Video Authentication using Shot Boundary Detection Technique-An Overview

Noraida Haji Ali and Fadilah Harun
School of Informatics and Applied Mathematics, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu Malaysia

E-mail: aida@umt.edu.my

Abstract. Video is the most challenging and has lots of issues than other type of multimedia data and video authentication is one of the popular issues regarding the video. Technologies of communication nowadays can simplify sharing of multimedia data such as text, images and videos through online or offline and a wide spread of video content its significant to assure the integrity and originality of video information. Recently, a lot of cases have been stated regarding an illegal activity in the video. Such as, video editing or video tampering attacks to ruin the authenticity of the video. With only minor alterations could change the meaning of the video. Video authentication detection is a popular issue and of high importance in various fields such as in forensic investigations, court of law and video surveillance. A lot of techniques are proposed by previous study to assure the originality of video in their own way. In this study, it focuses to detect tampering attacks and alterations in video using shot boundary detection techniques. Shot boundary detection is a very challenging task and it’s commonly used for structured video because these techniques can detect the changes made with normal shot change rate. Meanwhile, this research will emerge to produce new model for video structure detection using shot boundary detection with the histograms feature that is significant to design of powerful tools to detect an originality of video and to locate the tampering attacks in video.

1. Introduction

Technologies of communication nowadays can simplify sharing of multimedia data such as text, images and videos through online or offline. Various amount of multimedia editing tools can be downloaded and used easily to edit the content and structure of digital data, and the information and structure can be changed. Ensuring the integrity and authentication of digital video is very challenging and not easy task. This is because, it’s to make sure the content and structure of digital data given is original and exactly same as recorded. Recently, many cases have been mentioned about illegal activity in the video. Such as, video editing or video tampering attacks to ruin the originality of video content and structure. In a few applications the authenticity of video plays an important task in forensic investigations, police or law enforcement and the paten ownership. For example, in court of law it is seriously important to make sure the content of video is trustworthiness, not have an editing in the video and it comes from the legal source. Video authentication is a process to make sure the content and structure a given video is original without any alteration and exactly same as when it recorded [1, 2].
Video is one of the challenging and have a lot of issues associated with it because it’s have huge number of frames to handle [3]. It’s challenging because when develops a video increase when its changes from images to image sequences, or video clips. Also, each video clips have their own rules and formats. Based on past research, there are many techniques for determine authentically of video data in many fields like forensic investigation, law enforcement or for a proof in court case. Among the techniques used are watermarking and digital signature [4] but it cannot make it if no insertion of pre-processing is done. Our study is to focus detecting the abnormal attacks in video using the shot boundary detection. Shot boundary detection is the process to decomposing the video structure into their parts and can determine relationship between its units. Shot boundary detection is the first way to extract scene extraction of the video which is effectively for video indexing and structure analysis for determine the authentication of video [5]. A shot boundary detection is identify when the feature contrast showed a sharp alteration greater than threshold [6]. The structures that available in video system are not consistently and not reliable. Moreover, there is no an available database to support video system and view schema objects. These issues force in an intention to define the specifications of a new structure for the association of a video system. We hope can detect the tampering structure of a video and it can be more efficient for retrieve the content with the used of shot boundary detection techniques. An expected outcome of this study is to produce new model for video structure detection using shot boundary detection techniques that is significant to design of powerful tools to detect an originality of video and locate abnormality changes. Through the investigation of the techniques obtained by the proposed method, it is confirmed that shot boundary detection is helpful to do video clipping and grasp the whole structure of video image to make sure the structure is consistent and clear [7].

2. Problem Statement

Information and communication technology development in the country has been growing rapidly since more than 3 decades ago. Government and commercial portals also use almost all administrative and communications business with an online approach. Following the rapid development of ICT is the relevant risks which has emerged and evolved in almost every aspect of life that has brought real threat to the well-being of the country. Issues related to cybercrimes have posed serious threats and challenges to some, for example, government agencies, particularly to law enforcement agencies in keeping the law and order. With the rapid development of digital technologies nowadays showed that the rising of shared information in multimedia data. However, all these development of these technologies can give several issues regarding with copyright protection and authentication [8];

- Lack of security protection of all data information on video clips.
- Easy to get and download applications editing software to changes the contents and meaning (by deleting, rotation, adding or shuffling) of video.

This study focusses on the issues stated regarding altering the content of video and to make sure the authentication of the video based on its structure. Authentication is a process to make sure that the content has not been edited as being genuine in substance. Since video clips easy to alter and manipulate, the capability to detect changes to digital video is critical. Recently, various authentication detection techniques have been listed in literature, but most have it focused on images. Video tampering attacks is detected when changes occur without permission on the video sequence, it attacks on video content or attacks against temporal dependencies between frames [1].
In video tampering attacks, an object can be altered with different ways. Figure 1 shows a common example of video alteration where an object was adding in next frame. Beside that’s, the size, colour, and shape of the existing objects also can be altered for bad intention. The alteration made can change the meaning and authentication of the video itself. Video authentication has been a very active field of research over recent years [2]. The used of shot boundary detection techniques can help to achieve the structured in video like scene, shot and keyframe [11]. In order to visualize the whole structure, a hierarchical representation of video by the used shot boundary detection is proposed. Furthermore, efficient video abstraction and high-level video segmentation approaches can be performed with the use shot boundary detection in video content structuring [12].

3. Literature Review
Video authentication is a process to determine content in a given video is an original and exactly similar as when it captured. In video authentication detection its can be divided into two approaches; active and passive [2]. In active approach, it can be done if pre-processing insertions like watermarking and digital signatures added in the video. If the video had an abnormality alteration, it can be recovery with the watermarking and signatures process. Meanwhile, in passive approach is to detect the changes by extracting features from the video clips. And in this study focus with passive approach to verify the originality of video content, and to detect alterations performed on video data by using shot boundary detection.

In the past research [9], television streams very highly redundant and it want detecting repetitions scene in the underlying structure of video. But it’s still difficult to retrieve the entire video program with the exact boundaries limit, from first to last frame. It’s used shot matching strategy to retrieve the repetitions shots and frame, but it’s still not achieve the whole video structuring [9]. Boreczky [7], made a discussion that elaborated and described about different video shot boundary detection techniques and presented a study on the performances of various shot boundary detection algorithms. The techniques that have been used for shot boundary detection are pixel differences, statistical differences, histogram comparisons, edge differences, compression differences, and motion vectors. All each technique had their own advantages and disadvantages. The used of histogram comparison more effective other than other techniques because its simple histogram techniques that calculates grey level or colour histograms of the two images. A shot boundary is detected when bin-wise difference between the two histograms is above a threshold and it showed that had changes in the video. Xavier and Patrick [9], used shot matching strategy for detecting repetitions frame in television stream. It’s because television stream has highly repetitions and redundant structure. But it’s difficult to retrieve only can detect shot and frame that had repetitions but not achieve the whole structure. Research by Yong Rui [10], stated that video had two common issues, which is length and unstructured format so access to video is very difficult. It’s introduced the concept of table of content (TOC) for browsing and retrieval the hierarchical structure and, but it only retrieved only 3 level of structure, shot, groups and
scenes. However, researchers usually can get a good result by evaluate the visual content of the video and partitioning it into a basic unit of video called frame. The sequence of frame determines by order of frame number. A shot is an uninterrupted segment of video frame sequence with static or continuous camera motion. In general, combination a shot (scene) it’s to outcome one complete video clips. Scene a series of shots that are detection (SBD) is based on the identification of visual contrast due to the transformations. SBD also used for indexing and browsing of video hierarchically structure.

4. Shot Boundary Detection
Videos can be segmented into hierarchy level, scenes, shots and keyframes. Shot boundary detection is the step towards hierarchy structure extraction in videos, which is useful for video content analysis and tampering detection. It is suitable for many applications like indexing in video database, video compression and video access. The basic unit of any video is frame. A video can be segmented into shots by using shot boundary detection techniques. Meanwhile, keyframe can be extracted from the shots. Shot boundary detection (SBD) techniques has different features pixel based, histogram based, statistical based, motion based, compression based and edge detection. The pixel-based techniques are sensitive to camera motion and slow. Statistical based also has a limitation is slow due the complexity of the formulas used in statistical. The popular and common used techniques is histogram differences to detect the shot boundary. It’s because the histogram method is simplest way to calculate gray level or colour histogram between two images. Histograms techniques is compared frame each other side to detect the bin-wise difference to get the boundary of the shot. This technique also gives the accuracy of the boundary detection and very fast speed compare to others feature.

| SBD Features | Percentage (%) |
|--------------|---------------|
| Pixel        | 3.6           |
| Histogram    | 42.9          |
| Statistical  | 3.6           |
| Motion       | 25.0          |
| Compression  | 3.6           |
| Edge         | 21.4          |

Figure 2. Shot Boundary Detection (SBD) in Different Features.
In shot boundary detection techniques has many features and methods used to solve various issues occurs in video. Other researchers used more than one features in one case studies. Table 1 and Figure 2 showed the distribution of the 27 articles by the studied journal. The articles related to the popularity use of Shot Boundary Detection (SBD) in different features. The percentage of the results above its come from the research papers were studied from year 2000 to 2018 [11-37] and it showed the popular techniques used in SBD. The results clearly showed that the most popular features to find change in video structure is histogram analysis. Histogram can be of grey images or colour images that are used mainly in histogram analysis. If the bin wise contrast between the two approach above a threshold, and a shot boundary can be detected. Comparison made between pixel differences, statistical differences, histogram differences showed that histogram techniques were a good deal between accuracy and speed to handle video structure [38]. Sometimes other techniques also combined with histogram like statistical measurements features for detection of shot boundary. Motion analysis between two consecutive frames is another most popular technique in shot boundary detection. Shot boundary detection is based on the differences of visual because of transitions. The abnormalities between two frames can be found while shot change. This tampering detection occurs in two different type, and it can be as in Figure 3; abrupt (hard cut) and gradual (dissolve, fade in, fadeout, wipe).

![Figure 3. Gradual and Abrupt Shot Change [7].](image)

Scene construction is designed based on the results of shot boundary detection. In scene construction two important things must be considered is content similarity and temporal continuity. Content similarity means, shots within in same scene must had same content and temporal continuity is the shot is temporal is closed is others and it showed same scene. Keyframes are the frames in a video sequence that keep the content of its shots. They can be used as the starting points of the video for indexing. The keyframe extraction methods that is common used can be categorized into two approaches, analysis-based and clustering-based. Therefore, generally a video can be structured in a hierarchical form as “videos → scenes → shots → keyframes”.

5. Conclusion

Video is one of the biggest challenging in other media data types and video authentication is one of the popular issues regarding the video. Video authentication detection is a common issue and of high importance in various fields such as in forensic investigations of digital video for law enforcement agencies, video surveillance and presenting video evidence in court of law. It not easy to handle the originality of raw video sequences. One of the solutions to deal with video authentication is shot boundary detection and it can help to solve the issues to determine and prove the originality of video clip based on frame hierarchically structure. Shot boundary detection is a very challenging task. The used of shot boundary detection give an accurate and comprehensive results with structured video compared than unstructured video [39]. Many approaches have been proposed for shot boundary detection like pixel, histogram, statistical, motion compression and edge. In this study focused to find the differences between the sequences frame at various time interval and used histograms features to detect the changes occur. If the results between two sequences of frame is above threshold, a shot boundary is detected, and the frame differences is assumed. The advantages of histogram features for
shot boundary detection is very fast and accurate because the used of threshold to detect the changes in video clips [40]. Besides these, the results of the discussed techniques in this work were inefficient for videos with very fast shot change [39]. The less explored features like object detection and object analysis can be explored more to improve the techniques. Hope in in this research can improve the quality of video for being used to solve the editing video in cybercrime issues. Meanwhile, this research will emerge to produce new model for video structure detection using shot boundary detection with the histograms feature that is significant to design of powerful tools to detect an originality of video and to locate the tampering attacks in video.

References
[1] Upadhyay S and Singh S K 2012 Video authentication: Issues and challenges International Journal of Computer Science Issues (IJCSI) 9 p 409
[2] Sawant R and Sabnis M 2018 A Review of Video Forgery and Its Detection Journal of Computer Engineering (IOSR-JCE) 20 pp 1-4
[3] Suriani A L, Ali M, Ibrahim H and Ahmad F 2007 Video Data Modelling To Support Hybrid Query IJCSNS 7 p 53
[4] Wahab A W A, Bagiwa M A, Idris M Y I, Khan S, Razak Z and Ariffin M R K 2014 Passive video forgery detection techniques: a survey 10th International Conference on Information Assurance and Security pp 29-34
[5] Sowjanyaa M P S and Mishra R 2012 Video shot boundary detection International Journal of Electronics, Communication & Instrumentation Engineering Research and Development 1 p 2
[6] Waghmare M S P and Bhide A 2014 Shot Boundary Detection using Histogram Differences International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) 3 pp 1460 - 4
[7] Boreczky J S and Rowe L A 1996 Comparison of video shot boundary detection techniques Journal of Electronic Imaging 5 pp 122-9
[8] Queluz M P 2001 Authentication of digital images and video: Generic models and a new contribution Signal processing: Image communication 16 pp 461-75
[9] Naturel X and Gros P 2008 Detecting repeats for video structuring Multimedia Tools and Applications 38 pp 233-52
[10] Rui Y, Huang T S and Mehrotra S 1999 Constructing table-of-content for videos Multimedia systems 7 pp 359-68
[11] Petersohn C 2004 Fraunhofer HHI at TRECVID 2004: Shot boundary detection system TREC Video Retrieval Evaluation Online Proceedings TRECVID
[12] Browne P, Smeaton A F, Murphy N, O'Connor N E, Marlow S and Berrut C 2000 Evaluating and combining digital video shot boundary detection algorithms
[13] Zhou J and Zhang X P 2005 Video shot boundary detection using independent component analysis Proceedings (ICASSP’05) IEEE International Conference on Acoustics, Speech, and Signal Processing 2 pp 541-4
[14] Lee M S, Yang Y M and Lee S W 2001 Automatic video parsing using shot boundary detection and camera operation analysis Pattern Recognition 34 pp 711-9
[15] Fang H, Jiang J and Feng Y 2006 A fuzzy logic approach for detection of video shot boundaries Pattern Recognition 39 pp 2092-100
[16] Kim W H, Moon K S and Kim J N 2009 An automatic shot change detection algorithm using weighting variance and histogram variation 11th International Conference on Advanced Communication Technology pp 1282-5
[17] Xu W and Xu L 2010 A novel shot detection algorithm based on graph theory 2nd International Conference on Computer Engineering and Technology pp 628-30
[18] Lu Z M and Shi Y 2013 Fast video shot boundary detection based on SVD and pattern matching IEEE Transactions on Image processing 22 pp 5136-45
[19] Cernekova Z, Kotropoulos C and Pitas I 2003 Video shot segmentation using singular value decomposition *IEEE International Conference on Acoustics, Speech, and Signal Processing Proceedings (ICASSP’03)* pp 181-4

[20] Joyce R A and Liu B 2006 Temporal segmentation of video using frame and histogram space *IEEE Transactions on multimedia* 8 pp 130-40

[21] De Bruyne S, Van Deursen D, De Cock J, De Neve W, Lambert P and Van de Walle R 2008 A compressed-domain approach for shot boundary detection on H. 264/AVC bit streams *Signal Processing: Image Communication* 23 pp 473-89

[22] Deng Y and Manjunath B 2001 Unsupervised segmentation of color-texture regions in images and video *IEEE transactions on pattern analysis and machine intelligence* 23 pp 800-10

[23] Lelescu D and Schonfeld D 2003 Statistical sequential analysis for real-time video scene change detection on compressed multimedia bitstream *IEEE Transactions on Multimedia* 5 pp 106-17

[24] Amel A M, Abdessalem B A and Abdellatif M 2010 Video shot boundary detection using motion activity descriptor *Journal of Telecommunications* 2 pp 54-9

[25] Donate A and Liu X 2010 Shot boundary detection in videos using robust three-dimensional tracking *IEEE Computer Society Conference on Computer Vision and Pattern Recognition-Workshops* pp 64-9

[26] Mishra R, Singhai S and Sharma M 2013 Video shot boundary detection using dual-tree complex wavelet transform *3rd IEEE International Advance Computing Conference (IACC)* pp 1201-6

[27] Acharjee S and Chaudhuri S S 2012 A new fast motion vector estimation algorithm for video compression *International Conference on Informatics, Electronics & Vision (ICIENV)* pp1216-9

[28] Acharjee S, Dey N, Biswas D, Das P and Chaudhuri S S 2012 A novel Block Matching Algorithmic Approach with smaller block size for motion vector estimation in video compression *12th International Conference on Intelligent Systems Design and Applications (ISDA)* pp 668-72

[29] Acharjee S, Biswas D, Dey N, Maji P and Chaudhuri S S 2013 An efficient motion estimation algorithm using division mechanism of low and high motion zone *International Multi-Conference on Automation, Computing, Communication, Control and Compressed Sensing (iMac4s)* pp 169-72

[30] Toharia P, Robles O D, SuáRez R, Bosque J L and Pastor L 2012 Shot boundary detection using Zernike moments in multi-GPU multi-CPU architectures *Journal of Parallel and Distributed Computing* 72 pp 1127-33

[31] Yoo H W, Ryoo H J and Jang D S 2006 Gradual shot boundary detection using localized edge blocks *Multimedia Tools and Applications* 28 pp 283-300

[32] Heng W J and Ngan K N 2001 An object-based shot boundary detection using edge tracing and tracking *Journal of Visual Communication and Image Representation* 12 pp 217-39

[33] Liang L, Liu Y, Lu H, Xue X and Tan Y P 2005 Enhanced shot boundary detection using video text information *IEEE Transactions on Consumer Electronics* 51 pp 580-8

[34] Mishra R, Singhai S and Sharma M 2014 Comparative study of block matching algorithm and dual tree complex wavelet transform for shot detection in videos *International Conference on Electronic Systems, Signal Processing and Computing Technologies* pp 450-5

[35] Priya G L and Domnic S 2012 Edge strength extraction using orthogonal vectors for shot boundary detection *Procedia Technology* 6 pp 247-54

[36] Kanagaraj K and Priya G L 2018 Curvelet transform based feature extraction and selection for multimedia event classification *Journal of King Saud University-Computer and Information Sciences*

[37] Shekar B and Uma K 2015 Kirsch directional derivatives based shot boundary detection: an efficient and accurate method *Procedia Computer Science* 58 pp 565-71

[38] Zhang H, Kankanahalli A and Smoliar S W 1993 Automatic partitioning of full-motion video *Multimedia systems* 1 pp 10-28
[39] Pal G, Rudrapaul D, Acharjee S, Ray R, Chakraborty S and Dey N 2015 Video shot boundary detection: a review Emerging ICT for Bridging the Future-Proceedings of the 49th Annual Convention of the Computer Society of India CSI 2 pp 119-27

[40] Boreczky J S and Rowe L A 1996 Comparison of video shot boundary detection techniques Journal of Electronic Imaging 5 pp 122-8