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Video Forgery Detection Using Multi-Level Subtraction Approach

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ABSTRACT:Owing to easy accessibility of video editing software, video forgery acts have been escalating in recent years. Such video editing software used by criminals to tamper the videos. Such tampered videos are shown as evidence in court and thus, innocent person may not prove himself. To obtain accurate forgery detection from forged video, a Multilevel Level Subtraction (MLS) is proposed. It is based on pixel grey value subtraction that values decide whether given video gets tampered or not. The main objective of this paper is to implement highly accurate, efficient and feasible frame insertion forgery detection for video. This method works efficiently and accurately to detect a malicious acts in original videos. The method achieves high recall rate and precision rate.

KEYWORDS:— MLS, Video forgery detection, precision rate, recall rate, BBVD.

I. INTRODUCTION

The multimedia files are used in daily life such as evidence in court, military communication, medical records in hospitals etc. Therefore, it is very crucial to authenticate digital files effectively and accurately. Video forgery is a malicious act which associated to changing or improving video contents. So, video forgery can defined as modifying the video with hostile intension and it is illegal act which destroy any crucial system.

Video can modify by replacing original frames with forged frames, changing sequence of frame, deleting frames, adding new frames, copy paste frames.

There are different types of video forgery that is classified into two categories:

- i) Intra Frame forgery
- ii) Inter Frame Forgery

In first type of forgery act, the individual frame gets tampered whereas in second type of forgery act, neighbouring frames are tampered. These tampered acts are as follow:

A) Adding new frames :

New frames are added or inserted into given video sequence to make fake evidence.

B) Frame Duplication :

Attacker hides the unwanted frames by using duplication of frame to unfold some evidence or information.

C) Deleting original frames:

Existing frames are deleted from given video sequence to remove evidence.

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D) Shuffling of frames:

Attacker can change the sequence or order of frames in video to get some different meaning of video.

Generally, there are two categories of forgery detection:

- i) Active Detection
- ii) Passive Detection

In first detection method, tampered region of video can be identified by a pre-inserted watermark in video sequence. But it suffers from some limitations such as : If attacker knows how to watermark inserted into video sequence, then he or she can easily detect watermark. Also, imminent hardware required for insertion of watermark in video. In passive detection method, without relying on pre-escaped and pre- inserted information into video forgery can detected.

The main idea of proposed method is that at the tampered region of video, consistency of the BBVD ratio will get disturbed. Thus, video forgery identified by calculating three level subtraction of pixel grey value. From this subtraction ,get absolute value , which used to check whether forgery occurs or not in given video sequence. This method not only detect whether video tampered or not but also the location of frame forgery in given video sequence.

II. RELATED WORK

Various methods are implemented are as follow:

Video forgery detected by using inserting watermark information into video sequence in [1]. The watermark is invisible and fragile information which encrypted and the insert into DCT coefficient of each frame. MPEG-2 coding standard is used for watermark hardware. But this method is suffered from limitations. Owing to watermark, random values get added into each pixel thus, video become grainy. Cracker can easily know the watermark information by using reverse insertion process.

Optical flow consistency method explicated in [2] which based on consistency of optical flow of frames. The optical flow is computed by estimating motion vectors on each odd row and even row. Optical flow of frames is hundreds of times larger than others. If video gets tampered then, consistency of optical flow gets disturb. It has high complexity for computing optical flow of each pixel.

Inter frame video forgery can be identified by consistency of correlation coefficient of grey value in [3]. The main idea is that correlation coefficient of grey values of original video is consistent and its coefficient values are close to each other. If video gets tampered then, consistency will get disturb. If difference between correlation coefficient of adjacent frames is high then, conclude that video gets tampered. This method has lack of ability to detect duplication of frames of given video sequence.

Tampered point in video find using computing quantization parameters is introduced in [4]. The QP parameters of each pixel obtain by performing motion estimation. If QP values of any frame has been changed then, conclude that there may be tampered point . This technique has limitation that large number of QP values are difficult to analyse.

Forged region of video is detected based on block level tampered noise correlation which is explicit in [5]. Noise residue of each frame is calculated. The noise free image is obtained using inverse wavelet transform. Then, noise residue of original frames is compared with that of forged frames. If region is forged, then correlation values of noise residue is changed. Thus, forgery can identified by segregating the tampered region from non- tampered region by analyzing properties of noise correlation.

To detect the insertion and deletion of video frame which is obtained by using quotient of consecutive correlation coefficient of local binary pattern (QCCoLBP) is illustrated in [7]. If insertion or deletion operation is not performed on original video then correlation coefficient should be high and that are close to each other. If video gets tampered then

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correlation coefficient value is low at tampered point. The main limitation of this method is that , it can identified only if forgeries exist but cannot distinguish frame insertion and frame deletion.

III. PROPOSED METHODOLOGY

The principle of proposed method is based on correlation of adjacent frames. If correlation of adjacent frame is high then, conclude that original video not tampered. If some frames are deleted or inserted then, variation of brightness of frames is changed. Thus, consistency gets disturb and correlation value reduces. According to weber’s law, the ratio of Brightness variation is as follow:

$$R = \frac{\Delta B}{B} (1)$$

Where R is ratio of variation in brightness versus original brightness of pixel. ΔB is Varied Brightness value of different frames. B is original pixel grey value. At the initial stage of method , there is need to perform some framework. So, that frames are enable to use for processing.

A. Generation of sub-sequence groups

A complete video sequence is partitioned into temporal sub- sequence, it is shown as $G = \{g_1, g_2, g_3, \dots, g_n\}$ in Fig .1. Length of each sub-sequence is 15 frames out of which 5 frames are overlapped.

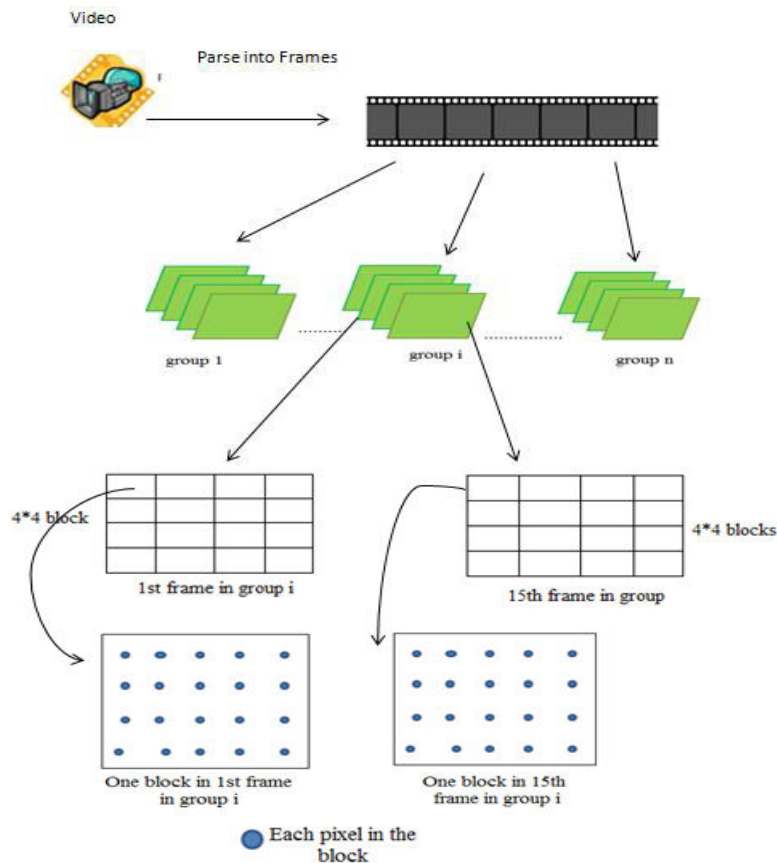


Fig. 1. Framework of BBVD method

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Fig. 1.shows framework of given video sequence so that video is enable for further processing. Each group contains 15 frames and each frame is divided into 16 sub-blocks such as $B_{sblock} = \{ b1, b2, b3, \dots, b16 \}$. The size of sub-block is 4×4 blocks. Thus, by applying weber's law, calculate R_{BBVD} . The R_{BBVD} is ratio of variation of brightness between each sub-block in first frame and its corresponding sub-block in the last frame .It is calculated for each frame in each group then, calculate average value of all ratio of BBVD in each group.

$$R_{BBVD} = \frac{\Delta B_{sblock}}{B_{ave}} = \frac{1}{M \times N} \sum_{i=1}^M \sum_{j=1}^N \frac{B_{fij} - B_{lij}}{B_{ave}} \quad (2)$$

Where B_{fij} and B_{lij} shows the grey value in each pixel of first in current block and the last frame of current block in current group respectively. M and N shows number of pixel in row and column respectively. Then, calculate average of all BBVD ratio of every 16 groups.

$$R_{BVD} = \frac{1}{16} = \sum_{i=1}^{16} (R_{bi}) \quad (3)$$

Where R_{BVD} is ratio of all BBVD of every 16 groups.

B. Proposed scheme –Multi Level Subtraction (MLS)

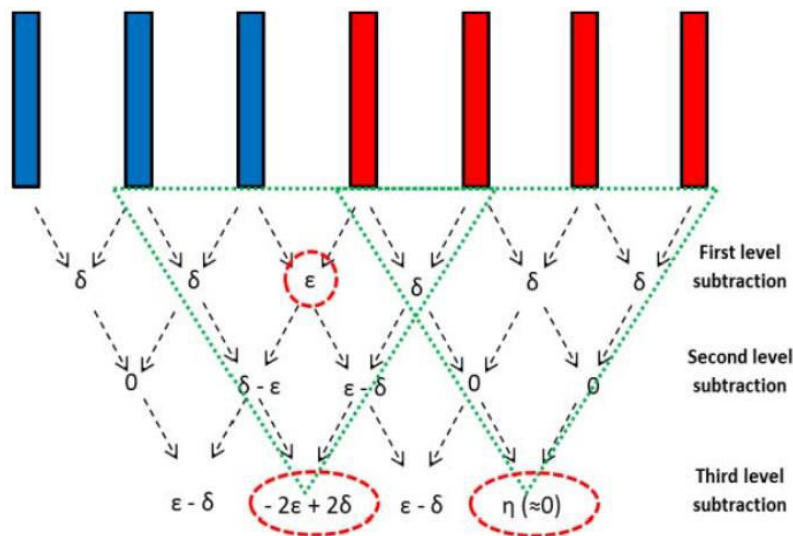


Fig. 2. Three Level Subtraction approach

Fig. 2.Shows three level subtraction of pixel grey value. Original frames in video are shown by blue colored frames, Forged frames are shown by red colored frames. A pair of adjacent blue colored frame of original video and a pair of adjacent red colored frames of forged video have high consistency or similarity.

In first level subtraction, adjacent frames subtraction is done. The subtraction of blue colored frames from original video is low which is shown by δ . The subtraction of adjacent red colored frames from forged video is very low which is shown by δ . But subtracted value obtain by subtraction of blue and red colored frame is high which is shown by ϵ , as two different frames having different pixel grey value (ϵ, δ).

In second level subtraction, adjacent values obtained from first subtraction are subtracted, then get two values are $(\delta - \epsilon)$ and $(\epsilon - \delta)$ shown in fig.2.

These values are opposite in sign but equal in magnitude.

In third level subtraction, adjacent values obtained from second level subtraction are computed. The $(-2\epsilon + 2\delta)$ value obtained at frame insertion boundary, shown in fig. 2.

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Subtraction of similar pixel grey value gives result close to zero. These subtracted values are utilized for deciding threshold value.

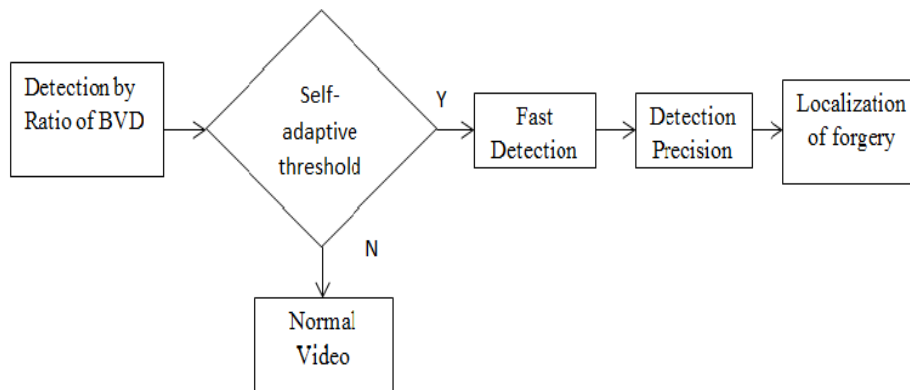


Fig. 3. Forgery detection and localization

Fig. 3. Shows a forgery detection and its localization by setting threshold value. If following three conditions are satisfied then, conclude that frame insertion forgery has occurred in video.

- i) If ε is more than 3σ . The probability of gross error detection is represented by 3σ . Thus, if value is more than 3σ , then it treated as the gross error.
- ii) If $(-2\varepsilon+2\delta)$ is greater than ε at frame insertion boundary, then it satisfied:

$$\frac{|2\varepsilon-M|}{M} \times 100 \leq a \quad (4)$$

Where a is threshold value, it measures difference between $|2\varepsilon|$ and M .

- iii) If $(-2\varepsilon+2\delta)$ is greater than $|\eta|$, then it satisfied:

$$\frac{|\eta|}{M} \times 100 \leq \beta \quad (5)$$

Where, β is threshold value which shows difference between $|\eta|$ and M .

If above three conditions are satisfied then, that location is declared as frame insertion boundary in video sequence.

IV. EXPERIMENTAL RESULTS

The MLS method applied on a video with resolution 454×232 pixels. A video contains movement of hands while playing a xylophone. The video available in the AVI format with length of 1 second and 515 kbps data rate. A three level subtraction is performed on every 30 frames per second. That is frame rate is 30 frames per second. The result is shown in fig. 4. At sixth frame, the subtracted value is high. It implies that given video gets tampered at sixth frame thus, it is an insertion boundary.

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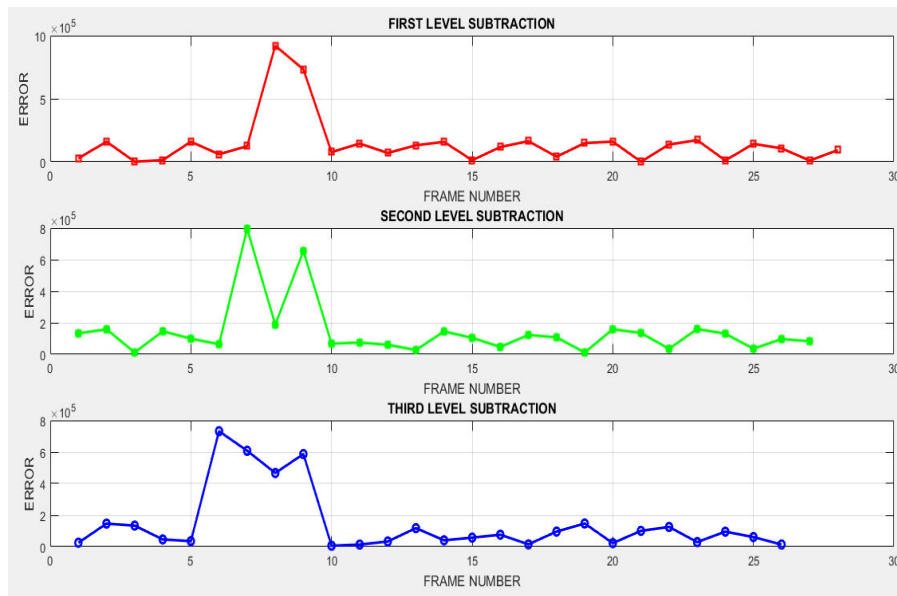


Fig. 4. Result of MLS method

A. Evaluation Parameters

The Efficiency of video forgery detection method can be estimated by two rates are called recall rate and precision rate. Recall rate is percentage of correctly detected video among all forged videos. Recall rate shown as follow:

$$R_r = \frac{N_c}{N_c + N_m} \times 100 \% \quad (6)$$

Precision rate is percentage of correctly detected videos among all detected videos. It is shown as follow:

$$R_p = \frac{N_c}{N_c + N_f} \times 100 \% \quad (7)$$

Where, N_c is number of video forgeries which correctly detected, N_m is number of missed video forgeries, N_f is number of falsely detected forgeries.

V. CONCLUSION

The multi-level subtraction of pixel grey value approach is efficiently detect video forgeries. From computing a subtraction of pixel grey values the threshold value is obtained. This threshold value decides whether video gets tampered or not. The given method correctly responds inserted frames from same camera recorded at same location. Therefore, it is capable of detecting video gets tampered or not also, detect insertion boundary in video sequence efficiently.

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