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A Review Paper on Video Watermarking

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Abstract—

Emergence of internet and social media has opened a new door for sharing the text, video and audio within themselves. Lots of information available in social media for everyone has created a serious threat of manipulating and distributing this information illegally with other. Digital watermarking is one of the important tool which is used for protecting the digital information from unauthorized person or agency.

Video watermarking is one of the variants of the digital watermarking which is used for authentication of video information. This paper is an attempt to go through the various techniques of video watermarking proposed in the past.

Keywords— **DCT (Discrete Cosine Transform), DWT(Discrete wavelet Transform),PSNR(Peak Signal to noise ratio), MSE(Mean Square Error)**

I. INTRODUCTION

In this era of information technology, information sharing has become easy and common among the different people and agencies across the world. With the introduction of high speed communication protocol like 3G and 4G along with the emergence of social media like twitter, face-book enable the people all across the world to share the information 24/7. Due to this information sharing, information is available to all which pose some threats to the confidentiality and integrity of the information. It has become easier to temper the information and redistribute it with the name other than the original owner of the information. This is a serious problem and needed to be resolved soon. Many researchers came forward with some algorithm to put a stop to this kind of illegal activity by adding security in digital content. Digital watermarking was one of the such attempt which was used to overcome this problem. In digital watermarking, a digital watermark which carry the ownership information, is embedded in to the digital content to prevent unauthorized access. Digital watermarking is used to protect the digital content like text, Image, audio and video. In Digital video watermarking, a watermark is embedded into the video which prohibit the unauthorised person to use it. Actually digital video watermarking is just the enhanced version of the digital image watermarking because video is composed of various frames which are still images. The amount of information which is inserted in to the digital information is called as the payload. One of the problem which is addressed by the video is its large volume which is not the problem in image watermarking.

In watermarking embedding algorithm, watermark is generally embedded either directly to the host media(Text/Image/Audio/Video) or to the transform version of the host media. Transform domain based watermarking approach, watermark is embedded in the frequency coefficients of the frames of the video. In this approach, first of all video is converted in to a frames or still images. These frames are then converted in to a frequency domain. After embedding the watermark, host media is again converted back to the spatial domain. Some of the common methods of transform domain are discrete cosine transform(DCT)[2,3] and Discrete Wavelet transform(DWT)[4]. In spatial domain based watermarking approach, embedding operation is done directly on the spatial domain or directly on the pixel of the frames. Transform domain based approach of watermarking is also performed in audio watermarking [3,4].

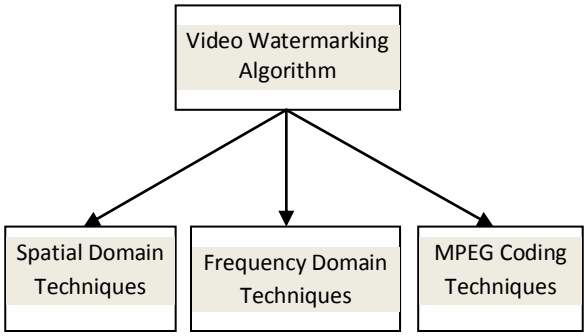

Figure 1 Video watermarking algorithm

Another form of video watermarking technique is known as the MPEG coding technique which is also being used in many applications.

There are five different sections in this paper. Section II describes some common terminology of the watermarking approach while section III describes various application of watermarking. Section IV throw some light on the past review work in digital video watermarking.

II. PROPERTIES OF VIDEO WATERMARKING

Video is generally composed of equally time spaced still images called frames. Since frames are itself an image therefore all the image watermarking algorithm can be applied to these frames and hence all the image watermarking algorithm are applicable to the video with slight modification. There are some challenges in video watermarking as compared to the image watermarking which need to be taken care of carefully for proper watermarking embedding operation. Some of the common challenges which is addressed in the video watermarking are frame averaging, frame swapping and compression operation[1]. These operation sometimes destroy the embedded watermark from the video which is undesirable. Perceptual Transparency, robustness capacity are some of the common terminology which is used in watermarking. Next section give the brief description of these properties.

A. Perceptual Transparency

This can be defined as the extent with which an embedded watermark remain unseen or unnoticed in host media. Temper resistance and robustness are some other properties of watermark which may conflicts with this properties.

B. Robustness

Resistance offered by the watermarking algorithm against some common signal processing operation is known as the robustness of the watermark. During the signal processing phase, some signal processing operation are performed on the image, audio and video signal such as Compression, filtering and rotation operations. A watermark approach is called robust if it is able to recover the watermark from the host media even after applying above mentioned signal processing operation. For achieving this goal, watermark si generally embedded in to the perceptually significant part of the host file.

C. Capacity

It is defined as the maximum amount of information which can be embedded by the watermarking algorithm.

III. APPLICATION OF VIDEO WATERMARKING

Video watermarking is most often used for providing the authentication and security to the digital content. Following are the common application of the watermarking.

1. For copy control[5].
2. In Text/audio/video fingerprinting[6,7].
3. For ownership identification.
4. For Authentication purpose.
5. For Monitoring of digital video broadcast[8].
6. In application like video tagging.etc.

IV. LITERATURE REVIEW

Jadhav, Anita, and Megha Kolhekar,2014 [11] 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[12] 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 [13], Presented an approach of watermarking based on extreme 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 [14] 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 [15] 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[16] 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 confirm its robustness against the MPEG compression.

Yung-Lung Kuo and his associates, in their paper 2013[17] 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[18] 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 [19] 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 result shows its robustness against geometric and non-geometric attacks.

Sadik ali M. And his associates, 2009 in paper[20] 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 [21] 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 appears claimed this method to be robust against frame dropping, frame swapping, frame averaging, compression and rotation.

Hanane Mirza, Hien Thai,2008 in [22] 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 [23] 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[24] 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[25] 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.

V. CONCLUSION

Evolution and past work in any research field is a valuable repository for young researchers which help them to grasp the past methodology. This paper discuss various techniques of video watermarking, its advantages and limitations. Spatial domain techniques such as Least significant bit (LSB) and its variants are easy and require less computational power but its poor security and poor robustness against some watermarking attack makes it unsuitable for watermarking purpose. Transfer domain or frequency domain techniques are though resource and computational power hungry but these techniques are robust against the watermark attack. Advance research in this field is going on in other domain as well. Adopting spatial domain techniques or frequency domain techniques depends on the requirement of the application.

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