 2014

Shot Boundary Detection using Histogram Differences

Ms. Sonal P. Waghmare, Prof A. S. Bhide

Abstract- For automatic detection of boundaries between shots in video, video shot boundary detection process is used. It is an essential basic process in video data access, indexing, search and retrieval. As there is increase in usage of on-line digital video, it has created a requirement for automatic video content analysis methods. Due to illumination change in video, we can not detect gradual transition of image and illumination interference creates problem in video shot boundary detection. These interference are often mistaken as shot transitions. It is a vital task to develop a method that will help us to detect video shot change in case of illumination change. Here we have proposed algorithm for video shot boundary detection in presence of illumination change. This is very essential for correct detection of shot boundaries and very useful in content based analysis of video. In this algorithm, first it removes illumination change using discrete cosine transform, then shot boundaries are detected using histogram difference method. A shot boundary is detected when the feature difference shows sharp change greater than threshold. We have used number of videos that include considerable illumination change for experimental study. The performance of proposed algorithm is better as compared to existing techniques.

Keywords - Video shot boundary detection, Discrete cosine transform, Threshold. Histogram Difference.

I. INTRODUCTION

A lot of study is done on video shot boundary detection in recent time. It is widely used in many applications in different domains like video indexing, video compression, video access. Today due to digital world, many videos are easily available online. Therefore for indexing and retrieving video capable, efficient and effective tools for are needed. As chunk of information is stored one video, initially any video processing tool need to segment the input video into primary shots in which every shot is defined as a continuous frame from a single camera at a given moment. The detection of shot boundaries helps for all video abstraction and high-level video segmentation approaches. Hence, shot boundary detection is one of the important methods for revealing higher level video content structure. Depending on transformation between the shots, the shot boundaries can be defined into two types: gradual transition and abrupt transition. The gradual transition is further sub divided into 4 types as dissolve, wipe, fade in and fade out, as per their characteristics of variable editing effects. The existing methods on shot boundary detection are discussed below. Pair-wise comparison, Likelihood ratio and histogram comparison methods have been used as a different metric for shot boundary detection by Zhang et al. [1]. Boreczky and Lawrence [2] have observed Object motion & camera motion as main source of false positives. They have shown a comparison of several shot boundary detection classification techniques & their fluctuations including statistical difference, compression difference Histogram, pixel difference, Edge tracking, discrete cosine transform, motion vector and block matching methods. They have observed that algorithm which have produced good results were running differences & motion vector analysis and region based comparisons.

Standard deviation of pixel intensities and edge based contrast as a metric to find shot boundaries and tested results on diverse set of video sequences. Gargi et al. [5] have measured and qualified the performance of different shot detection methods using moving picture expert group compression parameter information, color histogram and image block motion matching. Ford et al. [6] have evaluated results on various histogram test statistics, pixel difference. A comprehensive review of existing approaches and identification of main challenges for shot boundary detection done by Yuan et al. [7]. They shown that removal of disturbances due to motion of large object and camera is a big challenge in video shot boundary detection. Sethi and Patel [8] have tested statistical test used for identification of changes in scene. Jinhui yuan et al. [9] have used three vital techniques i.e. representation of visual content, classification of continuity values and construction of continuity signal are identified and formulated in the perspective of pattern recognition. For module evaluation the specific module varies in different approaches while the other module of the system retains the same implementation. The three mappings identified by the formal framework are research problem for pattern recognition, which have undergone relatively mature evolution. In the proposed algorithm illumination change is removed using discrete cosine transform. Then video shot boundaries are detected by using the techniques of finding difference by Histogram method i.e. Histogram difference method.

The rest of the paper is organized as follows, Section II describes discrete cosine transform method for illumination removal, section III describes for Histogram difference method. We discuss Experiment & results in section IV & conclude the paper in V.

Pixel based, Histogram based, Edge based, Motion based methods can be used for video shot boundary

detection. As per pixel based method, the intensity values of the pixels of the same locations of the consecutive frames do not change considerably unless there is a shot boundary. The initial pixel based algorithms checks the sum of absolute pixel intensity differences and if the difference is greater than certain value then video shot boundary is analyzed. A minor l changes in the illumination or very small vibration in the camera may lead in considerable changes in total value of the pixel differences. Another method called as the histograms which do not change with the spatial changes within a frame. Histogram differences are more robust against the object motion with a constant background. Also, histogram differences are sensitive to camera motion, such as tilting or zooming, panning. Histograms represents the global intensity of colors into a frame, sometimes two frames may have significantly same histogram. Further the edges also proved useful in shot boundary.

II. ILLUMINATION REMOVAL USING DCT

The discrete cosine transform (DCT) helps to discriminate the image into parts of differing importance with respect to the image's visual quality as shown in Figure 1. The DCT is similar to the discrete Fourier transform, it transforms a signal or image from the spatial domain to the frequency domain.

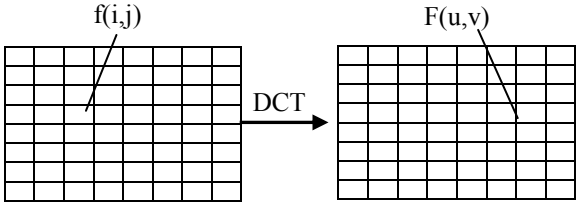

Fig 1: Spatial domain to frequency domain

The general equation for a 1D (N data items) DCT is defined

by the following equation

$$F(\mu) = \left(\frac{2}{N}\right)^{\frac{1}{2}} \sum_{i=0}^{N-1} A(i).\cos[\frac{\mu.\pi(2i+1)}{2.N}]f(i) \quad ....(1)$$

And the corresponding inverse 1D DCT transform is simple

$F^{-1}(u)$, i.e. where

$$A(i) = \frac{1}{\sqrt{2}} \quad for\ \xi = 0 \quad ....(2)$$

1 otherwise

General equation for a 2D (N x M image) DCT is defined by the following equation:

$$F(\mu,\vartheta) = \left(\frac{2}{N}\right)^{\frac{1}{2}} \left(\frac{2}{M}\right)^{\frac{1}{2}} \sum_{i=0}^{N-1}.\sum_{j=0}^{M-1} A(i).A(j).\cos\left[\frac{\mu.\pi(2i+1)}{2.N}\right]$$

$$\cos\left[\frac{\mu.\pi(2j+1)}{2.M}\right] f(i,j) \quad .... (3)$$

And the corresponding inverse 2D DCT transform is simple

$F^{-1}(u, v)$, i.e. where

$$A(i) = \frac{1}{\sqrt{2}} \quad for\ \xi = 0 \quad ....(4)$$

1 otherwise

The input image is N x M. f(i,j) is the intensity of the pixel in row i and column j. F( ) is the DCT coefficient in row k1 and column k2 of the DCT matrix. For most of the images, significant signal energy is at low frequencies, these appear in the upper left corner of the DCT. Compression is achieved as the lower right values represent higher frequencies, and are often small enough to be neglected with little visible distortion. 8 x 8 array of integers is given as input to DCT. This array is having information of each pixel's gray scale level. 8 bit pixels have levels from 0 to 255. The output array of DCT coefficient is having integers. It is computationally easier to implement and more efficient to regard the DCT as a set of basic functions which gives output of desired input array size (8x8) which can be precomputed and stored. This contains simply computing values for a convolution mask (8x8 window) that get applied. The values as simply calculated from the DCT formula. We have set (0,0) component of 2D DCT to zero and then take inverse 2D DCT to remove illumination/change. With the help of these step we get illumination removed and raw image for processing without any disturbances.

III. HISTOGRAM DIFFERENCE METHOD

Intensity transformation functions based on information extracted from image intensity histograms play a central role in image processing, in areas such as compression, segmentation, enhancement and description. The focus of this section is on obtaining, plotting and using histograms for image enhancement.

For analysis of images or video sequences from a digital CCD camera, image histogram is most important element. A histogram can tell us whether or not the image has been properly exposed, and what adjustments will work best. Noise is the most important variable that can strongly affect the quality of a digital image or video.

A histogram can also describe the amount of contrast. Contrast is the difference in brightness between light and dark areas in a frame Images, which can be usefully characterized by their gray-level histograms, from which global qualities, such as brightness, contrast, entropy and signal-to-noise ratio, can be determined.

Histogram based comparison methods are highly referred because they are robust to detrimental effects as camera and object motion and changes in scale and rotation.

Histograms are simple to calculate, and are the basis for a number of real-time images processing techniques.

IV. EXPERIMENT & RESULTS

The introduced shot boundary detection algorithm has been tested on different video data sets. We have performed many experiments on several documentaries, movie scenes, news and got satisfactory results. As shown in Fig 2. Is the original frame which is affected by illumination change disturbance. This disturbance is often considered as shot boundary which gives us a wrong result. An algorithm is developed using discrete cosine transform as explained above, which effectively removes illumination change effect as shown in Fig. 4.

Fig 2. Original Frame

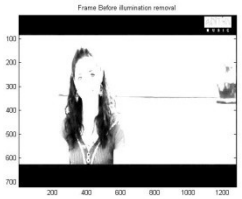

Fig 3. Frame before illumination removal

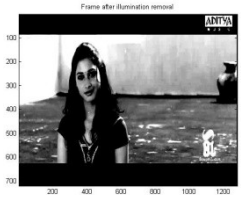

Fig 4. Frame after illumination removal

Fig 5. Frame no. 184 to 189 (Left to right), where shot transition can be observed between frame 187 & 188.

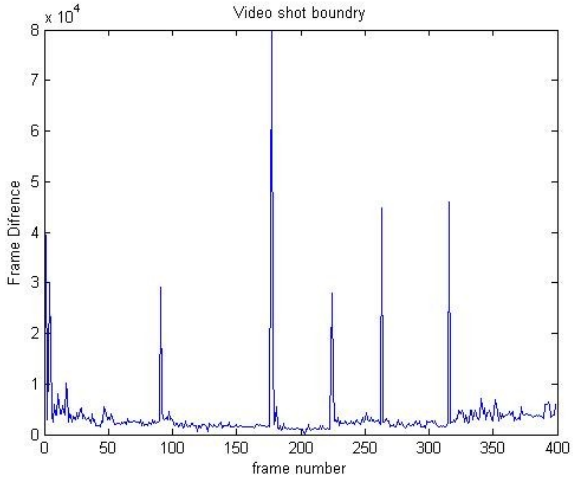

Fig 6. Video Shot Boundary detection for sample video input signal.

In the second part we have employed Histogram difference method as our base for detection of shot boundaries. As shown in Fig. 6, video shot boundary is detected between various frames at various time interval when scene change is observed. But we get highest peak between span of 150 to 200 frame number. We get shot change at frame number 187 which is shown in Fig. 5 as above. In Fig. 5, we can see frames varying from frame number 184 to 189, sudden change in scene is detected and same is recorded on graph too in Fig. 6. It can be seen that shot boundary is detected between this span, if the difference measured is maximum then shot boundary is detected. In this method, histogram difference of the current frame and previous frame is taken.

To calculate this difference Correlation equation is used. The Correlation equation is used to measure the difference between two consecutive frames. Based on the set threshold, a shot is said to be detected if the dissimilarity between the frames is higher than the threshold value.

$$d(H_1,H_2) = \frac{\sum_I (H1(I)-\overline{H1})(H2(I)-\overline{H2})}{\sqrt{\sum_I (H1(I)-\overline{H1})2 \sum_I (H2(I)-\overline{H2})2}}$$

where

$$\bar{H}k = \frac{1}{N}\sum_J \text{Hk (J)}$$

Where N is the total number of histogram bins.

H_1 is the histogram of first image.

H_2 is the histogram of second image.

In matlab, we can easily implemented Histogram difference algorithm, whenever shot boundary is present it will detect and show with the help of Graph.

Fig. 8 show the proposed algorithm for video shot boundary detection using DCT for illumination removal and histogram difference method for finding out shot boundary in video.

V. CONCLUSIONS

Accurate shot change detection is important for organizing video contents into meaningful segments for video scene analysis. In this paper we have presented novel approach to the detection of shot boundaries. We have first removed the effect of illumination change, as often illumination interference is mistaken as shot boundaries and its elimination is the major challenge to the shot boundary detection algorithms.

We address this issue by developing the structure features that are invariant to illumination using discrete cosine transform. Then to detect shot boundaries we used Histogram difference method. A shot boundary detected if the difference in the frames is higher than the threshold value. Our proposed algorithm has been tested on various videos, and is successful in avoiding disturbances due to illumination change and successfully detecting the shot boundaries.

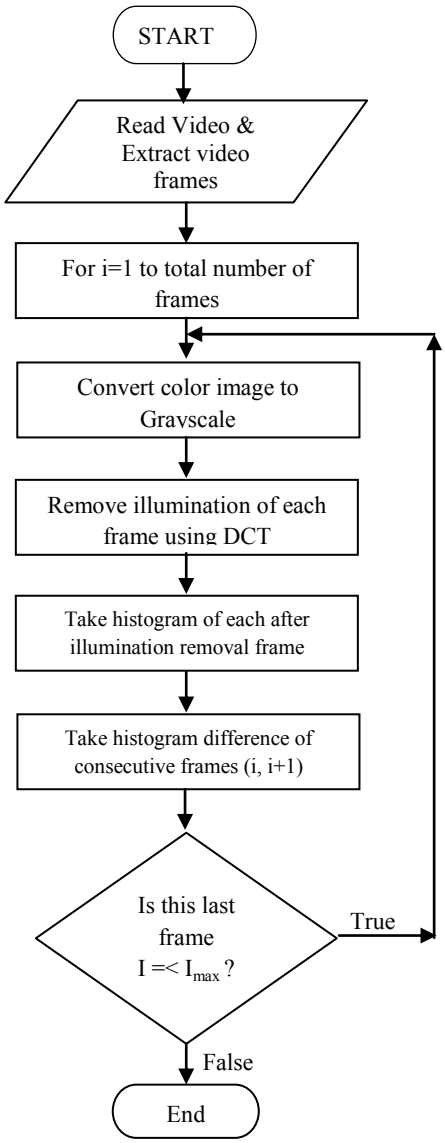

Fig. 8. The proposed Video shot boundary detection algorithm

ACKNOWLEDGMENT

I cannot complete my work without support of my internal guide.

REFERENCES

[1] H. J. Zhang, A. Kankanhalli, and S. W. Smoliar, ‘‘Automatic partitioning of full-motion video’’, Multimedia systems vol.1, pp. 10–28, 1993.

[2] J. S. Boreczky and L. Rowe, “Comparison of video shot boundary detection techniques”, in Procedings IS&T/SPIE Storage and retrieval for still image and video databases IV, vol. 2670, pp. 170–179, Feb. 1996.

[3] R. Lienhart, “Reliable transition detection in videos: A survey and practitioners guide”, International journal of image and graphics, vol.1, no. 3, pp. 469 – 486, Sept, 2001.

[4] A. Hanjalic, “Shot-boundary detection: Unraveled and resolved?”, IEEE transaction circuits system video technology, vol.12, no. 2, pp. 90 – 105, Feb. 2002

[5] U. Gargi, R. Kasturi, and S. H. Strayer, “Performance characterization of video shot-change detection methods”, IEEE transaction circuits systems video technology, vol.10, no.1, pp.1 – 13, Feb.2000.

[6] R ford, C Robonson, D Temple & M gelach, “ Metrics for short boundary detection in digital video system”, vol. 8, pp. 37-46, 2000

[7] J. yuan, H. wang, L. xiao, W. zheng, J Li, F Lin, et al., “A formal study of shot boundary detection on circuit & systems for video technology”, vol. 17,no. 2, pp. 168-186, Feb. 2007

[8] K. sethi & N. Patel, ”A statistical approach to scene change detection”, SPIE, proceedings on storage and retrieval for image & video database III, vol. 2420, pp. 329-338, Feb 1995

[9] Jinhui Yuan, Huiti wang, lan Xiao, Wujie Zheng, Jianmin Li, Fuzong Lin, & Bo Zhang, “A formal study of shot boundary detection”, IEEE Transaction on circuits & systems for video technology”, vol. 17, no. 2, pp. 234-239, 2007

[10] Parul S. Arora Bhalotra & Bhushan D. Patil, “Video shot boundary detection using finite ridgelet transform method”, ICT and Critical infrastructure: Proceedings of the 48th Annual Convention of Computer Society of India- Vol II, Advances in Intelligent Systems and Computing Volume 249, 2014, pp 163-171, 2014

Sonal P Waghmare is currently pursuing the M.E (Communication) degree in the Shri Sant Gadgebaba College of Engineering & Technology, Bhusawal, Maharashtra, India. She have received the B.E (Electronics & Communication) degree from Anuradha Engineering college, Chikhali, Maharashtra. She has one year of experience of teaching undergraduate. Her research interests are in the areas of image processing, video processing.

Anant S Bhide is currently working as a Associate professor in Department of Electronics and communication Engineering at Shri Sant Gadgebaba College of Engineering & Technology, Bhusawal, Maharashtra, India. He has done M.E. (Communication). He has ten years of experience of teaching undergraduate students and post graduate students. He has published more than 10 research papers in esteemed International journals.

