A Novel Video Watermarking Technique Based on Implicit Distortions and Quantization Parameter

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Abstract : Nowadays due to advances in technology sensitive videos or copyright videos are leaked or distributed illegally by the unauthorized users. The digital watermarking is an efficient method to protect the ownership of copyright video. A variety of imperceptible solutions exist for watermarking the video, but digital pirates may destroy the watermark by manipulating the video. Therefore this paper presents a novel video watermarking technique in which an encoder decision is explicitly changed. This explicit change will create large amount of implicit distortion. The implicit distortion is an encoder created artifacts implemented through H.265 or HEVC. The proposed scheme proves to be robust, imperceptible and stand against video manipulations. Further the watermarking technique can help combat piracy without disturbing innocent users.

***IndexTerms* - Watermark, H.265 or HEVC standard, imperceptible, robust, artifacts.**

I. Introduction

The rapid growth in the multimedia technology, image processing and communication network has made transmission of digital products easygoing. The digital pirates usually try to destroy the embedded watermark and upload it into torrent sites [1]. So watermarking has become an essential part of protection of digital data. The embedded watermark should not spoil or damage the quality of video and hence must be imperceptible. For an attacker it must be difficult or impossible to remove the watermark thus proving robustness against video manipulation and signal processing.

There are several ways to watermark the video which may include altering the bit value or computing dct or dwt. but these methods produce artificial distortion to the video and hence perceptible or not robust [2]. And hence a unique watermark is required so that if a pirate illegally distributes the video he / she can be identified by extracting the watermark.

II. LITERATURE SURVEY

This section describes the previous work done on watermarking techniques.

I.J.Cox and M.L.Miller introduced a watermarking technique in which the least significant bits on certain pixels are modified or changed because these least significant bits can be easily be swapped with the information of watermark without degrading the quality of the signal [3]. But the attackers can easily change or delete the least significant bit without any quality decrease.

F.Hartung and B.Girod proposed a watermarking technique based on spread spectrum where the watermark is added as a noise. This pseudo random noise was added to the video while taking care of the pixel change [4]. When pseudo random noise is used as a watermark its presence is detected by correlation techniques.

Chuan-Fu Wu and Wen Shyong proposed a watermarking technique using zero tree of dct. The watermark is embedded in the lower frequency range. The psnr obtained is lesser than the proposed system psnr value [5].

Jyothsna singh and abhinav dubey proposed a watermarking of mpeg-2 video using quantization index modulation. But it suffers a probability error or bit rate error [6].

In general, all existing techniques discussed above introduce artificial distortions to the video. So this paper introduces a new way of imperceptible distortions added in a natural way.

III. Proposed Scheme

The proposed technique of embedding watermark to the video is based on the implicit distortion by an explicit change. The entire video is divided into frames. The implicit distortion is created by altering a parameter which makes a video frame predict differently. As the future frames are dependent on the previous frames, the explicit change of quantization parameter will make the distortion propagate through the whole video through inter and intra frame propagation. The proposed scheme is implemented using the High Efficiency Video Coding (HEVC). The implementation of the proposed scheme requires no modification in consumer electronics.

In the extraction part of the watermark, the watermark embedded video is compared with several compressed video for many IQ measures such as average difference, correlation, absolute error etc. Furthermore from the compressed video we can find the pirate who illegally transmitted or uploaded the video.

As an alternative to the existing watermarking approaches, this paper proposes a novel watermarking technique in an implicit way during the encoding process. The proposed watermarking scheme is implemented through the following steps shown in fig.1.

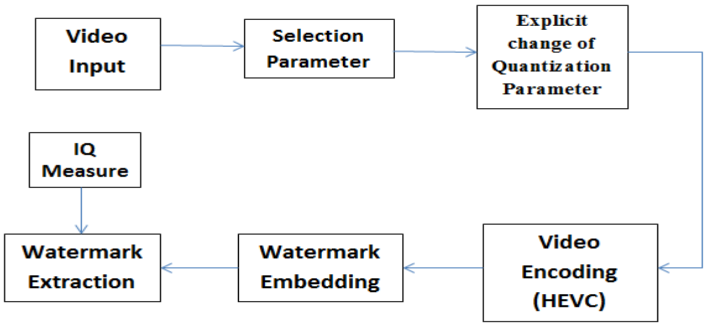

Fig. 1: Block Diagram of Watermarking process

3.1Video Input

The input video given for watermarking should be in yuv format. As human eyes are sensitive to brightness rather than colour a yuv colour encoding format is chosen. Here Y represents brightness or luminance, U and V represents colour or chrominance. In this type of encoding format it will sample the chrominance values at half the horizontal resolution of luminance samples. This means that for every two y sample there will be a U and V sample. Compared to traditional RGB format which encodes 3bytes for single pixel, YUV encodes 4bytes are needed for every 2 pixels. YUV is 30% less than the RGB encoding. So file size can be reduced.

3.2 Selection Parameter

There are many parameters in H.265 that needs to be defined first and then initialized or set to a value. During the encoding process, the entire video is divided into frames. For a particular image, it is still divided into 64x64 pixels called coding tree units. Further it is divided into 16x16 macro blocks. Again into 8x8 called as coding units. And 4x4 called as prediction units. There are several parameters that need to be initialized during encoding and some of them are listed as below:
MaxCUWidth: It is the maximum width of the coding tree unit that is 64x64.
MaxCUHeight: It is the maximum height of the coding tree unit that is 64x64.
MaxPartitionDepth: it is taken as 64x64. IntraPeriod is -1. Group of Pictures (GOP) as 4.
QuadTreeTULog2MaxSize as 6 and QuadTreeTULog2MinSize as 2.

3.3 Quantization Parameter

The quantization parameter (QP) is chosen as the best or major parameter for watermark embedding purpose. The QP is used as the quantization step size. More the QP value video will be highly compressed and lesser will be the bandwidth. Smaller the QP value creates slightly compressed video and more will be the bandwidth. In other words QP determines how much the details are retained. More the QP, details are combined so lesser bitrate. Hence an optimal QP value should be chosen for encoding. The value of QP needs to be changed dynamically so that group of pictures gets correct allocation of bits. Usually the QP will be 0-51 for an 8 bit image. The suitable range for QP is 20 – 45. The QP value is given in the watermark creating phase.

3.4 Video Encoding

In the proposed scheme, a High Efficiency Video Coding (HEVC) or H.265 is used as an encoding standard. The HEVC is a new or emerging encoding standard. Compared to the previous Advanced Video Coding (AVC) or H.264, HEVC uses 35 prediction modes and the former used only 9 prediction modes and a 50% reduction in bitrate can be achieved. The frame coding structures supported by HEVC are Low-delay-P, random access, low-delay-B [7]. A set of structures from different frames are formed within Group of Pictures. From one or more frames at lower coding levels the higher coding level can be predicted [8]. In HEVC there are 2 methods for compression:
Intra frame compression – Here compressing is done by looking at redundancy in the same frame. Each frame is encoded individually.
Inter Frame compression – Here the previous frame is compared to the present frame and encoding is done based on what is changed.

3.5 Watermark Embedding

The structure of the video is such that it contains coding information and the residual signal. The coding information will predict every region of the video based on the other near regions. If the prediction is not correct then the residual signal will correct the prediction errors. In the embedding process, a single coding decision is changed explicitly without disturbing other qualities. The region for which the coding decision is changed will predict differently. As this frame is used for prediction of other frames, those frames will also predict differently. Similarly the implicit distortions will propagate through whole video. Through inter and intra frame propagation the implicit distortion will spread through whole video. The watermarked embedded and compressed video is saved as a bin file. The single coding decision that is used as an explicit change is Quantization parameter. So creating this type of implicit distortion is watermark embedding process. The watermark is done for a single video with several ways by giving different QP values.

3.6 Watermark Extraction

In the extraction process of the watermark, all regions are considered instead of only one. The correlation is calculated with all the watermarks. Here many watermarked files in bin format that are compressed with different QP is selected. The decompressed video in the yuv format is compared with the compressed bin file for many IQ measures such as average difference, structural content, normalized cross correlation, normalized absolute error and cross correlation. The value of iq-measures is computed for all the compressed video with respect to the decompressed video. If the value of the iq- measure is zero or nearly equal to zero then that compressed video is the watermarked video for decompressed video. A score is given by calculating average of all the iq- measures. The graph of score for all the compressed video is found. Thus the score value 0 or nearly equal to 0 is the watermarked embedded video.

IV. RESULTS AND DISCUSSION

4.1 Evaluation Results of some watermarked sequences

Table 4.1: Result after watermarking

Quantization parameter	Number of frames	Time taken in sec	PSNR in db
20	10	201	41.5913
	20	444	41.4782
	50	983	41.44
32	10	110	32.70
	20	300	32.52
	50	609	32.35
38	10	100	29.053
	20	199	28.849
	50	514	28.68
45	10	88	25.31
	20	171	25.062
	50	541	24.84

Table 4.1 shows the evaluation result of some watermarked sequences in terms of quantization parameter, number of frames, time taken and psnr. The number of frames taken is 10, 20 and 50 for all the quantization parameter 20, 32, 38, 45. From the table1 it is clear that larger the number of frames more is the time taken. And psnr is high for low QP and psnr is less for high QP value. The QP and psnr is inversely proportional to each other.

4.2 Create new watermark

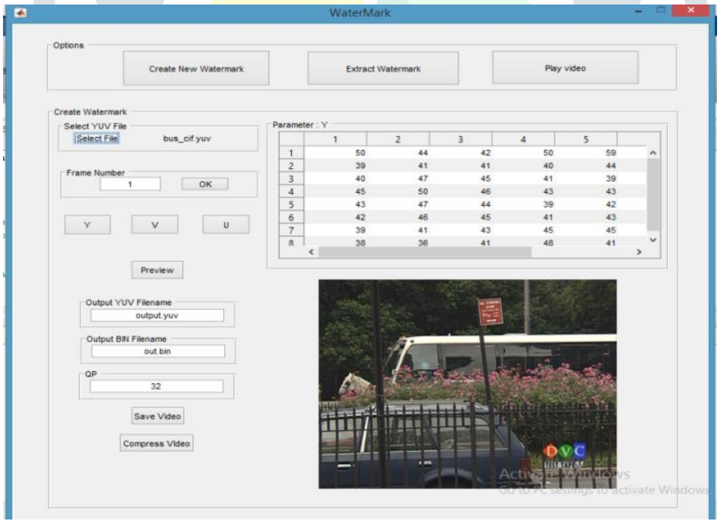

Fig.2 Creating a watermark in a video

The first step is to create a new watermark. The gui for that is shown in fig.2. The user has an option to select the video for which watermark is to be embedded. The selection validates only for yuv file. The interface also displays number of frames and the y, u, v parameter value in pixels. The selected video is displayed in the interface. QP 32 is the default value selected for compressing the video. The user can change the QP value for creating new watermark. The output.yuv represents the decompressed video and the out.bin file is the compressed file.

4.3 Extracting the watermark

When a watermark is created for a video then it is compressed and saved as a bin file. Several watermarked file are created using different values of QP. Those compressed files are displayed in the watermark files as shown in fig.3. The decompressed or the file for which watermark is to be extracted is selected. The start extraction will compare the selected file with the compressed file for many iq measures. The iq- measures show a 0 value for correct watermarked file. And it shows computed values for other files. These values are plotted as score for all the bin files.

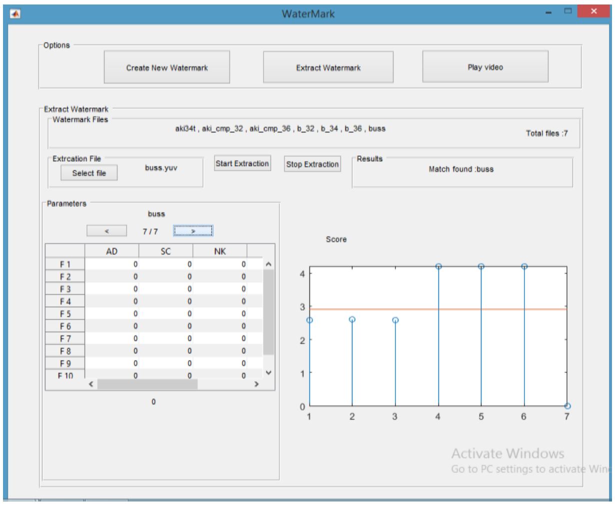

Fig.3 Extracting the watermark

V. CONCLUSION

A novel video watermarking technique has been proposed based on the implicit distortions. These distortions are created by explicitly changing a single coding decision such as quantization parameter. The explicit change created large amount of implicit distortion through intra and inter frame propagation. And the watermarked video was extracted successfully. A true positive detection of 100% and false positive detection close to 0% was obtained. The implicit distortions were treated as subjectively imperceptible i.e., negligible or no quality decrease was observed.

In conclusion, the watermarking technique can combat piracy. It can identify malicious consumers of video services who try to delete the watermark and illegally distribute the video. The proposed watermarking scheme requires no modification in the existing consumer electronics devices.

VI. ACKNOWLEDGMENT

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REFERENCES

[1] Yujie Zhang and Yuanyuan Zhang, Research on Video Copyright Protection System, 978-1-4577-1415-3/12 2012 IEEE.

[2] Sangeetha Yadav and Priyanka Anand, Dct based Digital Video Watermarking using Matlab/Simulink IJARCET vol 4 issue2 february 2015

[3] I. J. Cox, M. L. Miller, J. A. Bloom, J. Fridrich, and T. Kalker, Digital Watermarking and Steganography, 2nd ed. San Francisco, CA: Morgan Kaufmann Publishers Inc, 2008.

[4] F.Hartung and B.Girod Watermarking of uncompressed and compressed video 1998 vol 6 no. 3 pp 283- 301

[5] Chuan-Fu Wu and Wen-Shyong Hsieh, Digital watermarking using zerotree of DCT, IEEE Trans. Consum. Electron., vol. 46, no. 1, pp. 87– 94, Feb. 2000.

[6] Jyotsna Singh and Abhinav Dubey, MPEG-2 video watermarking using quantization index modulation 2011 IEEE 978-1-4244-7932-0/10.

[7] Jing He, En-Hui Yang et al., Adaptive Quantization Parameter Selection For H.265/HEVC by Employing Inter-Frame Dependency IEEE transactions 1051-8215 (c) 2017 IEEE.

[8] Glenn Van Wallendael et al., Encryption for High Efficiency Video Coding with Video Adaptation Capabilities, IEEE Transactions on Consumer Electronics, Vol. 59, No. 3, August 2013

[9] X. Ma, Z. Li, H. Tu, and B. Zhang, A data hiding algorithm for H.264/AVC video streams without intra-frame distortion drift, IEEE Trans. Circuits Syst. Video Technol., vol. 20, no. 10, pp. 1320–1330, Oct. 2010.

[10] H. Mareen, J. De Praeter, G. Van Wallendael, and P. Lambert, A novel video watermarking approach based on implicit distortions DOI 10.1109/TCE.2018.2852258, IEEE Transactions on Consumer Electronics