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Watermarking of videos using adaptive orthogonalization

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Abstract— The increasing amount of digital multimedia applications in recent days lead to the development of digital watermarking, which provides protection to the data from attackers. Video watermarking scheme which is robust to various types of attacks like spatial attack, temporal attack and compression attack is proposed in this new way of method. The hybrid of discrete wavelet transform and best basis selection is being used in this method. The best basis selection method is an adaptive orthogonalization method which helps to improve the PSNR value and compete against the attacks. The segmented videos are turned into frames and the Discrete Wavelet Transform (DWT) is applied to it. Next the best basis selection is performed on to the previously obtained matrix using DWT and then the binary watermark is embedded. The quality of the video is measured using PSNR value. The PSNR value is plotted against compression attack and spatial attack, also the BER is plotted against the temporal attack. Thus the result is evaluated on the basis of these bar diagram.

***Index Terms*— Digital watermarking, Copy right protection, Discrete Wavelet Transform (DWT), Wavelet Packet Decomposition (WPD), Best Basis selection**

I. INTRODUCTION

Digital data shows great advantage of storage and processing the same in an effective manner. The digital multimedia contents can be copied and stored by others in our present day today life. In order to prevent this situation digital watermarking is being used. By using their imperceptible modification digital watermarking embeds hidden information in the images, audio, video etc. This hidden information that is what we called as watermark. This prevents the illegal copying of music, photos or videos owned by someone who is the right owner. Robustness, invisibility, security and blindness are the important characteristics of watermarking technique. A particular kind of wavelet decomposition called wavelet packets that seperates signals in symmetrical levels of detail are used here. Field of application of watermarking holds the copyright protection, fingerprinting, stegnography, media forensics, device control, content authentication etc

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II. WATERMARKING SCHEME

A video signal is a one dimension digital or an analog one in nature. The spatiotemporal contents in a video are the frames. So the video is first divided into frames for the processing. Scene change detection is a method used for detecting the scene changes in the video. The segmented video is turned into shots. Scene change detection is mainly working on some measurements. These measurements are found from the images. The information obtained from the images may contain object shape, spatial correlation, DC coefficients etc. DC images are the reduced version of the original images [1]. In the case of a video data that should result in a compressed video a sequence of DC images known as DC sequence are required. This DC images and sequences help to eliminate the need of full frame decomposition. After the scene change detection cube selection is being performed.

Consecutive frames of a video comprises of some sequence of blocks that are co-located, they are called as the cube. Robustness can be obtained with the help of selecting the cubes based on the maximum midpoint difference. This will provide reduced error probability.

A. Discrete Wavelet Transform

By using a Discrete Wavelet Transform (DWT) a one dimensional signal is separated into two parts, a high frequency part and a low frequency part. The low frequency part is called as the approximation coefficients and the high frequency part is the detail coefficients. Further decomposed of the approximation coefficient will result in another two parts. This decomposition will continue until the desired level. In each level of the DWT (Discrete Wavelet Transform) decomposition an image separates into four parts these are approximation image (LL) as well as horizontal (HL), vertical (LH) and diagonal (HH) for detail components [2]. For a decomposition in n levels the set of coefficients obtained in the case of DWT is (3n+1), n represents the number of level. Less computation time is one of the advantage of DWT . The second level of decomposition shows that only the LL subband is further decomposed.. Fig.1 represents the 2D DWT.

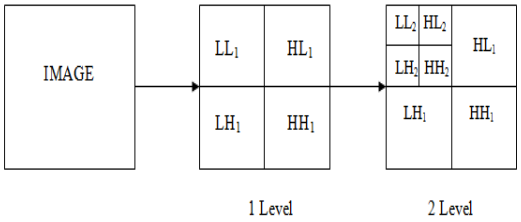

Fig.1 2D-DWT

Discrete wavelet transforms is also used as the most popular transformation technique adopted for image compression [3]. DWT has obtained a good level of acceptance in the areas like signal processing and image compression.

B. Best Basis Selection

The wavelet packet method is a generalization of wavelet decomposition. A level by level transformation from the time domain to frequency domain is obtained to a signal by using the wavelet packet decomposition. There is a decrease in the time resolution and an increase in the frequency resolution while moving through the decimation process. The WPT decomposes low as well as the high frequency sub band.So that the frequency bands can be observed in equal width. The signal is split into an approximation and a detail coefficient when considering a wavelet analysis, where as in the case of wavelet packet analysis, both details and approximations can be split up in the following decimation. By using this method there is a possibility to encode a signal in a number of different ways. The iteration of the high pass filter outputs means that the WPT allows for more than one basis function (or *wavelet packet*) at a given scale, versus the WT which has one basis function at each scale other than the deepest level, where it has two[5]. Thus the complete possible set of bases can be obtained from the set of wavelet packets. In another words the result obtained by iteration of low pass filter alone is a wavelet basis and the result obtained by the iteration of both low pass and high pass filters is a complete tree basis. So that "best basis" is defined as the basis that optimizes a particular criterion.

Scaling functions are used to generate low pass filters and wavelet functions are used to generate high pass filters in the case of DWT. The equation below shows the two scale (dilation) equation.

$$\phi(t) = 2\sum_{k=0}^{2N-1} h[k]\cdot\phi(2t-k)$$
$$\psi(t) = 2\sum_{k=0}^{2N-1} g[k]\cdot\phi(2t-k)$$

Two-scale (dilation) equations

Filters are generated by related, but different analysis functions in the case of Wavelet Packet analysis.

$$W_{2n}(t) = 2\sum_{k=0}^{2N-1} h[k]\cdot W_n(2t-k)$$
$$W_{2n+1}(t) = 2\sum_{k=0}^{2N-1} g[k]\cdot W_n(2t-k)$$

Where $W_o(t) = \phi(t)$
$W_1(t) = \psi(t)$

and 2N is the Filter length

The best basis selection begins by generating the full sub band tree. Then a cost value is assigned to nodes of the tree. This is done by finding the cost function at the associated sub band. After that the unwanted branches of the tree are removed starting from bottom level of the nodes to the top most level. The removal of the unwanted branches is as follows. Consider the cost value and then the cost value of parent node is compared with the sum of cost value of the children node. If the cost value of parent node is greater than that of the children node then the decomposition continues and the cost value of parent is assigned to the cost value of the children. If the cost value of the children node is greater than that of the parent node, then the decomposition will not takes place and thus remove the children node which are the unwanted branches. This process continues at each level of the tree. The best wavelet packet basis of the wavelet packet decomposition coefficients is obtained by considering the sub tree left after the removal of unwanted branches. This method provides good level of imperceptibility as well as robustness against various attacks [6].

Considering the acoustic signals, that are oscillating signals in nature the analysis by using the wavelet transform is sometimes inefficient because it only partitions the frequency axis finely toward the low frequency. The wavelet packet transform decomposes even the high frequency bands which are kept intact in the wavelet transform. Adapted waveform analysis uses a library of orthonormal bases and an efficiency functional to match a basis to a given signal or family of signals [7]. Wavelet packet decompositions adapt spatially inorder to best match the signal's locally varying time or frequency characteristics [8].

III. BLOCK DIAGRAM REPRESENTATION

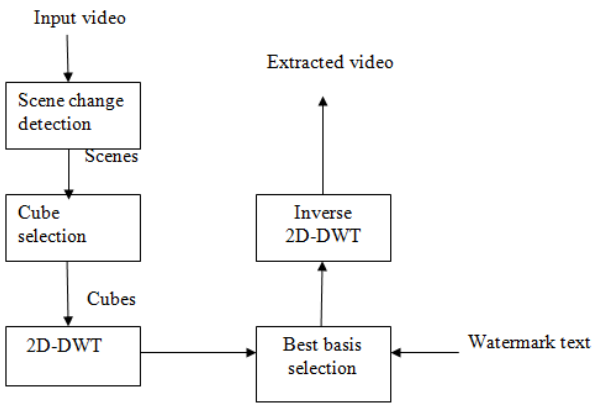

Fig.3 Block diagram of video watermarking using best basis selection

IV. EXPERIMENTAL RESULTS

By using this proposed method the PSNR value obtained is better. The video used here is "cat-video.avi".The PSNR value obtained is 76. The graph between PSNR rate and spatial attack ,temporal attack and compression attack shows that this method is a better solution for problems caused due to compression of data.Analysis on video is given below, in that the Fig.2 represents the input video.Fig.3 Fig.3 ,Fig.4, Fig.5, Fig.6, Fig.7, Fig.8, Fig.9, Fig.10, Fig.11 and Fig.12 represents the Energy levels 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 respectively. Compression attack is plotted against the PSNR which is shown in the Fig.13.A bar diagram representing spatial attack in the x axis and PSNR in the y axis is obtained which is shown in Fig.14. Temporal attack is plotted against the BER is shown in Fig.15..the extracted video is shown in the Fig.16

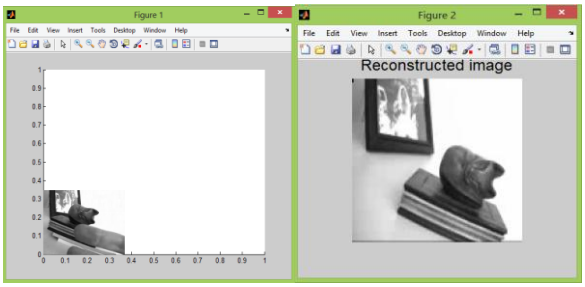

Fig. 2 input video Fig.3 Energy level 1

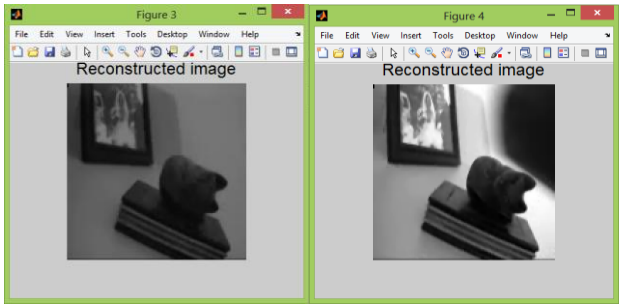

Fig.4 Energy level 2 Fig.5 Energy level 3

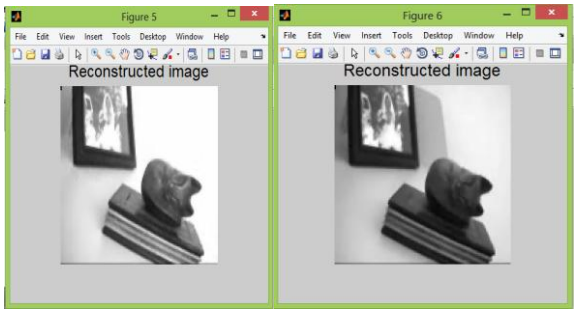

Fig.6 Energy level 3 Fig.7 Energy level 5

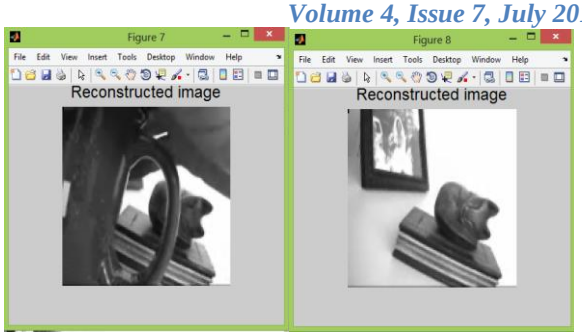

Fig.8 Energy level 6 Fig.9 Energy level 7

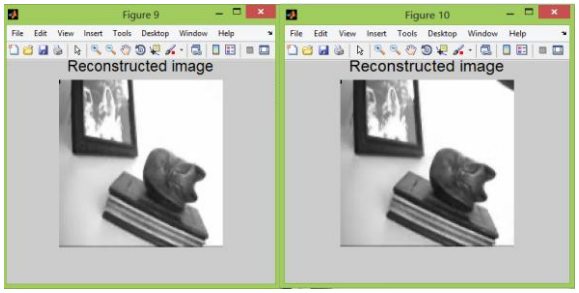

Fig.10 Energy level 8 Fig.11 Energy level 9

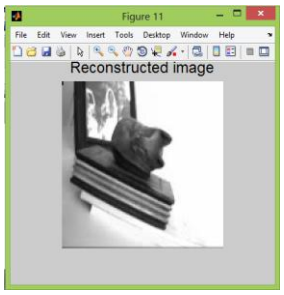

Fig.12 Energy level 10

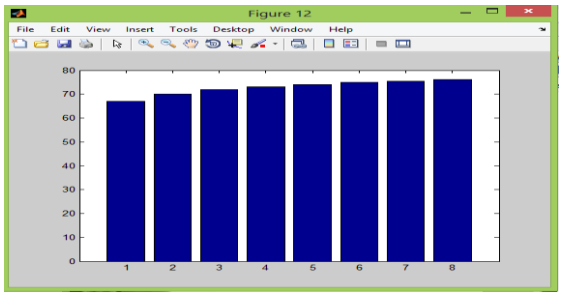

Fig.13 Bar diagram of compression attack & PSNR

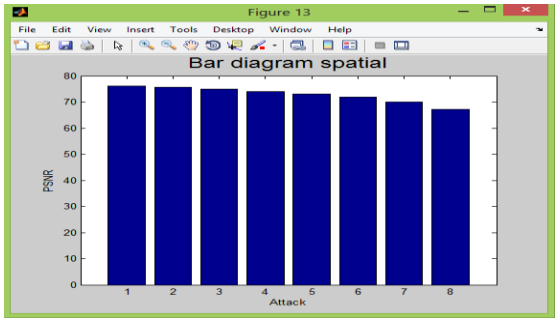

Fig.14Bar diagram of spatial attack &PSNR

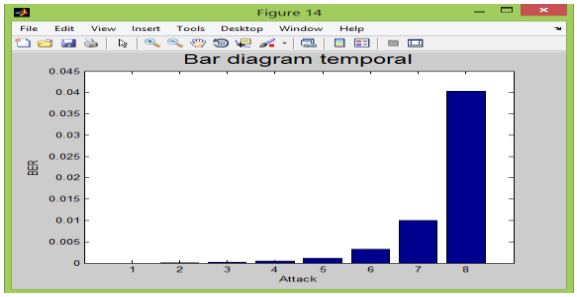

Fig.15Bar diagram of temporal attack & BER

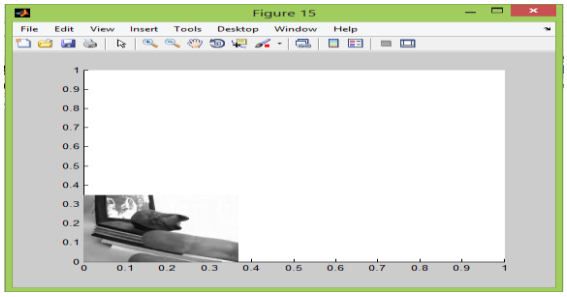

Fig.16 Extracted output video

V. Conclusion

Watermarking of videos using DWT and Best Basis Selection methods has been presented. The data is first embedded in the approximation coefficient i.e LL sub band of the DWT which means the 2D- DWT is applied. Next to it adaptive type of orthogonalization is performed, for this Best Basis Selection is being used. Increased robustness against attacks and an improved PSNR value are obtained by using this method.

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