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Categorical Study of DWT and DCT techniques for efficient Digital Video Watermarking

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ABSTRACT

The increasing popularity of the internet means that digital multimedia is transmitted more rapidly and easily. And people are very aware for media ownership. However, digital watermarking is an efficient and promising means to protect intellectual properties. Based on the intellectual property attention in the information era, how to protect the personal ownership is extremely important and a necessary scheme. In this paper, we are going to propose an effective video watermarking method based on identical frame extraction in 3-level Discrete Wavelet Transform (DWT) & effective video watermarking method based on DCT & embedding binary watermark into specially prepared plane in temporal dimensions in method suggests an algorithm for copyright protection of videos. The algorithm presented embeds a watermark into temporal dimension of cover content which is not perceivable to eyes but covers necessary information regarding copyright claim of the video. The main technique used for protection of hypothetical rights and copyright safekeeping is digital watermarking. Digital watermarking can be applied to media like text, audio, image, video etc. There is a growing importance in authentication and for protected copyright for Digital video streams. Nowadays, digital multimedia content (audio or video) can be copied and stored easily and without loss in fidelity.

Keywords: Digital watermarking, DCT, 3 Level DWT, PSNR, Entropy, MSE.

I. INTRODUCTION

Digital video watermarking was introduced at the end of the last century to provide means of enforcing video copyright protection. Video watermarking involves embedding secret information in the video. A digital video watermarking technique based on identical frame extraction in 3-Level Discrete Wavelet Transform (DWT). In this method first we have to divide the host video into video shots. Then from each video shot one video frame called identical frame is selected for watermark embedding. Each identical frame is decomposed into 3-level DWT, and then select the higher sub band coefficients to embed the watermark and the watermark are adaptively embedded to these coefficients and thus guarantee the perceptual invisibility of the watermark. For watermark detection, the correlation between the watermark signal and the watermarked video is compared with a threshold value obtained from embedded watermark signal[1]. A pseudo 3-D discrete cosine transforms (DCT) and quantization index modulation (QIM) against several attacks. Using the QIM, we can embed the watermark into the quantization regions from the successive raw frames in the uncompressed domain and record the relative information to create a secret embedding key. This secret embedding key will further apply to extraction.

Watermarking is embedding “ownership” information in multimedia contents to justify an authenticity. An invention of digital watermarking can be traced back to 1954, when Hembrooke filed a patent explaining a method for the identification of music signals through the embedding of inaudible codes, with the objective of proving ownership. However, in early/mid-nineties interest in digital watermarking technologies started to grow meaningfully, due to the initiation of Internet and the wide spread of digital contents distribution. Watermarking is a key process in the protection of copyright ownership of electronic data. In simple terms, Watermarking is a concept of embedding a special pattern, watermark, is embedded into a document that is it may be image or audio or video. Watermark can be a serial number or random number sequence, proprietorship identifiers, copyright messages, control signal and transaction dates.

II. METHODS AND MATERIAL

A. Objectives

- ✓ Study the basic concept of Digital Watermarking.
- ✓ To study 3 LEVELS DWT.
- ✓ To study WATERMARK EMBEDDING ALGORITHM.
- ✓ To study WATERMARK EXTRACTION ALGORITHM.
- ✓ To evaluate and results analysis.

B. 3 Levels DWT

Discrete wavelet transform (DWT) is a mathematical tool for decomposing an image. It is multi-resolution briefing of an image. The decoding can be processed sequentially from a low resolution to the higher resolution. The DWT decomposes the signal into high and low frequency parts. The high frequency part contains information about the edge components, while the low frequency part splits again into high and low frequency parts. The high frequency components are usually used for watermarking since the human eye is less sensitive to changes in edges and range of high frequency. After the first level of decomposition, there are 4 sub-bands: LL1, LH1, HL1, and HH1. For each successive level of decomposition, the LL sub band of the previous level is an input. To perform second level decomposition, the DWT is applied to LL1 band which decomposes theLL1 band into the four sub bands LL2, LH2, HL2, and HH2. To perform third level decomposition, the DWT is applied to LL2 band which decompose this band into the four sub-bands: LL3, LH3, HL3, and HH3.

In a video, sometimes different video frames are almost identical. A continuous identical video frames is called a video shot. n order to increase the performance of watermark embedding process the proposed system will separate the video into video shots. Each video shot has one or more video frames that are almost identical. In order to determine whether image pixels. Moreover we also consider on global characteristics of the frames, which is intensity histogram. According to video standard, the intensity for a RGB frame can be calculated as,I = 0:299R + 0:587G + 0:114B (1)Where R, G and B are Red, Green and Blue value of the pixel. Generally, the human visual system is least sensitive to the range of high frequency. Among three channels of the RGB image, the blue channel has characteristic of the highest frequency range. So, for the high performance the blue channel is transformed into DWT and the watermark is embedded from HL3 sub-band of the blue channel of the host video frame. If the HL3 sub-band is fill -up then the remaining watermark signal is embedded in LH3 sub-band. Again, if the LH3 sub band is over then HH3. If HH3 is over then the next upper level is used that is HL2, LH2, HH2 is used. In this way all the watermark is embedded into the video frame this process has the benefit of larger watermark can be embedded into the video. As we are placing the watermark into the high frequency part of the blue channel, so the greater invisibility of the watermark in the watermarked video frame is achieved. This section illustrates the overall technique of our proposed digital video watermarking technique based on 3-level DWT. At first, the formation of 3-Level DWT is presented. Then the proposed watermark embedding process, including identical frame extraction technique is discussed in detail. Finally, the watermark detection process and its different steps are discussed in detail.

C. Watermark Embedding Algorithm

The steps of embedding algorithm are as follows:

Input: RGB video frames.

Output: Watermarked Video

1. The watermark is converted into binary image form as W' (i; j) E {0, 1} for i, j = 0 to M, where M is the number of binary pixel in the image to be encoded.
2. The value 0 represents black and 1 represent white value. The binary form of the image W' (i; j) is then transformed to obtain the vector W' (i, j) E {1,-1}, Where 0 is replaced by 1 and 1 is replaced by -1.
3. Finally two dimensional watermark w(i;j) is changed into one dimensional watermark w(l)(l=1;2; L);Where L is the length of the watermark.
4. After separating the video into video shots the system will apply 3L-DWT on the blue channel of RGB frame.
5. In the 3L-DWT coefficients, we embed pre processed watermark image from the HL3 to HH1

sub-band and then it is transformed into 3-level inverse DWT form.

6. At this stage, for RGB video frame we get the watermarked blue channel which is then combined to other two channels to obtain the watermarked video

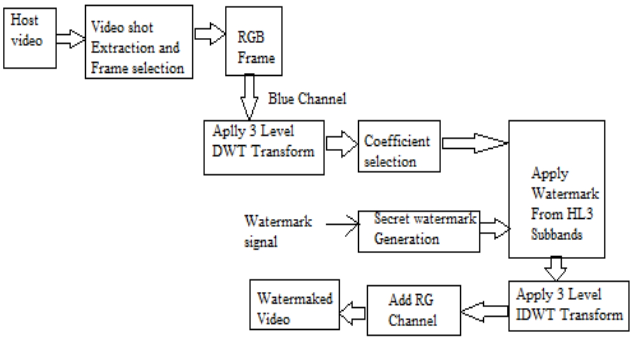


Figure 2. Watermark Embedding Algorithm

D. Watermark Extraction Algorithm

The steps of extraction algorithm are as follows:
Input: Watermarked Video.

Output: Extracted Watermark.

1. Before detecting the watermark the system need to extract the video shots and then select the appropriate identical frame from each video shot.
2. Then the 3-level wavelet transform is performed on the blue channel of the selected frame. Finally compute the average n.
3. Consider the size of the selected coefficient blocks is MXN and the total length of the watermark is L then the average of the selected coefficients in the sub-bands is calculated (n).
4. Now determine the correlation C between the selected DWT coefficients F' (i; j) and the provided watermark vector w and compare C with n.
5. If the provided watermark signal and the embedded watermark signal are similar then the value of the correlation is larger than the average or threshold value otherwise not, i.e. if C>n then we can say that the provided watermark is detected, otherwise not.
6. N as F' (i; j) may be negative and w has value -1 or 1, so n always greater than C. As a result a scaling parameter k is required so the adjust threshold. The value of K is estimated empirically through experiments.

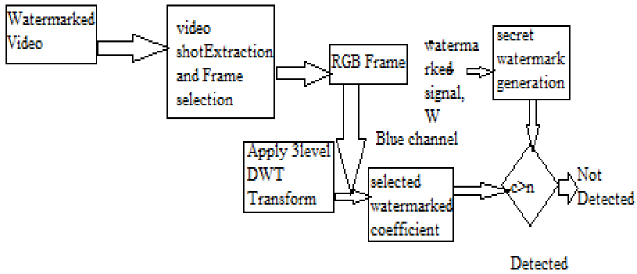
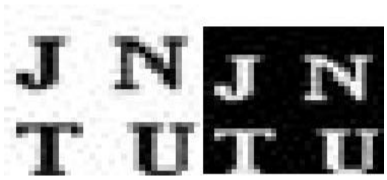


Figure 3. Watermark Extraction Algorithm

III. EVALUATION AND RESULTS

If we embed both logos i.e. watermarks shown below in a video and distinguish this video into identical frames 73 Identical frames are formed of that video.



(a) **(b)**

Then if we decide to embed a logo or watermark in say 73rd frame then following results have been achieved,

Figure 4. Proposed Video

Figure 5. Watermarked 73rd Frame of video

Table.1. Parameter comparison

Parameter	Before embedding	After embedding(a)	After embedding(b)
PSNR	Infinite	71.2566	52.9334
MSE	0	0.0045	0.330934

Entropy	Nil	6.9387	6.8785
Embedding processing Time	Nil	4.42 sec	$1.799X10^{4}$ Sec
Embedding Extraction Time	Nil	4.317 Sec	$9.99X\ 10^{-5}$ Sec

Thus by comparing the results we can conclude that if watermarks are having more are having more numbers of white pixels it is difficult to extract perfectly because of losses and if we use (b) watermark which is having more number of black pixels less damage or cropping of watermark occurs.

IV. CONCLUSION

A 3 level DWT based video watermarking technique has been implemented. In this paper, identical frame based video watermarking technique is proposed which is unobtrusive. This paper has little bit complexity but as we are hiding data LL3 or any sub band it is more secure and if we are using watermark containing more number of black pixels it is easy to extract with better results. Though system has limitations it shows good results against some common attacks.

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