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A Review on Video Watermarking

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***Abstract*—** Last decades witness the remarkable increase in the exchange of digital data over World Wide Web. Copyright protection of the digital media has been the key issue in the last decade. Video watermarking is a technique to protect the video from unauthorized person. Security and robustness is to properties of watermarking algorithm. The skill of protecting the data from unauthorized person is known as security while the resistance offered by the watermarking algorithm to any type of modification in cover content is robustness. This paper present an extensive review work accomplished in video watermarking.

Keywords— DWT (Discrete Wavelet transform); DCT (Discrete Cosine transform; SVD(Singular Value Decomposition); Watermark

I. INTRODUCTION

Video is the most watch multimedia content in the world wide web media. High usage of multimedia content the internet has marked some serious issues like Forgery, counterfeiting and pirating of the digital content. Easy access of these digital content in the internet has made it possible for anybody to make a copy of these content and use it in unauthorised way.

Such kind of copyright abuses is the motivational factor for developing the new algorithm of digital image and video watermarking. Watermarking is the process of embedding or inserting the copyright information in digital media in such a way that nobody other than an authorised person is able to detect and extract. The need of watermarking the video file arises with the facts that most of the information in the internet is also available in the form of video file. In most of the cases company's logo some other copyright information in the form of gray-scale or black and white images are used as watermark. Now a days, techniques for embedding the colour watermark is being developed.

In video watermarking, watermark is embedded in the video frames. In past lots of video watermarking techniques has been presented [1].These algorithm exploit different properties of video for embedding the watermark information while keeping the video quality intact. Digital can be secured by applying suitable encryption algorithm but encryption is not able to protect the data from illegal copying and distribution. Watermarking algorithm on the other hand, is used for protecting the data copy and distribution.

Watermarking algorithm which are used in image watermarking can be extended for video watermarking as video is basically a group of still images(known as Frames). Video frames contain huge amount of redundant data which is used for watermarking purpose. While embedding the watermark in video sequence, motion and motion-less regions need to considered. Imperceptibility, Security ,capacity and robustness are some common properties of watermark[2].

Imperceptibility: imperceptibility, means causing little degradation to the cover or host video.

Security: security means, the algorithm must be capable of providing security to the digital data by applying appropriate algorithm

Robustness: Means algorithm must be capable of extracting watermark information after video manipulation or even after applying some common signal processing operation.

Capacity: The algorithm must be capable of embedding more watermark information.

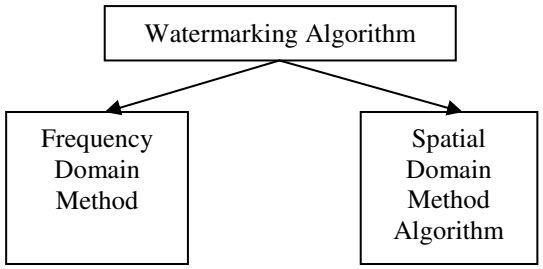

Figure 1 Watermarking Methods

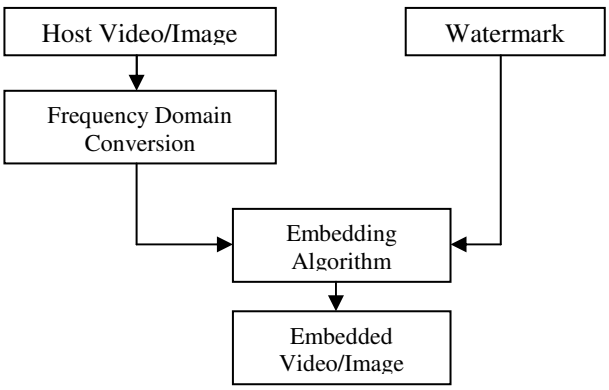

Figure 2: Watermark Embedding in Frequency Domain

Watermark in the host media can be inserted either in spatial domain [3,4] or in frequency domain (Fourier, DCT DWT and Fractal) by transforming the host[5,6].

II. LITERATURE REVIEW

In any video, watermark can be embedded by three methods-

(i) Direct embedding of watermark in raw video.
(ii) Watermark embedding during video encoding process.
(iii) Watermark embedding after video compression.

Since video is a group of still images known as frames therefore all the image watermarking algorithm can also be applied to the video data.

Some of the noteworthy contribution accomplished in this area is presented in this section.

Jadhav, Anita, and Megha Kolhekar,2014 [7] in their paper throw some lights on the digital watermarking application, video watermarking authentication. Past study on the video watermarking indicates that 3D cosine transform is mostly used for video watermarking. In their paper they applied 3D cosine transform for video watermarking and showed the outcome of their algorithm. They came in to the conclusion that this scheme work well in correlated videos. They proposed the embedding algorithm based on scene change detection in video. Their scheme was based on 3-D DCT.

Venugopala, P. S., H. Sarojadevi, Niranjan N. Chiplunkar, and Vani Bhat, 2014,In their paper[8] also proposed scene based watermarking algorithm in which extraction of watermark is accomplished thorough blind method. In their method they performed embedding of 8-bit gray scale image as watermark in different scene of video data.

In their method video sequence is divided in to different group on the basis of some selected luminous values. Relative relationship of the different groups are adjusted for inserting the watermark bit. This method is able to insert lots of watermark bits in the video sequence without producing noticeable distortion. Different types of watermark attack and video manipulation doesn't affect the watermark extraction.

Agarwal, Charu, Anurag Mishra, Arpita Sharma, and Girija Chetty , in their paper 2014 [9], Presented an approach of watermarking based on extreame learning machine(ELM). They used DWT domain for this scheme. This method is able to embed the watermark in uncompressed AVI video format. Various parameter suggested its robustness and high speed. They also use scene detection for watermark embedding. ELM is trained using LL4 coefficients of the frames. With the help of predefined formula output of ELM embed the binary watermark. Video obtained by embedding shows good visual quality. Five different types of watermarking attacks were also performed in order to see the effect of attacks on the watermark extraction. High normalization coefficients and low bit rate shows good watermark extraction. Fast ELM training are supposed to be the reason behind the good result. Low time complexity and robustness of this schemes makes it good algorithm for real time implementation.

Cedillo-Hernandez, Antonio,2014 in his paper [10] suggested a video watermarking algorithm which robust against video trans-coding . In his approach, robustness against the video trans-coding is achieved by employing four criterion which is based on human visual system(HVS) while keeping its imperceptivity perceived. Quantization index modulation is applied in this algorithm in 2-D DCT domain. The algorithm is tested using Peak signal to noise ratio(PSNR) and SSIM(Structural Similarity Index). This method achieved good visual quality. Simulation result reveal that this algorithm has good robustness against video transcoding as well as some common image processing operation.

Singh, Th Rupachandra, Kh Manglem Singh, and Sudipta Roy, 2013 in their paper [11] proposed a new scheme of watermarking in which different parts of the watermark is embedded in different scenes of the video sequence. Frame mean is used for embedding the watermark. Experimental results shows its robustness against various known attacks. Visual cryptography is used in this method for enhancing the security.

Wassermann, Jakob,2013 in his paper[12] suggested a novel method of digital watermarking in video sequence. His method shows robustness against the MPEG compression. First of all the input video sequence is decomposed 2 level wavelet transform. One dimensional wavelet transform is used for this purpose. LL part or low frequency coefficients band is used for embedding the watermark. 16 x 16 block wise DCT is applied before embedding operation. Spread spectrum technique is used for embedding the watermark. Watermark is divided in to 16 basis images with the help of hadmard transform. These basis images of the watermark is embedded in video sequence instead of binary 1 and 0. Experimental results confirms its robustness against the MPEG compression.

Yung-Lung Kuo and his associates, in their paper 2013[13] proposed an algorithm for copyright protection by watermark embedding in video. In their approach they used frame of high intensity, high texture and high motion for increasing the robustness of watermarking in spatial domain. Their algorithm is based on the fact that Human visual system(HVS) is not able to sense variations produced due to the high brightness, high texture and fast motion in video sequence. This technique of watermarking is adaptive in nature. In this technique first of all, video is divided into different sub blocks consist of different frames. Then discrete wavelet transform is used to convert these blocks into frequency component. Blocks are divided in to feature and non feature blocks. Watermark is embedded in feature blocks using spread spectrum technique.

Experimental results reveals that this method is very good to deal the attacks like linear transformation, frame adding , frame dropping and frame swapping.

Masoumi, Majid, and Shervin Amiri,2013
In their paper[14] claimed a new approach of watermarking for copyright protection in video sequence. In their approach they also used wavelet transform. In this method first of all scene change analysis is used to detect the motion part of the video sequence. 3D wavelet transform is then applied to the motion part of the video sequence. Third level 3-D coefficients of HH,LH and HL is used for inserting the watermark. Spread spectrum technique is used for watermark embedding purpose.
Since in the extraction, video is not required so it is a blind watermark detection. Due to its ability to detect the watermark blindly, it is very useful in the application where the original video is not available. Result obtained by applying this simulation reveals that its performance is excellent in term of robustness and transparency.
Moreover, this method also shows robustness against common frame attacks like frame dropping, frame averaging and frame swapping.
It is also robust against Gaussian noise and median filtering attack. Results reveals that it is also very robust against lossy compression such as MPEG-4 an,MPEG-2 and H.264.
Lin, Wei-Hung, Yuh-Rau Wang, 2009 in their paper [15] presented another blind watermarking algorithm which is based on the quantization of maximum wavelet coefficients. In this method, Wavelet coefficients are grouped together in the form of blocks of different size. These blocks are chosen randomly from different sub-bands.
In this method different energies are added to the maximum wavelet coefficient in such a way that a maximum coefficient in the block always remain maximum. Local maximum coefficients are chosen for watermark embedding which makes this algorithm resistant against some common attacks.
Since this algorithm is block based, therefore original image or watermark is not required for extraction phase. Simulation results shows its robustness against geometric and non-geometric attacks.
Sadik ali M. And his associates, 2009 in paper[16] presented an algorithm which was based on Hartung Method. In Hartung technique, spread spectrum technique in DCT (Discrete Cosine Transform) domain is used.
As per the result presented in their paper, this algorithm also show robustness against cropping, scaling and rotation.
Lama Rajab Tahani Al-Khatib Ali Al-Haj In [17] presented a algebraic transform of SVD(Singular value decomposition) based video watermarking algorithm. This is also very effective and robust method for video watermarking. In this algorithm, watermark bit is embedded diagonal-wise in the SVD-transformed video.
In this method first of all the video is divided in to video scene. SVD is applied to frames of each scene. For better result, video frame is converted to YCBCR from RGB format. Result presented in this appear claimed this method to be robust against frame dropping, frame swapping, frame averaging, compression and rotation.
Hanane Mirza, Hien Thai,2008 in [18] presented a video watermarking approach based on principal component analysis(PCA). Information content and color similarity based video shots are selected. From each video shots, key frames are extracted. Each frame consist of three color channel RGB. Watermark is embedded in these color channel. As per the result obtained in this paper, This method shows high robustness against some common watermarking attacks such as frame dropping, frame averaging etc. It also produce good perceptual quality of embedded video.
Chung, Yuk Ying, and Fang Fei Xu, 2006 in a paper [19] proposed Novel hybrid approach of digital video watermarking which uses error correcting codes(ECC). One of the advantage of this method is that it maximizes the payload while keeping the video quality degradation minimum by choosing an appropriate position for watermark embedding in the video. In this paper a new hybrid approach of digital video watermarking scheme with an Error Correcting Code (ECC) is proposed. This watermarking scheme maximizes the watermark Hybrid error correcting codes like BCH(31,8) and Turbo(3,1) with repetition codes are implemented and compared in this paper. Simulation results showed that hybrid approach of BCH and repetition code is able to achieve higher error correcting ability for different noise conditions.
Noorkami, Maneli, and Russell M. Mersereau ,2006 in their paper[20] presented a new approach to measure the motion intensity in video sequences and used this information for watermark embedding. They suggested that in video sequence, motion characteristics can be estimated perfectly by the information inferred from the motion vectors in an encoder. In this paper, motion intensity is measured with the help of copy-mode macro blocks and motion history is used for capturing the spatial distribution of motion. This approach is applied to identify the moving areas of video frames. In this method watermark is not embedded in moving area for avoiding watermarking artifacts produced in P and B frames by embedding watermark in I-frame.

Simulation result reveals that this method is able to reduce the watermarking artifacts in the video much better than other method which fail to exploit the motion information.

Xiamu Niu Martin , Martin Schmucker , Christoph Buschin 2002 in paper[21] presented a video watermarking approach which is rotation invariants, scaling invariants and Translation invariants(RST invariants).

In this approach, Pixel along the temporal axis is used to embed the watermark information within a watermark minimum segment(WMS). This approach is based on the facts that along the time axis, RST operation are same in every frames for very short interval and pixel position of watermark minimum segment is also changed in the same way cancelling out the possibility of change in the pixel position. Therefore this approach gives good watermark detection even after RST operation. Author also suggested the solution of the synchronization problem along the time axis. This is achieved by inserting special reference orthogonal sequence which has the same length as the WMS(Watermark minimum segment) along time axis. Simulation result claimed that this method is robust against RST attack. Shearing and bending of frames, frame dropping, lossy compression and also color-space conversion.

III. CONCLUSION

In this paper an attempt has been done to present a review work in video watermarking. Most of the image watermarking techniques can be extended to video watermarking also. With the increase of copyright violation cases in digital media compelled the researchers to continue update the video watermarking techniques in order to fight against copyright violation. Review work presented in this paper definitely help the researcher to study the past work and develop some new algorithm of video watermarking.

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