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Blind Video Watermarking Scheme For Mpeg-4 Videos With Parity Sequences In Transform Domain

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Abstract- High quality video broad casting is of high demand both with DVB-2 (Digital Video Broad casting) and Internet services. But these broadcasted data is distributed without protection. Invisible mode of video watermarking is one of the solutions, here in this paper a novel approach of data embedding scheme is proposed for MPEG-4 videos with different parity check codes and processed in transform domain. A subjective and objective analysis is performed to examine the proposed approach. Experimental results on various videos have shown that LDPC (Low density parity check) code with Gold spreading sequence in transform domain outperforms when compared against the other methods.

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I. Introduction

With the advent of digital video broadcasting over the internet and DTH (Direct to Home) /DVB (digital video Broadcasting) many issues of copy right protection is of great importance [3] [4]. Since the duplication of digital video signals does not result in the inherent decrease in quality of the suffered analog video signals. Invisible watermarking is one of the solutions for the protection of the digital data. A water mark is a digital code that is embedded in the video sequence which can be used to transmit that video to the copyright owner in others terms this can be used to send the copy of digital data only to the legal user. This allows illegally reproduced copies to be traced back to the receiver from which they are originated. A simple diagram used to depict the scenario.

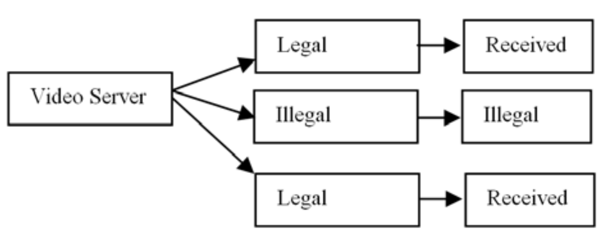

Figure 1: Block diagram of Copyright protection

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The digital video watermarking is regarded as a complete cryptogram communication system in which the watermark is regarded as the transmitted message and the video frame as the channel or carrier for the watermark and the pixels that are encountering attacks as the noise in the channel [1]. Based on this concept we can use parity check codes for error correction codes. In this paper we use LDPC codes for error correction.

Error correction codes are commonly used to protect memories from so-called soft errors, which change the logical value of memory cells without damaging the circuit. As technology scales, memory devices become larger and more powerful error correction codes are needed. To this end, the use of more advanced codes has been recently proposed. These codes can correct a larger number of errors, but generally require complex decoders. To avoid a high decoding complexity, the use of one step majority logic decoding codes was first proposed in for memory applications

LDPC code was first presented by Gallager [2], these codes have many advantages like stronger ability to correct errors and have the lower error floor, it's a parallel algorithm which is very much suitable for hard ware implementation, lower delay in decoding process, lastly it uses the length of the watermark and the value of the transformed coefficients for adaptive embedding. In [5], XU Ba et al proposed a blind video watermarking algorithm based on LDPC, improving the robustness of video watermarking algorithm in the original domain. In [6], Hsu et al proposed a video watermarking scheme based on DCT, using the DCT coefficients to embed watermark. In [7], Hartung et al proposed a scheme that the watermark is added in the MPEG-4 facial motion parameters. The disadvantage of the method is that extracting the watermarking requires the original host signal and the rate of extracting is unbalance. In [8], Chen Chao et al proposed a video watermarking algorithm in compressed domain, using the intermediate frequency coefficient of the luminance to embed watermark. Also, in [9], Li Jing et al proposed a robust blind video watermarking algorithm, using the low-frequency coefficient of the luminance component to embed watermark

In this paper an invisible mode of video watermarking is proposed with LDPC codes, for more security different spreading sequences are convolved during the embedding process. The paper is organized as follows

II. Proposed Approach

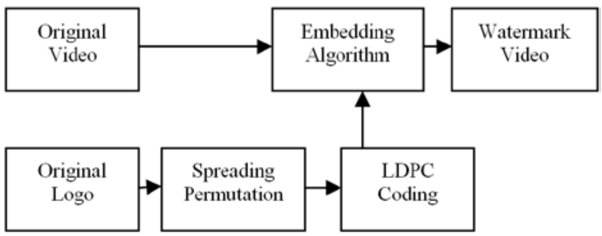

Figure 2(a): Embedding process

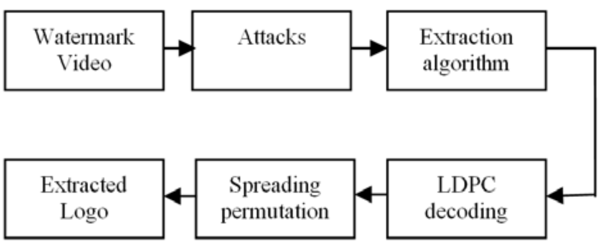

Figure 2(b): Extraction Process

Figure 2 : Block diagram of embedding and extraction process

Original Video: In this paper for the experimental analysis different videos available at [10]. The sample video frames are displayed below

Figure 3 : Video frames of the video samples considered for experiments

a) *Embedding Algorithm*

- *Consider a frame which is in true color RGB which is converted into Ycbcr.*
- *Consider the Y component of the color transformed frame*
- *Apply DCT (Discrete Cosine Transform) [11][12] and consider the middle frequency components for embedding line [32:32: MxN] where M & N are the x & y dimension of the frame.*
- *Consider a logo to be embedded of size 32x32 and make the values to be as {-1, +1}.*
- *Generate a random sequence of size [1 MxN] and consider the frequency position as stated in before point*
- *Encode the message data with LDPC*
- *The embedding process is*

$$V_i' = V_i + a_i b_k p_k \qquad (1)$$

Where 'i' is the i[th] Dct coefficient and 'k' is the middle frequency component , V_i is the original DCT coefficient and V_i' is the modified coefficient , $p_k \in \{-1,1\}$ is the spreading sequence .the value of a_i is set as

$$\begin{aligned} &\text{If } |V_i|<2 \text{ then } a_i = 2 \\ &\text{If } 2<|V_i|<10 \text{ then } a_i = 2.5 \\ &\text{If } 10<|V_i|<20 \text{ then } a_i = 3 \\ &\text{If } |V_i|>20 \text{ then } a_i = 5 \end{aligned} \qquad (2)$$

Spreading sequences: In this paper three different types of spreading codes were used PN sequence [13], Gold Codes [14] and Walsh/Hadamard codes [15].

b) *Extraction Process*

- *The watermarked video frame is converted into Ycbcr from which the 'Y' component is selected for the process*
- *Apply the DCT transform and convolve the middle frequency coefficients with spreading sequence.*

$$E_k = \sum_{i=kxcr}^{(k+1)xcr-1} V_i' p_i \qquad (3)$$
$$Cr = 32$$

- *Consider the sign of the resultant coefficient value and perform LDPC decoding to extract the logo*

III. Experimental Results

Experiments were conducted using the video sequences from [10] on Matlab 2012 Version, windows 7 OS

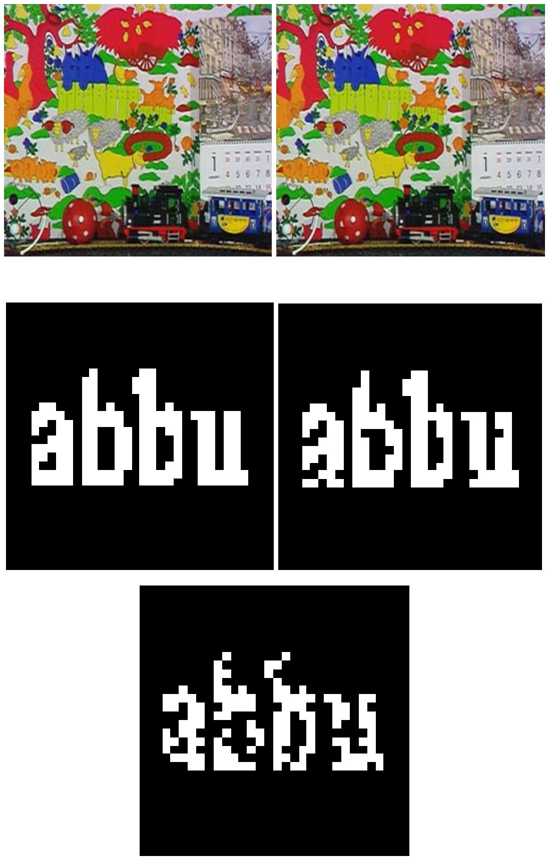

Figure 4: (a) Original Video frame (b) Watermarked frame (c) Original Logo (d) extracted with PN spreading sequence and LDPC coding (e) extracted Without LDPC coding

Table 1 : Analytical results with and without Pre coding

Parameter	NO PRE-CODING	LDPC
BER	0.04	0.01
NC	0.99	0.99
PSNR	49.28	49.31

Table 2 : Analytical results for extraction with different spreading sequences

Parameter	LDPC with PN seq	LDPC with gold codes	LDPC with Hadamard
BER	0.01	0.011	0.011
PSNR	48.29	48.32	48.27
MSE	0.964	0.956	0.967

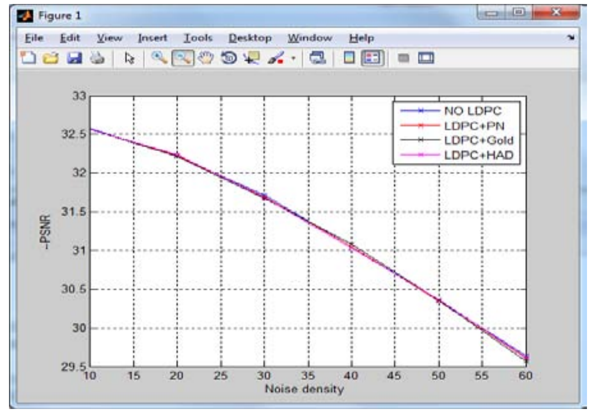

Figure 5 : Performance analysis for mobile video sequence with proposed approach

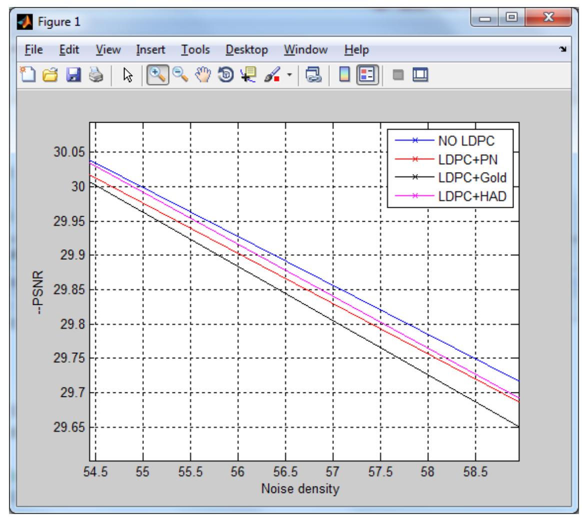

Figure 6 : Zoomed Graph of the figure 4

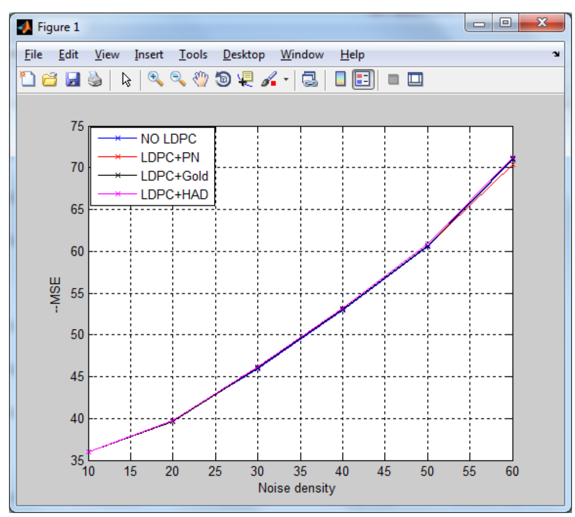

Figure 7: Mean square Error Analysis of the proposed approach for the Mobile.avi video sequence

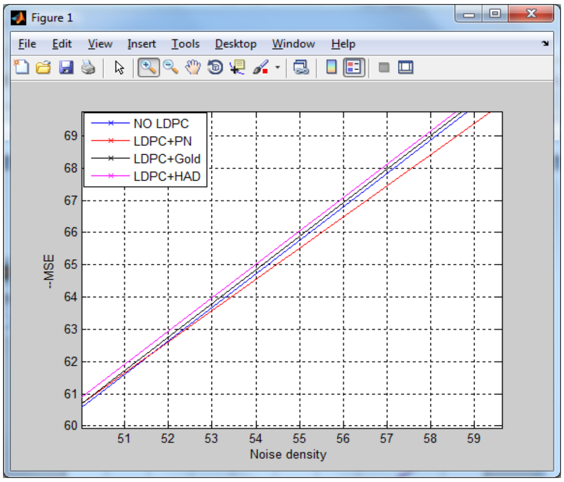

Figure 8 : Zoomed graph of figure 6

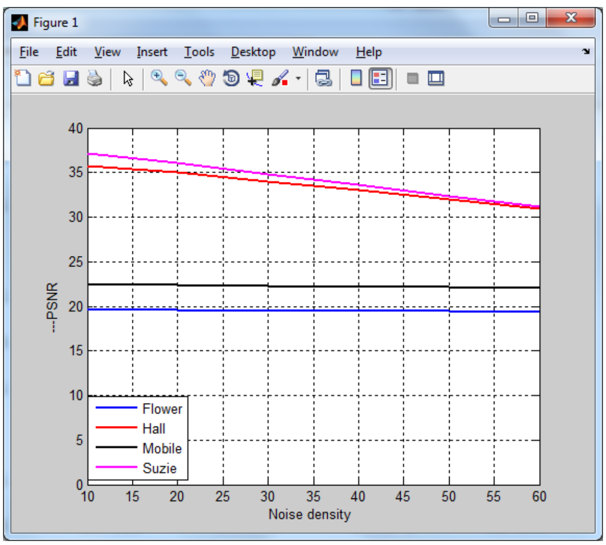

Figure 9 : PSNR analysis for different video sequences

IV. Conclusion

A invisible mode of video watermarking with pre coding and spreading sequences is proposed in this paper , the present approach is compared against three spreading sequences and found that when encoded with LDPC gold sequences of spreading leads to the low bit error and also high visual quality of the video sequence. This work can implemented for all the DVB and internet services where the quality of video is of greater demand. This work can be further extended by implementing this methodology with advanced trans forms like contour let and curve lets.

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