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Original Research Article

EFFICIENT VIDEO WATERMARKING USING WAVELET PACKET

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Abstract - A group of moving visual images called frames along with corresponding text and sounds are called Video. The popularity of using digital video on Internet leads to illicit copying and dispersal of content. In order to avoid this, video watermarking technique is used as a preventive measure for illegal copying of copyrighted material. In this paper, watermarking algorithm for embedding a digital watermark in any video is proposed. The proposed algorithm preserve the video quality and provide security. The performance of the algorithm is analyzed using Peak Signal to Noise Ratio, Normalized Correlation and Mean Squared Error with respect to various videos. Experimental evaluation demonstrate that the proposed algorithm perform satisfactorily compared to traditional algorithms in terms of payload, transparency and video quality.

Keywords: Discrete Wavelet Packet Transform (DWPT), Discrete Wavelet Transform (DWT), Video Processing, Digital Watermarking, Video Security, Encryption, Extraction.

Introduction: The popularity of digital video has extremely increased as the number of videos is used during communication, entertainment and education. It is considered as a vital tool which combines all types of multimedia elements like audio, text, static and moving images. Video communication provides the advantage of being valuable and has the power to convey a great deal of information in a time-constrained environment. Also, as a result of the recent development in IT (Information Technology), huge amount of high quality digital contents is also generated from HDTV (High Definition Television) broadcasting and DVD. The swift growth in the network protocols and infrastructure, along with sophisticated services like high speed internet have made it possible to store, stream and share a large scale of videos in an easy and cost effective manner. However, these advancements prove to be challenging while taking the intellectual video content protection into consideration [1]. This has necessitated the need

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for techniques that control access to video content by restricting viewing rights, reproduction rights or copying rights. Media protection or Digital Rights Management (DRM) is the set of techniques used for this purpose [2]. Out of these techniques, digital watermarking in DRM has given more attention while proving the integrity and validity of the owner [3, 4]. Video watermarking [5, 6, 7] makes the digital video content so that a particular copy can be traced back to the original user and is mainly used as a protective measure for unauthorized copying of copyrighted material. To protect video content using watermarking, there are two crucial questions that have to be handled carefully i) when to embed watermark ii) where to embed watermark. In uncompressed video medium, the watermark is embedded into the raw frames of the video signal. The watermarking algorithm work is not influenced by the compression algorithm and therefore is more robust. Here, both compression and watermarking algorithms seek irrelevant data for embedding and therefore has to be designed carefully. These algorithms result with more quality degradation and therefore the proposed algorithm try to minimize them. The paper explains the various techniques used in proposed watermarking algorithms for uncompressed video data and discusses the experimental results based on performance metrics and finally concludes the paper.

Wavelet and Wavelet Packet: In order to represent complex signals efficiently, a basis function should be localized in both time and frequency domains. The wavelet function is localized in time domain as well as in frequency domain, and it is a function of variable parameters. The wavelet decomposes the image, and generates four different horizontal frequencies and vertical frequencies outputs. These outputs are referred as approximation, horizontal detail, vertical detail, and diagonal detail. The approximation contains low frequency horizontal and vertical components of the image. The decomposition procedure is repeated on the approximation sub-band to generate the next level of the decomposition, and so on. It is leading to well known pyramidal decomposition tree. Wavelets with many vanishing yield sparse decomposition of piece wise smooth surface; therefore they provide a very appropriate tool to compactly code smooth images. Wavelets however, are ill suited to represent oscillatory patterns [13, 14]. A special from a texture, oscillating variations, rapid variations in the intensity can only be described by the small-scale wavelet coefficients. Unfortunately, these small-scale coefficients carry very little energy, and are often quantized to zero even at high bit rate. The weakness of wavelet transform is overcome by new transform method, which is based on the wavelet transform and known as wavelet packets. Wavelet packets are better able to represent the high frequency information [11]. Wavelet packets represent a generalization of multiresolution decomposition. In the wavelet packets decomposition, the recursive procedure is applied to the coarse scale approximation along with horizontal detail, vertical detail, and diagonal detail, which leads to a complete binary tree. The pyramid structure of wavelet decomposition up to third level is shown in figure 4.1, tree structure of wavelet decomposition up to third level is shown in figure 4.2, structure of three level decomposition of wavelet packet is shown in figure 4.3, and tree structure of wavelet packets decomposition up to third level is shown in figure 4.4.

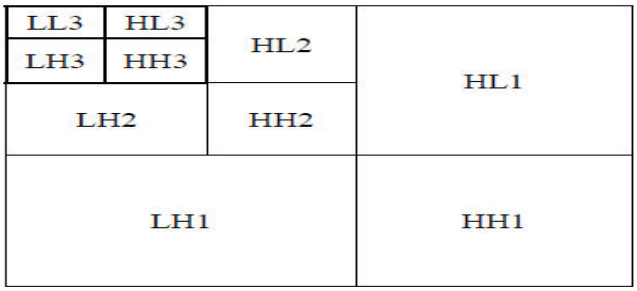


Fig.1: The-pyramid structure of wavelet decomposition up to third level.

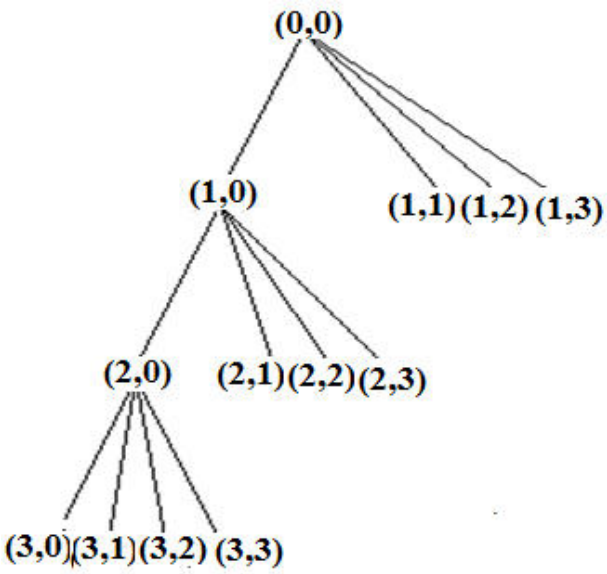


Fig.2: The-tree structure of wavelet decomposition up to third level.

LL_1LL_2	LL_1HL_2	HL_1LL_2	HL_1HL_2
LL_1LH_2	LL_1HH_2	HL_1LH_2	HL_1HH_2
LH_1LL_2	LH_1LH_2	HH_1LL_2	HH_1HL_2
LH_1LH_2	LH_1HH_2	HH_1LH_2	HH_1HH_2

Fig.3: The structure of two level decomposition of wavelet packet.

Implementation Scheme

The increase in the development of digital communication medium needs a method capable of offering a good content protection for multimedia contents like images, video and audio. In order to increase the protection of copyright information, the embedding procedure uses a watermark, created using visual cryptography (VC) technique [8]. This section presents the watermarking technique for uncompressed video domain based on the effective, amalgamation of watermark image. It is grouped into two stages. The first stage selects the the copyright watermark whereas the second is used to embed and extract watermark from uncompressed video data. The copyright image is selected by the user first and then this image is embedded in each of the video frames. The embedding procedure is shown below in the form of the flow chart.

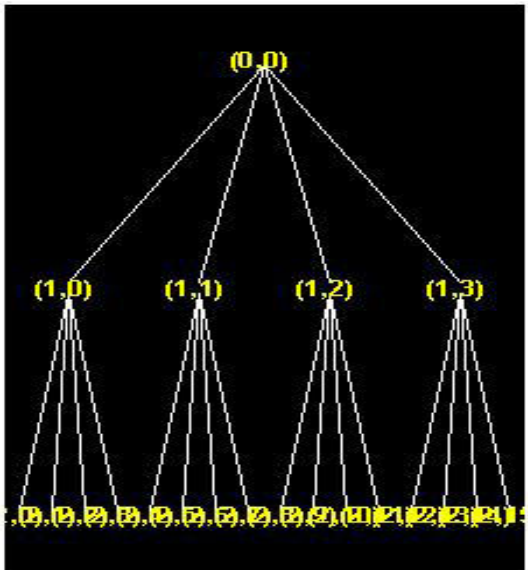


Fig.4: The complete decomposed three level tree.

Algorithm for Embedding

Step1. Any Video is taken as an input.

Step2. Divide this video into frames.

Step3. Select each frames (By running loop).

Step4. Decompose each frame using Wavelet Packet

Algorithm.

Step5. Take any Copyright Image.

Step6. Decompose Copyright Image using Wavelet Packet

Algorithm

Step7. Add the coefficients of Input frames with the scaled

version of Copyright Image.

Step8. Convert the new frames into video.

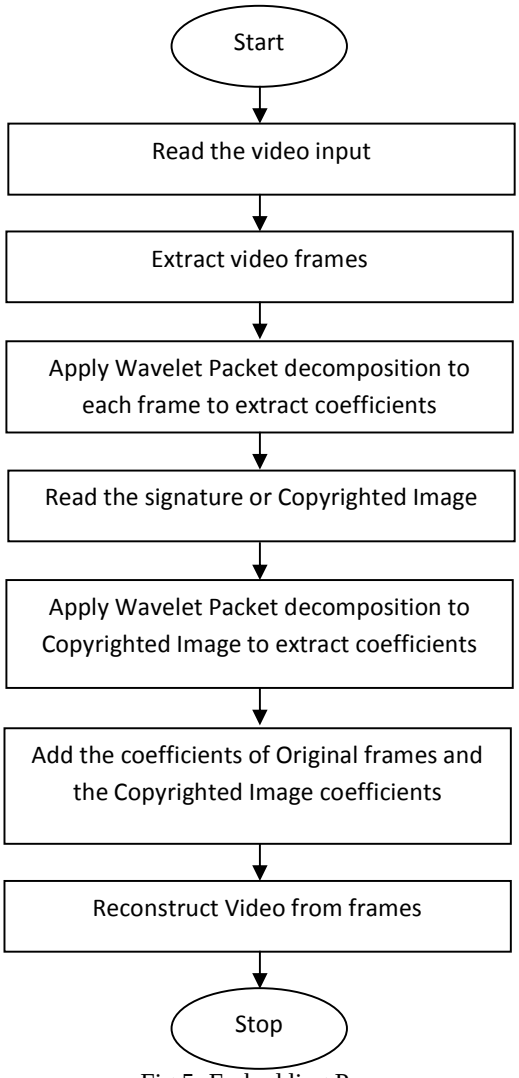


Fig.5: Embedding Process.

The extraction procedure is shown below in the form of the flow chart.

Algorithm for Extraction

Step1. Watermark Embedded Video is taken as an input.
Step2. Divide this video into frames.
Step3. Select each frames (By running loop).
Step4. Decompose each frame using Wavelet Packet
Algorithm.
Step5. Take Original video.
Step6. Divide this video into frames.

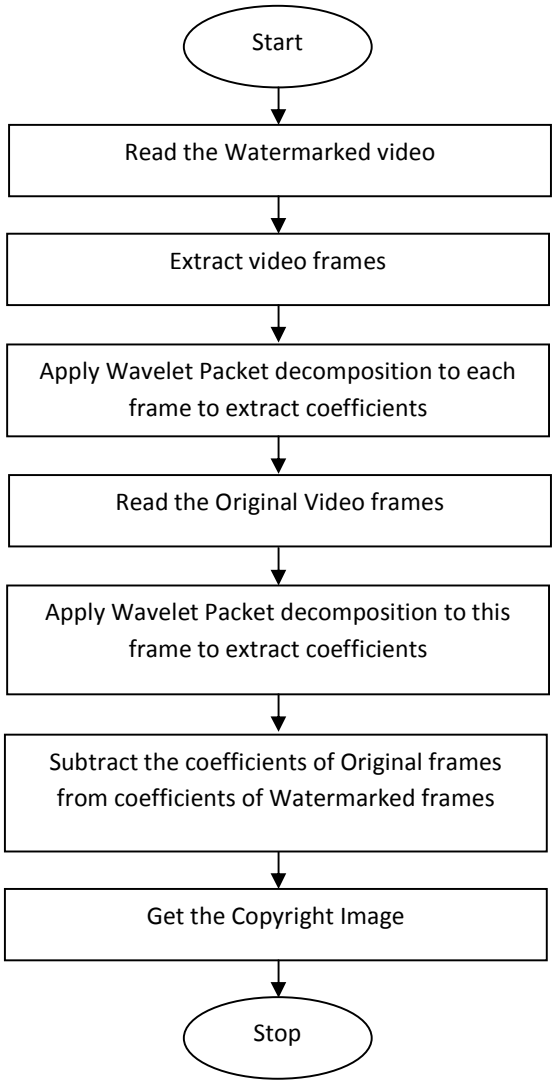


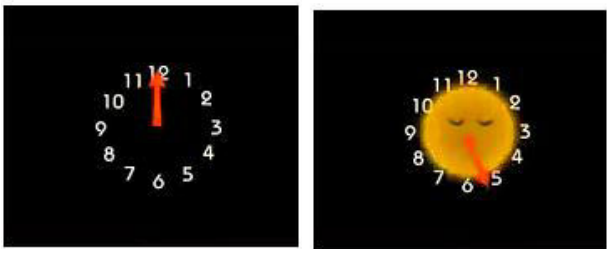
Fig.6: Extraction Process.

Results and Discussion: Here, in proposed work an embedding and extraction of copyright image has been implemented on Wavelet Packet Method. Six raw video sequences (Akiyo, foreman, coast guard, tennis and two real video) are used as test sequences. The size of these video sequences is 262 x 262 with a frame rate of 15 frames/ second and watermark image is of size 262 x 262. Video data is taken as input, divide this video into number of frames, then frames are selected for applying the proposed method, then Wavelet Packet Method is applied for embedding the watermark in the coefficients of original Image. Proper extraction of

watermark is achieved by applying Wavelet Packet Reconstruciton function to reconstruct the frames and get the watermarked frames which is just reverse of the embedding process to get the extracted watermark. For performance, evaluation and for the transparency, it is a significant factor in watermarking and generally used to measure the performance of the system. PSNR used as a standard to estimate invisibility. Figure below shows the original and embedded frames of the video.

Table-1: PSNR Comparison of Video Frames with Previous Results.

Video	PARAMETERS		
	MSE	PSNR (in dB)	NC
Real Video1 (Morning)	0.0022	51.1025	0.0520
Real Video2 (Bruno)	9.3628e-04	44.8692	0.0490
Akiyo Video	9.8337e-05	40.9300	0.0316
Foreman Video	2.1811e-04	37.3744	0.0401
Coastguard Video	0.0016	37.6007	0.0067
Tennis Video	9.4454e-04	44.7448	0.0445



(a) 1st Frame (b) 20th Frame

Fig.7: Frames of Original Real Video.

(a) 1st Frame (b) 20th Frame

Fig.8: Frames of Watermarked Real Video.

Conclusions

Here implementation of digital video watermarking scheme based on DWPT is proposed. The experimental results have confirmed that this new technique has imperceptibility and robustness with respect to the PSNR value. This is a fusion technique of video watermarking based on Wavelet Packet Algorithm. Embedding operation is performed in decomposed coefficient, so proper extraction of watermark is achieved. And there is no noticeable difference between watermark video and original video that it can be perceived by the human eye. This watermarking scheme is suitable for video signals in the .avi, .mp4 etc. formats. Higher value of PSNR indicates that the algorithm keeps the quality of the image and invisibility of the embedded watermark. Software model is design by using MATLAB Software version R2012a. There is no noticeable difference between the watermarked video frames and the original frames. Here as the table shows the high value of PSNR and therefore the performance of the developed algorithm is good and as a future work this could be implemented to check the method for various attacks.

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