Available online at www.elixirpublishers.com (Elixir International Journal)

Electrical Engineering

Elixir Elec. Engg. 82 (2015) 32367-32371

ISSN: 2229-712X

Developing an Efficient Algorithm for Video Shot Boundary Detection Using Dual Tree Complex Wavelet Transform

Ravi Mishra[1], S. K Singhai[2] and Monisha Sharma[3]

[1]Dr. C. V. Raman University, kargi Road, Kota, Bilaspur (c.g), India.

[2]Department of Electrical Engineering, Government Engineering College, Bilaspur (C.G), India.

[3]Department of Electronics & telecommunication Engineering, (FET), SSGI, SSTC, Junwani Bhilai (C.G), India.

ARTICLE INFO

Article history:
Received: 5 April 2015;
Received in revised form: 28 April 2015;
Accepted: 6 May 2015;

Keywords
Fade,
DTCWT,
Dissolve,
Wipe,
Shot.

ABSTRACT

In recent years, the development of software and hardware technology has enabled the creation of large amount of digital video content. The innovation being done in multimedia streams from last few years necessitates the development of efficient and more effective methodologies for storing information related to video, audio, text etc. Accessing of content based video data requires segmentation of each video stream into its primary blocks. The general objectives are to segment a given video sequence into its constituent shots, and to identify and classify the different shot transitions in the sequence. The video stream consists of a number of shots, each sequence of frames are represented using a single camera. Switching from one frame to another indicates the transition from a shot to the next one. Therefore, the detection of these transitions, known as scene change or shot boundary detection, is the first step in any video-analysis system. A number of proposed techniques for solving the problem of shot boundary detection exist, but the major challenges to them is Detection of gradual transition and the elimination of disturbances caused by illumination change or fast object and camera motion . The reliability of the scene change detection stage is a very significant requirement because it is the initial stage in any video retrieval system. Thus, its performance has a direct impact on the performance of all other stages. On the other hand, efficiency is also crucial due to the voluminous amounts of information found in video streams. In my research paper, a new robust and efficient algorithm capable of detecting transitions in AVI videos is developed.

Introduction

The impulsive growth of digital video applications entails the generation of vast amount of video data; however, the technologies for organizing and searching video databases are still on demand. Video is the most resourceful media for capturing the world around us. It has been the primary concern of the movie, television industry and has developed procedures and techniques to index, store, edit, retrieve, sequence and present video material.

Shot boundary detection (SBD) is the basis of enlightening higher levels of the hierarchical video structure. The next structural level above the shot is scene levels as shown below. The shot boundaries thus usually represent overlapping of scene, so gathering information on the shot boundaries and scene boundaries helps us to gain more insight in the challenging factors.

Shot boundary detection searches for and recognizes the visual discontinuities caused by the transitions, to segment a video stream into its elementary content units. Despite the long research history and numerous proposed techniques, shot boundary detection is not completely solved. Since sports video is arguably one of the most challenging domains for robust shot boundary detections.

The basis of detecting shot boundaries in video sequences is the fact that frames surrounding a boundary generally display a significant change in their visual contents. The detection process is then the recognition of considerable discontinuities in the visual-content flow of a video sequence. Primary step of this process is feature extraction, where the features depict various aspects of the visual content of a video. Variation occurs from i frame to the next (i+1) frame. The discontinuity value represents magnitude of this variation. Then, this difference is compared against a threshold T. If the threshold is exceeded, a shot boundary between frames i and (i+l) is detected. Thus a reliable conclusion is drawn about the presence or absence of a shot boundary between frames i and i+l. This indicates the presence of a clear separation between difference value ranges for measurements performed within shots and at shot boundaries. Finding shot boundaries are useful in some applications like advertisement, news, movies, TV programmes etc. Shot boundary detection also makes it possible to build video players in which the user can rewind and fast forward one shot at a time, or browse the contents of the video by its key frame representation.

A video sequence can be viewed as a well-organized document and can be categorized into logical units at the following different levels:

• **Frame level:** A frame represents a single image in a video sequence.

• **Shot level**: A shot is a sequence of frames recorded contiguously from a single camera and representing a continuous action in time or space.

• **Scene level**: A scene is a continuous sequence of shots having a common semantic significance.

Tele:
E-mail addresses: ravimishra_elex@yahoo.co.in

• **Sequence/story level**: A sequence/story is composed of a set of scenes.

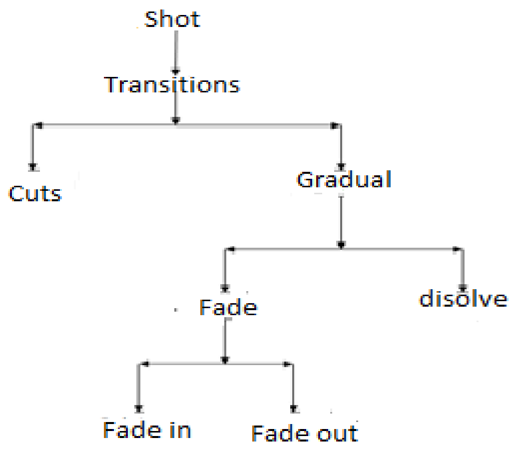

Figure 1. Structure analysis

A transition generally represents sequential discontinuities in video sequences where the sequence of frames between two successive shot shows variation. There are two kinds of shot transitions, i.e. abrupt changes (also called cuts) and gradual ones, which are presented mainly in the forms of fade, dissolve, and wipe.

A video stream consists of a sequence of image. The video stream can have arbitrary length. The illusion of moving picture is generated by showing rapidly a sequential series of still images. The human eye is too slow to see the individual still images, and thus interprets the sequence of still images as a constant movement. On an average the frame rates of videos are calculated about 24 or 30 images per second, which is enough to generate the illusion of continuous movement. Edited video typically consists of multiple shots. A shot is a series of sequential frames that have been captured using a single camera. Shots are bound together using several kinds of cuts or transition effects. In movie terminology multiple shots form a scene, which is defined to be a set of consecutive shots that form an unit that seems to be continuous in time.

Each shot, scene and story can be depicted coarsely for visualization and summarization purposes. The frame depicts the most significant visual feature of the related video segment. Depending on the complication involved in video segmentation, there can be one or multiple video frames depicting it. The frames are frequently extracted from the shot level, and appropriate shot frames are then be selected to represent the higher-level components in the video hierarchy.

The shots are clearly visually separable by humans. Most of the transitions between shots can be classified into abrupt cuts, and gradual fades, dissolves and wipes.

There are a variety of methods available to detect shot boundary in videos based on pixel differences [9], color differences, statistical differences, compression differences, edge differences [10], histogram comparison and motion vector [11]. In this paper, comparison of three algorithms

A hard cut is an abrupt transition in which there is an instantaneous transition from one shot to another subsequent shot.

Figure 2. Video frames depicting hard cut

A fade as shown in Figure 1.3 is a transition in which every pixel on the screen fades into single color, typically white or black ie. fade in, or from a single color back into natural image ie. fade out.

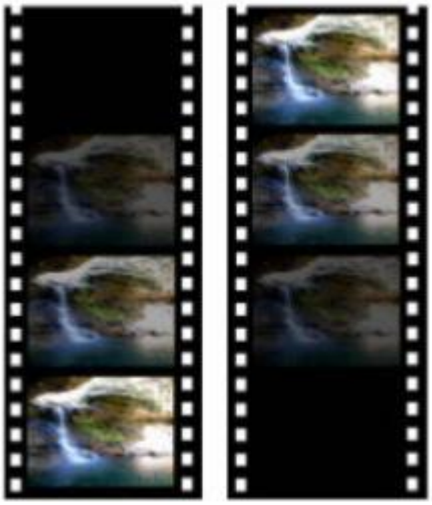

Figure 3. Video frames depicting fade transition Fade in (left) and Fade out (right)

In dissolves as shown in Figure 1.4 the RGB values of the pixels are gradually changed from one shot to another, and thus parts of both shots are shown simultaneously for a while.

Figure 4. Video frames depicting dissolve transition

Wipes as shown in Figure 1.5 are transitions in which each pixel of the first shot is replaced by the pixels of the second shot in an organized pattern like circular, diagonal, vertical, horizontal etc. For example, sequentially changing each column of pixels from left to right is a typical wipe effect.

Figure 5. Video frames depicting wipe transition

Digital editing allows us to create countless types of additional transition effects. These are used for stylistic effect in entertainment videos. However, most of the cuts in typical news broadcasts can be classified into the mentioned four classes of transitions. For shot boundary detection purposes it is usually sufficient to be able to recognize the instance when a transition takes place. Some shot boundary detection algorithms also use separate detection algorithm for separate transition classes, and therefore knowing the characteristic properties of each transition type it can be useful.

Non-real time video shot boundary detection

For non-real time video shot boundary detection we used test videos having edit effects like fade, cut etc. First step towards the approach is to convert video into its frame. The elements of frames are known as node or vertices and the path joining the node with other node to form a tree pattern is called edge. A graph is always represented by G = (V,E). With this node we form a tree pattern based on the number of available nodes.

The dissimilarities between the tree pattern is examined by DWT so form results in frame difference. This difference is calculated in terms of histogram difference for abrupt change which is insensitive to changes in colour, luminance because there is a sudden change between two adjacent frames so no similarity exist there. In case of gradual, we see minute changes in luminance, color, and motion of both camera and background which is very frequent. So for this we use standard deviation of pixel intensities in combination with contrast change feature, to calculate frame difference. It deals with color, intensity feature including motion and luminance characteristics. Proposed algorithm is tested for several videos e.g. sports, animated, wildlife, cartoon, action, movies etc.

Lastly the calculated difference is compared against a reference level known as threshold value. In the proposed algorithm we chose adaptive thresh holding. Adaptive threshold measure the average discontinuity within a temporal domain.

Real time video shot boundary detection

Live video shot boundary detection will be implemented in Graphical User Interface in which three push buttons has been configured as “START VIDEO”,”STOP VIDEO” and “EXIT”. Functions are used to get the live video streaming from the connected camera of computing system (laptop). Functions are used to configure the input settings of data acquisition for video streaming. Start button is used to start the video from camera for getting the data acquisition from the camera and display on the first axes on the window of GUI.

Calculate the sensitivity and modifying the video error after that we are updating the video frames. Sensitivity will be calculated and video error has been modified after that video frames are updated. Function has been used to save the snapshot image and show on the axes of the GUI continuously.

To check the motion variation of video if the motion has huge variation means if the difference of current image frame and previous image is more than expected then store the image in the data base and display in the second axes window.

The structural features of an image are extracted by using DTCWT on the sub bands of the image to determine the shot boundary detection by using functions.

Result and Discussion

The output observe for different videos (non- real time) is as follows:

For Abrupt Transition

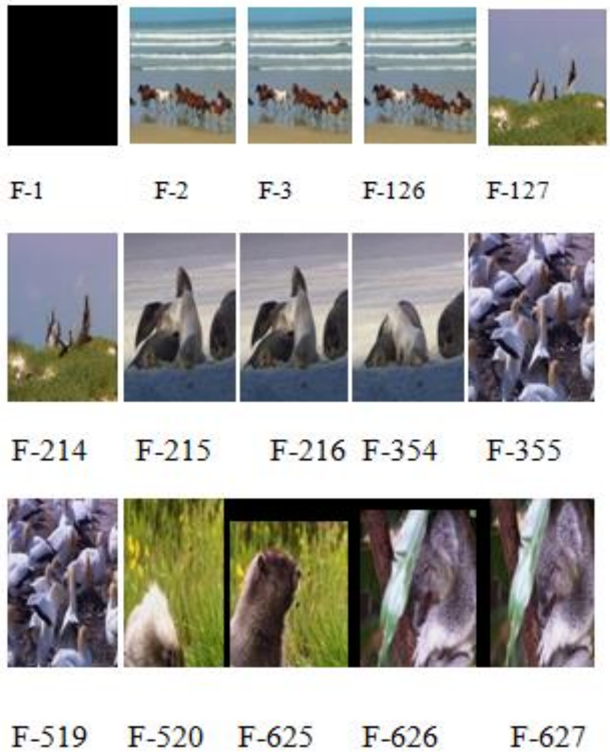

Figure 6. Frames for abrupt transition

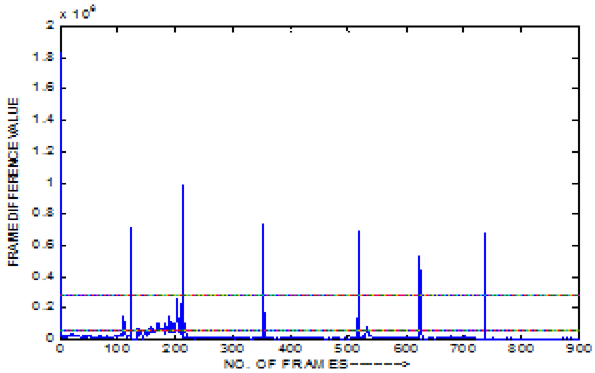

Figure 7. Output for hard cut (abrupt transition)

For gradual transition

Video with dissolve effect

Figure 8. Video with dissolve effect

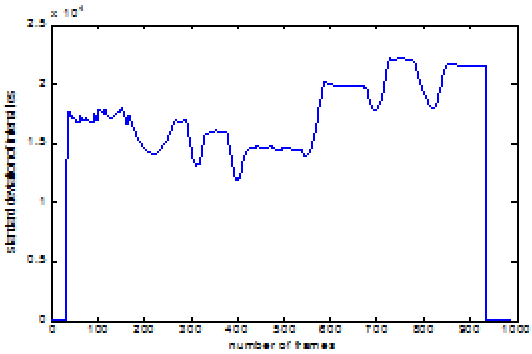

Figure 9. Output for dissolve transition (including dissolve effect as well as motion and luminance)

Output for real time video shot boundary detection

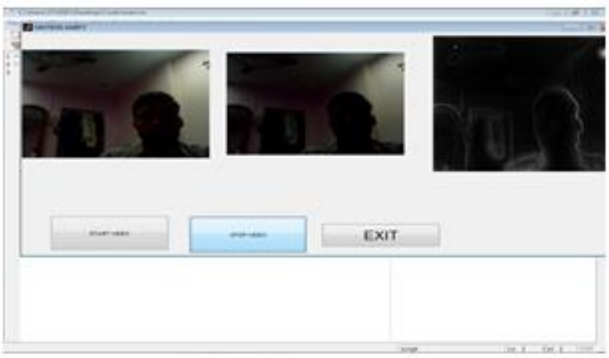

Figure 4.3.1 GUI implementation for real time video shot boundary detection (1)

Figure 4.3.2 GUI implementation for real time video shot boundary detection (2)

Conclusion

In this research work we proposed a newly develop algorithm in conjunction with the advantageous feature of predefined method. We frame our task as an outlier detection problem during different occurring transitions. For non-real time videos we used DTWT and nodal analysis concept for efficient result and better accuracy. We test different video types and observe their result and measure performance for various design parameters. Thus our system produces favorably good result compared to various existing approaches.

The method we used for frame difference calculation i.e., histogram difference and standard deviation of pixel intensities using contrast change parameters show high accuracy in detecting abrupt and gradual transition respectively.

For real time video shot boundary detection we prepare Graphical User Interface in which three push buttons has been configured as “START VIDEO”,”STOP VIDEO” and “EXIT”. START VIDEO button is used for video recording. Data acquisition functionality is used to record the video with the help of local webcam connected to the system. Now we are monitoring the live video in the mean while we are checking the difference between the previous image frame and current image frame by using a comparison parameter. Now we are extracting the structural features of an image by using DTCWT on the sub bands of the image. If the comparison parameter is increase beyond its limit we save that image and display the image in second window means if there is a huge motion difference comparison parameter will vary more which indicate shot boundary.

References

1.Ravi Mishra ,S.K.Singhai ,M. Sharma “Comparative study of block matching algorithm and dual tree complex wavelet transform for shot detection in videos” Electronic system, signal processing and computing technologies(ICESC), 2014 International Conference, Jan 2014

2.Sowmya R ,Dr.Rajashree Shettar “Analysis and Verification of Video Summarization using Shot Boundary Detection”- , American International Journal of Research in Science, Technology, Engineering & Mathematics, 3(1), June-August, 2013, pp.82-86

3.Zhe Ming Lu and Yong Shi “Fast Video Shot Boundary Detection Based on SVD and Pattern Matching-”Image processing IEEE Transactions (Volume:22 , Issue: 12), Dec. 2013

4.Ravi Mishra ,S.K.Singhai,M. Sharma “ Video shot boundary detection using dual-tree complex wavelet transform” -Advance Computing Conference(IACC),2013 IEEE 3rd International, Feb. 2013

5.Mr. Sandip T. Dhagdi, Dr. P.R. Deshmukh “Key frame Based Video Summarization Using Automatic Threshold & Edge Matching Rate” International Journal of Scientific and Research Publications, Volume 2, Issue 7, July 2012

6.Pablo Toharia et al “on Shot boundary detection using Zernike moments in multi-GPU multi-CPU architectures”- Journal of Parallel and Distributed Computing Volume 72 Issue 9, September, 2012

7.Partha Pratim Mohanta, Sanjoy Kumar Saha, Member, IEEE, and Bhabatosh Chanda[2012] Member IEEE, “A Model-Based Shot Boundary Detection Technique Using Frame Transition Parameters” IEEE transactions on multimedia, vol. 14, NO. 1, february 2012.

8.Goran J. Zajić, Irini S. Reljin, Senior Member, IEEE, and Branimir D. Reljin, Senior Member, *IEEE*, “Video Shot Boundary Detection based on Multifractal Analisys” Telfor Journal, Vol. 3, No. 2, 2011

9. Baber, J.; Afzulpurkar, N.; Dailey, M.N.; Bakhtyar, M.; “Shot boundary detection from videos using entropy and local descriptor”, Digital Signal Processing (DSP), 2011 17th International Conference on Zhao Huan, July 2011, pp 1-6.

10 Paul Browne, Alan F Smeaton, Noel Murphy, Noel O’Connor, Seán Marlow, Catherine Berrut, “Evaluating and Combining Digital Video Shot Boundary Detection Algorithms”, Conference or Workshop Item, Feb-2009.

11.Bo Han; Weiguo Wu; “Video scene segmentation using a novel boundary evaluation criterion and dynamic programming”, Multimedia and Expo (ICME), 2011 IEEE International Conference on, July 2011, pp 1-6.

12.Wenzhu Xu & Lihong Xu[2010] “A Novel Shot Detection Algorithm Based on Graph Theory” ” 2010 2nd International Conference on Education Technology and Computer (ICETC).

13.LihongXu & WenzhuXu[2010] “A Novel Shot Detection Algorithm Based on Clustering” 2010 2nd International Conference on Education Technology and Computer (ICETC)

14.Vasileios T. Chasanis, Aristidis C. Likas, and Nikolaos P. Galatsanos[2009] “Scene detection in videos using shot

clustering and sequence alignment" IEEE transactions on multimedia, vol. 11, no. 1, January 2009
15.Gang Zang, Wenlong Wang Xiaoyan Kuan Yue Niu " a new shot boundary detection approach based on motion estimation of MPEG-4" Management and Service Science,2009.Mass'09, International Conference on 2009
16.Yufeng Li, Zheng Zhao [2008] "A Novel Shot Detection Algorithm Based on Information Theory. 2008 IEEE Pacific-Asia Workshop on Computational Intelligence and Industrial Application
17.Jinhui Yuan, Huiyi Wang, Lan Xiao, Wujie Zheng, Jianmin Li, Fuzong Lin, and Bo Zhang [2008] "a shot boundary detection method for news video based on object segmentation and tracking" IEEE transactions on circuits and systems for video technology, vol. 17, no. 2, february 2008
18.Kota Iwamoto and Kyoji Hirata[2007] "Detection of wipes and digital video effects based on a pattern-independent model of image boundary line characteristics
19.Daniel DeMenthon [2006] "Shot boundary detection based on Image correlation features in video".
20.Liuhong Liang Liuhong Liang, Yang Liu, Hong Lu, Member, IEEE, Xiangyang Xue, and Yap-Peng Tan, Senior Member, IEEE [2005],"A Enhanced Shot Boundary Detection Using Video Text Information", IEEE Transactions on Consumer Electronics, Vol. 51, No. 2, MAY 2005
21.Jesús Bescós, Guillermo Cisneros, José M. Martínez, José M. Menéndez, and Julián Cabrera[2005] "A Unified Model for Techniques on Video-Shot Transition Detection" IEEE transactions on multimedia, vol. 7, no. 2, april 2005