Research Paper Engineering

Analysis, Verification and Comparison of Various Algorithms on Shot Boundary Detection

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ABSTRACT

Now days there are tremendous amount of videos available on internet. Entertainment video, news video, sports video are accessed by users to fulfill their different needs. Our daily routine systems are also producing huge amount of videos for example surveillance system, shopping malls, home videos etc. These videos need to be accessed for different purposes. Current research topics on video includes video abstraction or summarization, video classification, video annotation, content based video retrieval. In nearly all these application one needs to identify shots in video which will correctly and briefly indicate the contents of video. This paper compares some of the popular shot boundary detection techniques. The merits and demerits of each of the techniques are also discussed. Some experiment done are also discussed.

Keywords : Color Histogram Difference Based, Edge Change Ratio Based, Cut detection, Pixel Based techniques, Shot detection

I. INTRODUCTION

A Video can be segmented into scenes, shots and frames. A scene is logical group of shots. A shot is sequence of frames captured by single camera operation. Shot boundary detection is the process of identifying transition between adjacent shots.

Costas cotsaces, Nikos Nikolaidis and Ioannis Pitas[1] presented about various shot transition(gradual and abrupt),spatial feature domain, Temporal domain of continuity matric, shot change detection methods. Ramin Zabih,Justin Miller and Kevin Mai[2] suggested about the detection and classification of scene breaks in video sequences. And also describes edge change ratio based method to detect cuts, fades and dissolve. Nagasaka et al [3] propose color histogram difference based method by taking RGB component difference between two consecutive frames.

II. TYPES OF SHOT TRANSITION

Fig. 1 shows different shot transition types. There are two types of shot transition: abrupt and gradual. Gradual transition is further classified as fade, dissolve and wipe. Abrupt transition occurs in single frame. Hard cuts are example of abrupt transition.A fade out is a slow decrease in brightness resulting in a black frame; a fade in is a gradual increase in intensity starting from a black image. Dissolves shows overlapping of two images, frames of first shots are fade out and frames of second shot are fade in.. The Hard cut is shown in Fig. 2 below, Fade is shown in Fig. 3 and dissolve is shown in Fig. 4 below. Detection of gradual cuts are more difficult than detection of hard cuts.

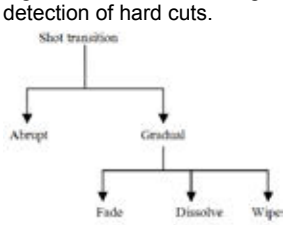

Fig. 1 :Types Of Shot Transitions

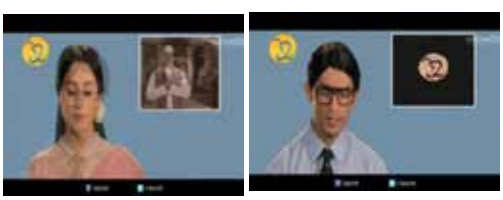

Fig. 2 : Hard Cuts

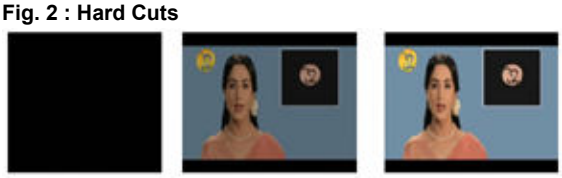

Fig. 3 : a) Fade in

Fig. 3 : b) Fade out

Fig. 4 : Dissolve

III. SHOT DETECTION METHODS

A. Color Histogram Difference Based Method

This method computes color histogram difference of two consecutive frames of given video sequence. If the difference between shot is above some threshold, shot boundary is assumed. This difference can be computed as sum of absolute

difference between bin values.

$$d_{RGB}(X,Y) = \sum_{i=1}^{M} |h_x(i) - h_y(i+1)|$$

Where hx is the color histogram of image x which contains M different bins. This method is less sensitive camera or object motion. This method detects hard-cut, fade and dissolve and fails when there is large amount of motion. Pye et al [4] has used three histogram differences, considering separately the three color components of the RGB space.

B. Edge Change Fraction Method

Another important feature that has been proved to be useful in detection of shot boundaries is Edges. In this method First the edges of two consecutive frames are detected by using the canny edge detector, then number of edge pixels are calculated in consecutive frames, then number of entering and exiting edge pixels are calculated, then ratio of entering edge pixel & edge pixel of higher order frame and ratio of exiting edge pixel & edge pixel of lower order frame is calculated, maximum value of these two quantities gives edge change fraction.

Let μ_n be the number of edge pixel in frame n, E_n^{in} and E_{n-1}^{out} the number of entering and exiting edge pixels in frames n and n-1 respectively, Then

$$ECR_n = \max\left(E_n^{in}/\mu_n, E_{n-1}^{out}/\mu_{n-1}\right)$$

This gives the value of edge change fraction between frames n-1 and n. This method is very useful in detecting fade, dissolve and wipe, disadvantage of this method is that it's computation time is high.[5]

C. Pixel Difference Based Method

This is both the most obvious and most simple algorithm of all: The two consecutive frames are compared pixel by pixel, summing up the absolute values of the differences of each two corresponding pixels. Pixel difference method reacts very sensitively to even minor changes within a scene: fast movements of the camera, explosions or the simple switching on of a light in a previously dark scene result in false hits. On the other hand, pixel difference method hardly reacts to soft cuts at all, It detects all visible hard cuts.

$$\left(\left|\sum_{i=1}^{X}\sum_{j=1}^{Y} P(I_t, i, j) - \sum_{i=1}^{X}\sum_{j=1}^{Y} P(I_{t-1}, i, j)\right|\right) > T$$

If this equation is satisfied then shot boundary is detected. Where P (, i, j) is pixel quantity. T is threshold.[3]

IV. EXPERIMENT RESULTS

Experiment done in MATLAB R2009a for different types of video using these three different techniques.

Figure below shows the results of movie trailer type of video for three different techniques and when we compare these three techniques in table cuts detected by these three methods are almost same. Figure of Front panel of gui is also shown.

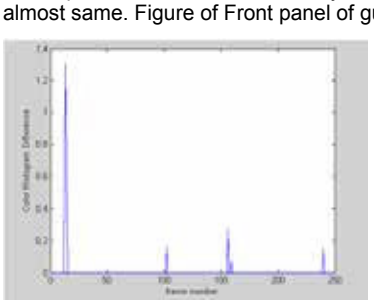

Fig. 5 : Result of movie trailer type video using Color histogram difference method

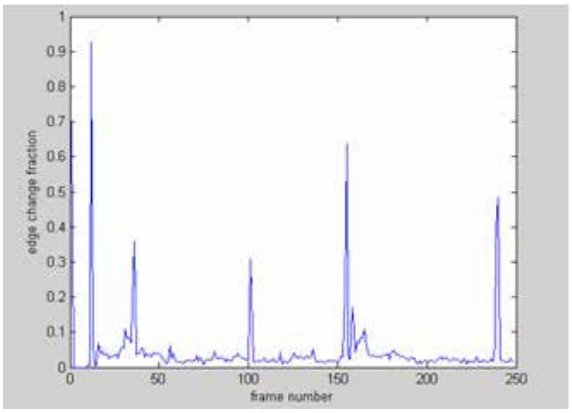

Fig. 6 : Result of movie trailer type video using Edge change fraction method

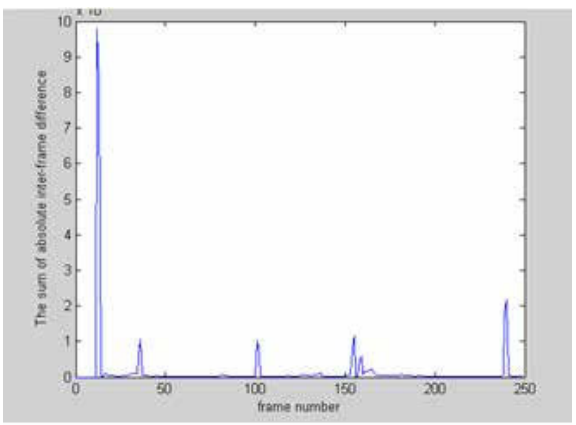

Fig. 7 : Result of movie trailer type video using Pixel difference method

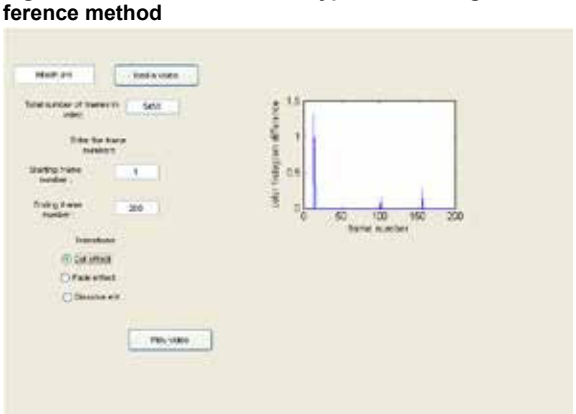

Fig. 8 : Front Panel of gui

TABLE I
Experiment Results

Method used	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6
Color histogram difference	12	100	154	157	239	-
Edge change fraction	12	35	100	154	157	239
Pixel difference	12	35	100	154	157	239

V. CONCLUSION

From the above experimental results we conclude that when we compare the three methods of shot boundary detection, we get the same result of shots as shown in the table.

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