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2-level DWT based Watermarking with scene change detection

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Abstract—

Embedding any digital information into multimedia like audio, video and image is watermarking. Digital information can be in the form of image, video, etc. Watermarking is the technique used for many applications to protect the data. Watermarking can be done using spatial and frequency domain. Spatial domain includes least Significant Bit (LSB) method and frequency domain includes Discrete Wavelet Transform (DWT), Discrete Fourier Transform (DFT) and Discrete Cosine Transform (DCT) methods. 2-level DWT is used for video watermarking. Compared to DFT and DCT transform, DWT transform is more computationally efficient. We are proposing with and without scene change detection. Scene change detection is used to detect the scene changing which includes abrupt and gradual. MSE for various video is calculated to measure the success of the algorithm. This method represents less complexity and has smaller computation deal, so it can meet the real-time requirement.

Keywords— Video Watermarking; Scene Change Detection (SCD) Algorithm; Discrete Wavelet Transform; Embedding algorithm; Extraction Algorithm

I.INTRODUCTION

In the past several years there has been tremendous growth in multimedia technology and its applications. This growth has increased the necessity to build secure methods for legal distribution of the digital content over the internet. Digital watermarking can be classified as image, audio and video watermarking. In video watermarking, video is divided into video sequence and then watermark is embedded to this video sequence. Video sequence is a collection of consecutive images which when moved at particular rate gives the impression of moving pictures to naked eye and to whom human mind interprets as video sequence. Image watermarking and video watermarking is similar related to some common characteristics [1]. Some techniques are enhanced in video watermarking compared to image watermarking. Video watermarking algorithms run in original video sequences and some compress the video before embedding watermark. We proposed to embed watermark in uncompressed domain. To select frame for embedding watermark in video sequence, we proposed scene change detection. A process that divides data into shots is scene change detection. Scene change can either be abrupt or gradual for video frames [14]. If sudden change in the scene occurs, then it is called as abrupt scene change. On the other hand, gradual scene change related to effects like fade in/out, dissolve, zoom, etc. Gradual scene change compared to abrupt scene change is more difficult and can cause scene change algorithms to fail [17]. Comparing two scenes is important part to detect scene change. There are different algorithms used to detect scene change.

II.PROPOSED SYSTEM

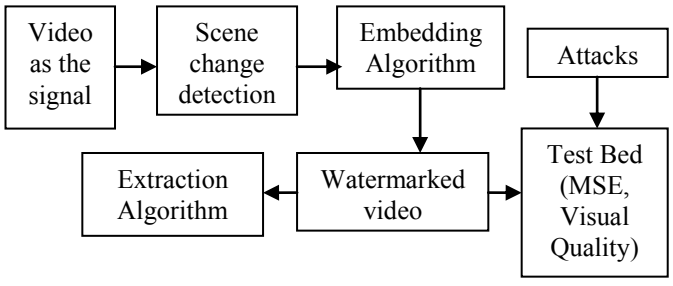

Fig. 1. Proposed block diagram of video watermarking

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The Proposed system includes scene change detection, embedding algorithm, attacks and extraction algorithm.

A. SCENE CHANGE DETECTION

There are various techniques for Scene change detection. We have implemented scene change detection using Otsu's thresholding based, pixel-based and edge- based. Scene change detection basically is based on full image video analysis. Intensity information and motion information is used calculate inter-frame difference. These algorithms detect abrupt and gradual scene change.

1) Otsu's thresholding-based method

In this, comparing of two images related to global thresholding can detect scene change. Background and foreground pixels are the two pixels which are used calculate threshold for each pixels. Then, Compare the two foreground and background pixels and accordingly set the threshold, if foreground pixel value exceeds than the threshold set, then there is a scene change [15], [16].

1. Read the AVI format video and convert video into frames.
2. To detect scene change, 10 frames are selected from video.
3. The frames selected are converted into gray.
4. Depending on foreground and background pixels, applying global-threshold.
5. After getting the global threshold, convert into binary.
6. Divide video frame into blocks of 4×4. Take mean square error of each frame.
7. Threshold is set on trial error basis as 0.2 for gradual and 0.5 for abrupt.
8. Take the difference of each video frame and then compare.
9. If the difference of each frame is greater or equal to 0.5 or 0.2, then there is a scene change taking place otherwise no scene change.
10. Display video frame number and the video frame where scene change is taking place.

B. EMBEDDING ALGORITHM

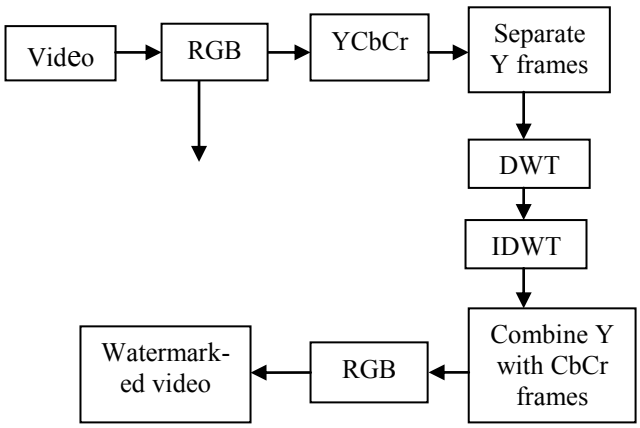

Fig. 2. Embedding Procedure

1. Read the AVI format video and convert video into frames.
2. Get the watermark image.
3. Convert selected frames which are in RGB format to YCbCr.
4. Separate Y frames from YCbCr.
5. Apply 2-level DWT using haar filter on Y frames.
6. Add watermark image to the approximation coefficients (LL2) with the help of watermark equation.
   Watermark equation is represented as:

$$V' = V + cA \qquad (3)$$

   Where, c is the scaling factor in the range of 0 to 1, V is the selected wavelet coefficients, A is embedding watermark image coefficients.
7. Take 2-level IDWT after adding watermark.
8. Now, combine Y frames to CbCr.
9. Convert back to RGB.
10. Display the output i.e. watermarked video.

Discrete Wavelet Transform

In image processing, DWT plays important role because image data are spatial- spectral resolution and are discrete which is dependent on frequency. Spatial –resolution is large in high-frequency bands and small in low-frequency bands.

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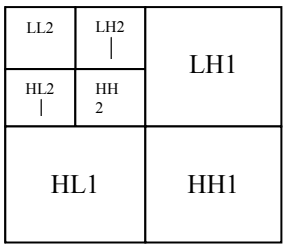

Fig. 3. 2-Level DWT

Fig. shows 2-level DWT. The band with lowest frequencies that is LL2 sub image has the smallest spatial resolution. LL2 band consists of approximation values of original image. Other bands such as (LH2, HL2, HH2, LH1, HL1, and HH1) are high frequencies and consist of detailed information of original image [3].

Performed Attacks

Geometric attacks like rotation and cropping are performed on the watermarked frames. The result shows that with modification in watermarked frames modifies watermarked coefficients also.

C. EXTRACTION ALGORITHM

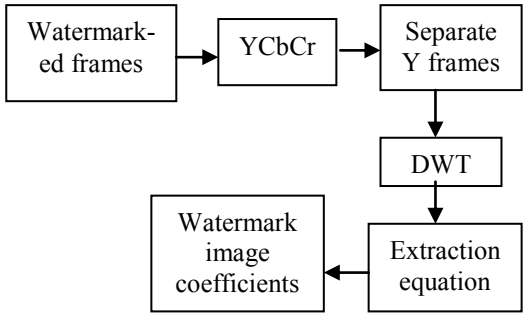

Fig. 4. Extraction Procedure

1. Convert watermark frames which are in RGB format to YCbCr.
2. Apply 2-level DWT using haar filter on Y frames.
3. To get watermark coefficients back use the extraction equation which is shown below:

$$\frac{V'-V}{c} = A$$

Where, c is the scaling factor in the range of 0 to 1, V is the selected wavelet coefficients, V' is watermarked wavelet coefficients and A is watermark image coefficients.

III.RESULTS

A. SCENE CHANGE DETECTION

Fig. 5. Frames (10) selected from test1_video(Abrupt)

Fig. 6. Scene change taking place at 5th frame for test1_video

Fig. 7. Frames (10) selected from test2_video(Gradual)

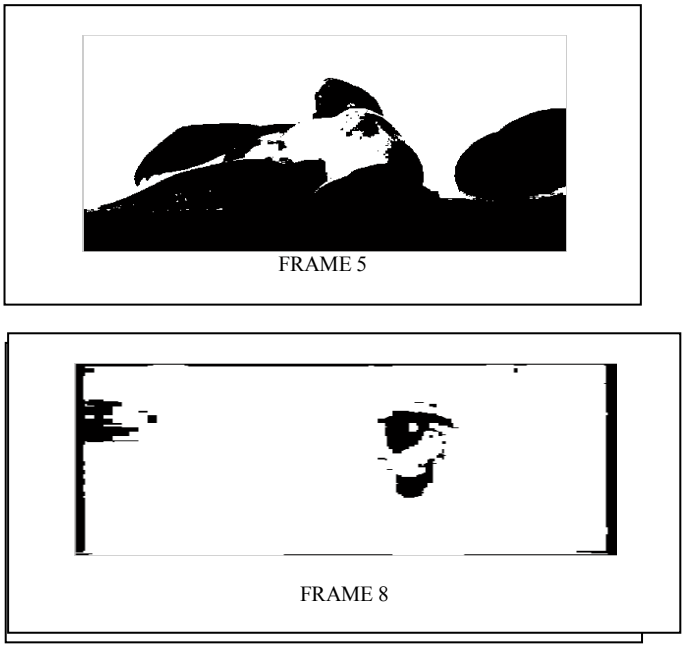

Fig. 8. Scene change taking place at 8th frame for test2_video

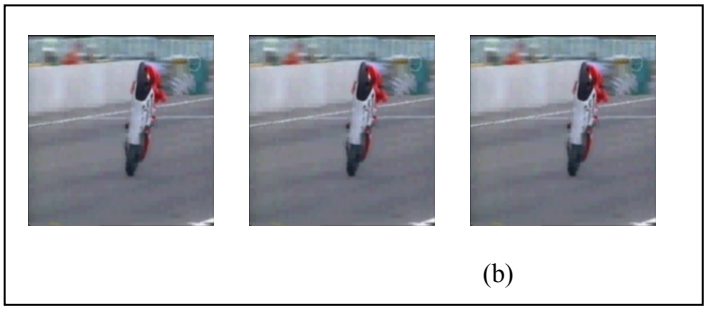

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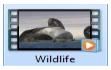
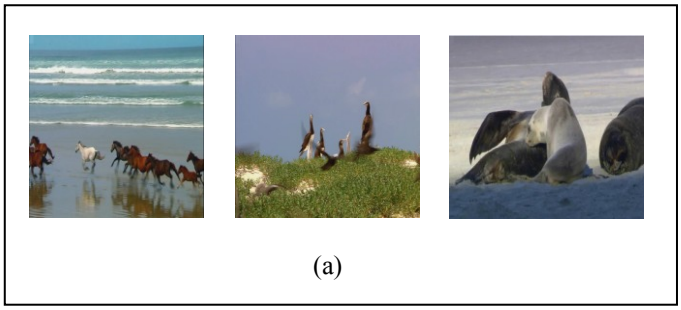
TABLE 1.COMPARSION OF TEST VIDEOS DEPENDING ON THEIR SIZE AND SCD

TEST VIDEOS	*TOTAL NO. OF FRAMES*	*NO. OF FRAMES SELECTED*	*MANUAL SCD SEEN*	*DETECTED SCD BY ALGORITHMS*
 SIZE:25MB	760	10	05 ABRUPT SCD	06
 SIZE:1.73MB	198	10	NA GRADUAL SCD	08

TABLE 2.COMPARSION OF TEST VIDEOS DEPENDING ON THEIR SCALING FACTOR,MSE AND VISUAL QUALITY

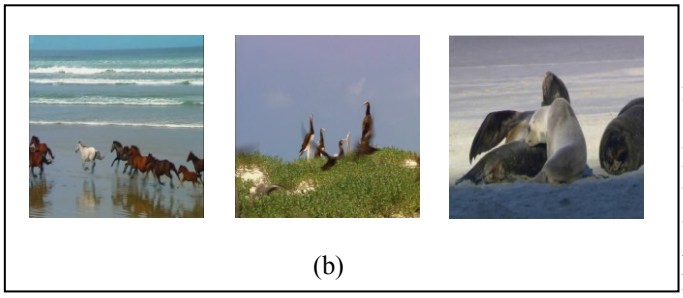
Test videos	Scaling factor(C)	MSE	Visual Quality
	0.3	2.9632e-008	Excellent
	0.5	7.6633e-008	Good
	0.7	1.5033e-007	Acceptable
	0.9	2.4734e-007	Not Acceptable
	1.2	3.0744e-007	Not Acceptable
	0.3	1.3486e-005	Excellent
	0.5	3.4877e-005	Good
	0.7	6.8416e-005	Acceptable
	0.9	1.1257e-004	Not Acceptable
	1.2	1.3992e-004	Not Acceptable

B. EMBEDDING WATERMARK



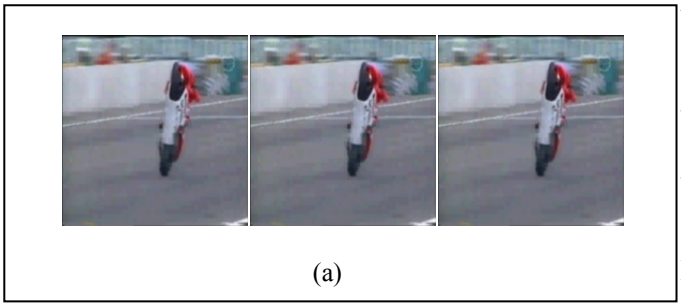
(a)

Fig. 9. Original frames of test1_video(Abrupt)



(b)

Fig. 10. Watermarked frames of test1_video(Abrupt)



(a)

Fig. 11. Original frames of tes2_video(Gradual)
Fig. 12. Watermarked frames of test2_video(Gradual)

IV.CONCLUSION

Video model is an essential part of many video applications, including video browsing, indexing and retrieval. Scene change in the video is done by scene change detection algorithms. To simulate results we have used MATLAB @R2011a. A total of around 2 videos of abrupt and gradual are tested by applying various methods like Otsu's thresholding –based, pixel-based and edge-based. These methods are able to detect all scene change. Threshold is set on trial error basis as 0.2 for gradual and 0.5 for abrupt. Time taken by Otsu's method is comparatively less compared to pixel- based and edge-based. For embedding procedure, the test video is tested for various scaling factor in which 0-0.8 define invisibility factor. MSE is calculated for the test video which is less. We have observed that with increase in scaling factor, visual quality degrades.

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