TELKOMNIKA Indonesian Journal of Electrical Engineering
Vol. 13, No. 2, February 2015, pp. 300 ~ 304
DOI: 10.11591/telkomnika.v13i2.6873

A Novel Method for Sensing Obscene Videos using Scene Change Detection

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Abstract

Video scene change detection has great importance of managing and analyzing large amount of videos. Traditionally this technique used for indexing, segmenting and categorizing different types of videos. Very few works addressed to classify obscene using scene change detection method. In this research we proposed a simple approach for sensing objectionable videos by observing scene changes into different video genres. Video scenes are grouped into set of key frames. After analyzing duration of each scene and counting the number of key frames of designated scene, it has been shown that obscene videos have infrequent scene changing nature. While in sports, dramas, music and action films have large number of scene changes. We used six types of video genres and the decision has been made by setting a threshold based on extracted key frames. Experimental result showed that the accuracy is 83.33% and false positive rate is 16.67%.

Keywords: *scene change detection, key frames, content based video retrieval, obscenity detection*

1. Introduction

Video scene change detection is very useful for video indexing, analysis and content-based retrieval of visual information [1, 2]. It is a vital operation in all multimedia applications such as video on demand (VOD), digital archives, news media etc [3]. Low-level video segmentation is the first step in all video scene change detection [3]. A scene composed of several shots, which denoted as continuous frames of one action [1], [3-4]. Existing works demonstrated luminance or color histogram differences of consecutive frames [2]. As we know that luminance is susceptible to small changes and hence cannot give appropriate results for scene change detection [5, 6]. Scene change detection also performed in compressed video data (MPEG-1) [7, 8]. In that approach key frames can be represented as binary edge maps. After calculating correlation between the edge maps, two consecutive frames can be compared. Earlier works emphasized low level structures on videos and very few works demonstrated scene segmentation on objectionable videos [12, 13]. Some papers indicated objectionable video processing in parallel and distributed fashion but failed to address obscenity detection appropriately [26, 27]. Online objectionable videos and images are now easily accessible due to availability of high-speed Internet and rapid growth of multimedia technology. A report shows that a large number of teens and children search pornographic contents everyday [28]. This is a threat for the society and concerns of Internet safety. Taking care of this issue, scientists are working hard and initiated different filter techniques to screen malicious contents. In this paper we presented a method to find obscene videos using scene change detection. Video scenes are grouped into set of key frames. Observing change of scenes, we analyzed the presence of obscenity among a large set of obscene and benign videos.

The rest of this paper can be organized according to the following structures: section 2 briefly describes different scene change detection methods and their applications, our proposed method is described in section 3, quantitative results are analyzed in section 4 and finally section 5 contains conclusion and future work.

Received October 19, 2014; Revised December 18, 2014; Accepted January 4, 2015

2. Scene Change Detection Approaches

A digital video can be formed by frames which are presented as consecutive manner for viewer's perception [23]. Key frame denoted as representative frame which contain significant content of a shot. Based on the content complexity of shots, one or more key frames can be extracted from a single shot [24]. Shot denoted as continuous frames taken by single camera as continuous action of time and space. Cut or hard cut are abrupt transitions from one shot to another. Soft transitions are known as wipes, fades and dissolves. In this effect one shot can be replaced by another. It also called as gradual transitions. Fade are of two types, fade out and fade in. The first one is a gradual transition between a scene and a constant image and fade in is between a constant image and a scene [25].

2.1. SAD (Sum of Absolute Differences) (Soft cut)

It is a simple algorithm where two sequential frames are compared using addition of absolute values of each pixel. After that subtraction occurs from corresponding pixels [9-11], [18]. The result is a positive number which is further used as score. SAD is susceptible to minor scene changes. The false hits occurs when fast camera movement or sudden light on in a dark scene. It hardly reacts to soft cuts [19]. Yet, SAD is used often to produce a basic set of "possible hits" as it detects all visible hard cuts with utmost probability.

2.2. Histogram Differences (HD) (Hard cut)

It is similar to Sum of absolute differences. It computes histogram difference of two sequential video frames. Histogram tells quantitative distribution of colors in a frame [20]. HD is less susceptible to minor changes of scenes and hence fewer false hits. HD is completely depends with histogram calculation which is its major drawback. It is believed that two frames can have the same histograms. For example, dessert and beach pictures can have the same histogram though the contents are not the same. For hard cut detection this method is not suitable [21].

2.3. Edge Change Ratio (ECR) (Wipe or dissolve)

Edge change ratio (ECR) also compares contents of video frames. It can have the capability of transforming frames into edge pictures. Using an image processing tool (dilation), ECR compute a probability finding that following frame contains the same objects [13, 22]. It can detect hard cuts as well as different soft cuts. However, it cannot detect wipes as it considers the fading in objects as regular moving objects through the scene. Despite, ECR can be extended manually to recognize special forms of soft cuts [23].

2.4. Shot Change Detection based on Sliding Window Method (SCDSW)

In video segmentation, traditional sliding window (CSW) has been used by many researchers for adaptive thresholding [12], [14-15]. CSW can detect hard cut by taking the ratios of present feature value and its local neighborhood. However, it has a significant number of false alarms and missed cuts. It is shown in [16-17] that, this method can be improved by combining with color histogram differences. The improved sliding window method has three steps processing such as pre filtering, sliding window filtering and scene activeness investigation of frame by frame discontinuity values. Camera/object motions are more robust using cut detection which is based on possibility values [24]. One of the purposes is to relax the threshold or parameter selection problem that is to make the intermediate parameters to be valid for a vast range of video programs and to reduce the influence of the final threshold on the whole detection accuracy [25].

3. Scene Change Detection for Obscene Videos (proposed method)

In section 2 we described some common video scene change detection methods (SAD, HD, ECR and SCDSW). All methods devoted to detect sudden or gradual transitions of scenes. In those works we didn't find any indication that how often the scenes are changing. Our proposed method is based on a ground truth of frequent and infrequent nature of changing scenes. The experiment carried out on 13 unstructured videos with arbitrary length containing objectionable and benign scenes. At first all Key frames are extracted using an open source tool

ffmpeg [17]. Then summarize the result for instance Table 1 demonstrated the extracted key frames, its types and hit or misses status of different video genres.

Table 1. Extracted key frames of different videos

SL/No	Extracted Key Frames	Type*	Remark*
1	24	O	H
2	101	O	M
4	10	O	H
5	17	O	H
6	39	O	H
7	48	O	H
8	46	B	H
9	76	B	H
10	65	B	H
11	1	B	M
12	29	B	H
13	20	B	M

* O→Obscene, B→ Benign, H→ Hit, M→Miss

It is shown that the number of key frames for obscene videos is significantly smaller than benign videos. The specific genres of benign videos are drama, news, sports, jokes and music video.

4. Results

The performance of our method has been elucidated in Table 2. Higher true positive rate and lower false positive rate signifies the strength of our approach.

Table 2. Accuracy chart

True Positive Rate (TPR)	False Positive Rate (FPR)
83.33%	16.67%
False Negative Rate (FNR)	True Negative Rate (TNR)
33.33%	67%

The following figure (Figure 1) showed scene change scenario of different types of video genres. Here, drama, movie trailer, TV show and obscene videos have been demonstrated for simplicity. It has been observed from the random shots that, most of the videos change scenes after few or just a second duration. But scene changing nature of objectionable videos is quiet long. For instance scene changes of the given video genres are 5, 1, 9 and 34 seconds respectively. It means obscene videos have longest scene duration and the shortest scene changes in movie trailer. It is to be noted that TV shows have longer scene duration than dramas. The reason for this is that, shot taking time in TV shows are lower than dramas [25].

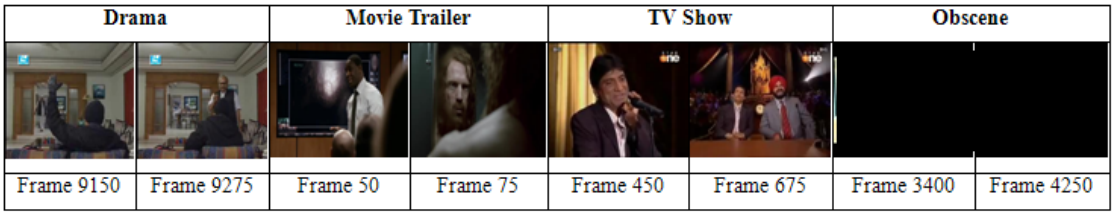

Figure 1. Scene change on different types of video genres

5. Conclusion

There is a vast amount of objectionable videos available in online due to rapid growth of Information and communication technology. It is very difficult to filter all malicious contents from Internet. Researchers are advocating their efforts to do so. In this research we proposed a simple method of identifying obscene videos using scene change detection. It has been observed that obscene videos infrequently change scenes whether in other types of videos such as action films, dramas, news, movie trailer and TV shows have significant number of scene changes [Table 1]. There is a controversial behavior on live and edited music videos. Live music videos don't have enough scene changes which contradict with obscene videos, but edited music videos have significant scene changes [Table 1]. Using the ground truth, we identified more than 80% videos containing obscenity. Skin color and erotogenetic body parts detection can further applicable for better accuracy.

Acknowledgements

This research was supported in part by Shenzhen Technical Project (grant no. HLE201104220082A) and National Natural Science Foundation of China (grant no. 61105133) and Shenzhen Public Technical Platform (grant no. CXC201005260003A).

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