© 2017 IJSRSET | Volume 3 | Issue 8 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

An Efficient Information Hiding Scheme using Reversible Technique for Video

Yakesh Jadala
Assistant Professor, Department Computer Science and Engineering, SNIST, Hyderabad, Telangana, India

ABSTRACT

Now a Days the circulation of multimedia content over the internet technology is very prominent and it is important to provide security and authentication to content owner. In this Process, technology has to provide security for content without data loss or theft while transmitting the data through internet. Till now, In C. C. Chang like technologies provided some security for the content but while extracting the original content robustness and visual clarity is less. In various technologies lot of disturbances are observed because they do not consider the HVS characteristics. At present achieving the reversibility become complicated task. Here, we proposed an efficient data embedding scheme using reversible technique for MPEG-4 video and we analyzed the video characteristics using Human Visual system(HVS) and PSNR values for better visual qualities.

Keywords : DCT, Multiple bits reversible process, PSNR, MSE, HVS, MPEG-4 standards.

I. INTRODUCTION

In the present multimedia broadcasting technologies the data embedding in the image, video, audio etc., is very important for the authentication purpose by using water marking and steganography [7]. The various data embedding schemes are useful for the cover contents such as image, audio, video etc. for embedding the data 'I' The secret information which is hided data by using various embedding schemes it can store in image, video etc., It depends on the application of embedded scheme will be varied with the digital data representation of image, video etc. How much data has need to compress it depends on the usage of compression standards like JPEG, MPEG, JVT, H.264 etc. for better storage and transmission, extraction [11]. Present technology days, there is a b relationship between multimedia data and compression standards in that data embedding is a good research area. The data embedding is done in both domains i-e. compressed and uncompressed domains on image or video. The data hiding in the compressed domain is the present technology demanding and it has various advantages [12].

The widely used transforming technique is that DCT, in this technique the multimedia data is transformed to frequency domain. In the compression standards like JPEG, MPEG, JVT etc. The primary step is that embedding data into the quantized DCT co-efficient for better robustness. In practical implementation of data embedding we should consider the bit rate control etc. the common practice data can be embedded in reversible or irreversible manner both in the compressed and uncompressed standards. Most of the peculiar applications like RADAR, Military, Medical imaging are required to get the information in original form. So, the embedding scheme intention is that we should get back the data in original form or restoration of data [10, 4, 14, 9, 12]. For reversible process more modification are required for the cover content a part from the regular modifications bits additional modifications are required to the secret data .In this process ,the original content get visual degradation, this become a challenging task for research to improve the visual quality and embedding capacity [7].hence, to achieving the better capacity embedding is limiting factor for hide the data in reversible for embedding [12,6,6] The scheme uses the middle frequency coefficients for embedding the data achieves better visual quality in PSNR, MSE etc., this is enough for embedding the data reversible manner for to involve in more modification to the cover content [6].most literature work for watermarking or steganography application's ,aim of work measures PSNR, MSE etc. are used for better visual quality of degraded image/video [5]. manner .To achieve this there are few techniques for better HVS and embedding capacity[3,15].some other works will help to analyze the characteristics under the category of frequency domain for that purpose middle frequency coefficients of DCT block are used While embedding the data in DCT domain it should consider the HVS characteristics for visual quality since ,when the data embedded in DCT domain the PSNR is not so good compression technique .This paper we covered following section -2 explanation about the compression standards in MPEG-4 and proposed scheme ,section -3 explain the results analysis and we conclude the paper in the section 4&5.

II. PROPOSED WORK

We embed the data into the MPEG-4 video during the process of compressing raw YUV video into MPEG -4 format. Broadly ,the embedding framework in MPEG-4 include the formation of intra coded frames and inter coded frames followed by encoding .specifically it include the components like DCT, quantization, embedding, prediction ,encoding as in figure1. The MPEG-4 compression involves the formation of sequence of three kinds of frames :I-frames, P-,B-frames are called predicted frames. The I-frames are coded using intra frame technique, i.e. they can be reconstructed without having the reference to any other frame. The P-frames are coded using the inter frame technique called forward prediction. They are forward predicted from the recent I-frame or P-frame. The B-frames are also coded using inter frame technique but they are both forward predicted from the recent and backward predicted from the future I-frame or P-frame, i.e. two other frames are necessary to reconstruct the B-frames. Hence, in the MPEG-4 compression the I-frames are the key frames without which the reconstruction of the compressed video is not possible. Multiple feedbacks can be used by the encoder in predictive coding to improve the performance of coding . In this paper ,we choose the luminance component (Y) of the every I-frame for embedding the data. we take 8x8 block of a luminance component (Y) of an I-frame, get the quantized DCT coefficients and embed the data into it. Note that we present only the steps of interest in MPEG-4 compression in figure 1.

a. Models and Notations

The raw YUV video consist of sequence of frame F = $\{\bar{f}_1, \bar{f}_2, ..., \bar{f}_n\}$ be the sequence of original frames of raw YUV video ,where 'n'is the total number of frames .each frame f_i€ F consists of one luminance ,two chroma components. Let $\bar{f}_i = \{Y, Cb, Cr\}$ where Y is the luminance component and Cb, Cr are the two chroma components of f_i .all these components can be compressed using MPEG-4 encoder. While the compression process is being carried out, the MPEG-4 encoder expresses the frames in F as the sequence of I-,P-,B- frames. Then $F\text{-}=I \cup P \cup B$, where I is the set of I-frames called reference frames and P,B are the sets of P-,B- frames, which are the predicted frames .Though, all the frames in F- can be used for embedding the data ,we use only I-frames for embedding .Let Let $I = \{I_1, I_2, ..., I_m\}$ where m<n. as we concern with I, let $I_i=\{Y^i, C^i_b, C_r^i\}$,where Y^i is the luminance component of Ii, $C^i_b$and C_r^i are the two chroma components of Ii. we consider Y^i embedding the data. Here each Y^i, of size n_1 xn_2 ,is partitioned into 8x8 blocks of intensity values. we assume that both n_1,n_2 are the multiples of 8. Let $Y^i=\{B_1^i, B^i_2 ...., B^i_l\}$,Where B^i_j is the j^{th} 8X8 block of Y^i and l= $(n_1 x n_2)/64$.Here $m^{\wedge}$=mxl gives the total number of blocks in the setI . These 8x8 non-overlapping blocks are transformed into 2-dimensional DCT using (1).

$$F_{u,v} = \frac{\alpha(u)\alpha(v)}{4}\sum_{x=0}^{7}\sum_{y=0}^{7} B_j^i(x,y)\hat{g}(x,y,u,v) \qquad (1)$$

where

$$\hat{g}(x,y,u,v) = \cos\left(\frac{(2x+1)u\pi}{16}\right)\cos\left(\frac{(2y+1)v\pi}{16}\right)$$

$$\alpha(e) = \begin{cases} \frac{1}{\sqrt{2}} & \text{if } e = 0, \\ 1 & \text{if } e \neq 0. \end{cases}$$

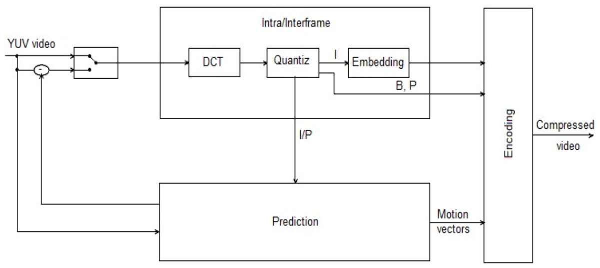


Figure 1: The framework of embedding in MPEG-4

Here, $0 \le u,v \le 7$, and $B^i_j(x,y)$ represent the intensity value (pixel value) of block B^i_j at the coordinate (x,y) in the special domain and $F_{u,v}$ represent the coefficient at the coordinate (u,v) in the frequency domain .the inverse DCT(IDCT) is obtained by (2) as follows ,where α(e) are the same as in (1),and $0 \le x,y \le 7$.

$$B^i_j(x,y) = \sum_{u=0}^{7}\sum_{v=0}^{7} \frac{\alpha(u)\alpha(v)}{4} F_{u,v}\hat{g}(x,y,u,v) \qquad (2)$$

Let $B^{\wedge i} = \{B^{\wedge}1, B^{\wedge}2, \ldots. B^{\wedge}_l\}$ be the set of 8x8 blocks of DCT coefficients of Y^i,and Q be a 8X8 block of the quantization table used in intraframe coding .Let $C^i = \{C1, C2, C3 \ldots. C_l\}$ be the set of 8x8 blocks of quantized DCT coefficients and $C^{i^\wedge} = \{C'1, C2', \ldots\ldots C_{,l}\}$ be the set of embedded blocks of Y^i.Let $D_i (1 \le i \le 9)$ be the set of quantized DCT coefficients from high frequency to low frequency of a 8x8 block as show in figure 2[6]. Let $(d_{i,1}, d_{i,2}, \ldots. d_{i,k(i)})$ be the sequence of quantized DCT coefficients in the set $D_{i,}$ where k(i) is given in table (1).

b. Data Embedd`ing procedure

We embed the data in the middle frequency components as in C.C.chang et.al. scheme [6].the sets $D_i(1 \le i \le 9)$ are consider for embedding as shown in figure 2.we embed the data into the middle frequency zero coefficients of the chosen sets. the data is embedded based on the number of ceaseless zeros b_i ,from high frequency to low frequency in the chosen set. when $b_i \ge [k(i)/2]$, use the quantized DCT coefficient $d_{i,[k(i)/2]}$,where k (i) is given in the table1.the major difference between the proposed scheme and the C.C chang et.al. scheme is that embeds a single bit any where in the sets D_i when $b_i \ge 2$ where as the proposed scheme embeds multiple bits (encoded form) exactly in the middle of the sets $D_{i,}$ which results in better visual quality in terms of HVS based measures.Further ,it is simple and correctness of reversibility can easily be verified. let $x = d_{i,[k(i)/2]}$,use the following s,f,s',g functions where s is used to encode the data bits ,f is used to embed the bits ,s' is used to extract and decode the data bits and g is used to restore new coefficients as shown in figure.3

$$S(s,t,u) = \begin{cases} 0 & \text{if } s=t=u=0, \\ 1 & \text{if } s=0, t=0, u=1, \\ 2 & \text{if } s=0, t=1, u=0, \\ 3 & \text{if } s=0, t=1, u=1, \\ 4 & \text{if } s=1, t=0, u=0, \\ 5 & \text{if } s=1, t=0, u=1, \\ 6 & \text{if } s=1, t=1, u=0, \\ -1 & \text{if } s=1, t=1, u=1, \end{cases} \qquad (3)$$

Where s,t,u three consecutive data bits in I to be embedded .

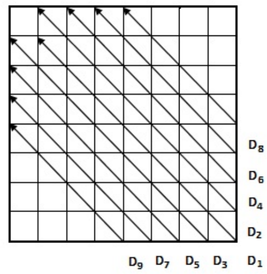


Figure 2: Chosen sets for embedding

i	1	2	3	4	5	6	7	8	9
K(i)	7	7	7	6	6	5	5	4	4

Table 1: The size of the chosen sets for embedding

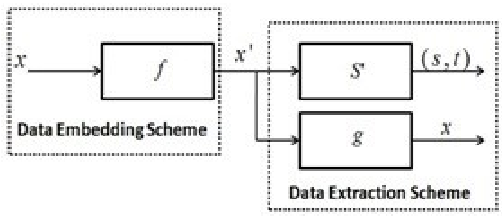


Figure 3. The Embedding and Extraction Procedure

$$X' = f(x) = \begin{cases} S(s,t,u) & \text{if } x=0 \\ x+6 & \text{if } x>0, \\ X-1 & \text{if } x<0, \end{cases} \qquad (4)$$

$$S'(x) = \begin{cases} (0,0,0) & \text{if } x=0, \\ (0,0,1) & \text{if } x=1, \\ (0,1,0) & \text{if } x=2, \\ (0,1,1) & \text{if } x=3, \\ (1,0,0) & \text{if } x=4, \\ (1,0,1) & \text{if } x=5, \\ (1,1,0) & \text{if } x=6, \\ (1,1,1) & \text{if } x=-1 \end{cases} \qquad (5)$$

$$g(x) = \begin{cases} 0 & \text{if } -1 \le x \le 6 \\ x-6 & \text{if } x>6, \\ x+1 & \text{if } x<-1 \end{cases} \qquad (6)$$

These functions satisfy the following conditions :

1.$|x - x'| \le 6$

2.for all x;f(x)=x'=>g(x')=x.

3.for all s,t,u;S(s,t,u)=y=>s'(y)=(s,t,u) and the function {000,001,010,011 ,100,101, 110,111} or the symbol ⊥ ,which indicates that no bits were embedded in y.

Algorithm 1: Data embedding scheme

Input : I={I_1,I_2,…………I_m} be the set of I-frames and Ï be the data to be embedded .

Output: the set of I-frames with embedded data for all I_i€ I do

    extract the Y^i from I_i
    partition Y^i →{B_1^i,B_2^i…….,B_l^i}
    for each B_j^i€ Y^i ,where 1≤j≤l do
        find the DCT coefficients in B^i_j :$\dot{B}_j^i$ =DCT(B_j^i);
        quantized DCT coefficients in $\dot{B}_j^i$ in as Below :
        For i_1 ← 1 to 8 do
            for i_2← 1 to 8 do
                $C_j(i_1,i_2)= \dot{B}_j^i(i_1,i_2)/Q(i_1,i_2)$;
            end
        end
        consider D_k(1≤k≤9) sets of C_j as shown in figure2;
        Let b_k be the number ceaseless zeros from high frequency to low frequency in the set D_K;
        begin
            if b_k=[K(k)/2]-1 and x=$d_{k,[K(k)/2]}$≠ 0
            Then
                eliminate the ambiguity using the Function f in equation in (4)
            End
            if b_k≥[K(k)/2] and x=$d_{k,[K(k)/2]}$=0
            Then
                Embed three consecutive bits s,t,u from Ï
                Using the function f in equation (4)
            end
        end
        Let the resultant block be $C_j^{'}$;
    end
        combine all the C'_j;
        $C^{\wedge i}$←{C_1,C_2,.....,$C_l^{'}$};
        restore the $C^{\wedge i}$ back to I_i={C^i,C_b^i,C_r^i}
end

we first denote every three data bits with single value as given by the function S as given by the function S in equation (3).then the data bits in the encoded single value is embedded into the x=$d_{i,[k(i)/2]}$ using the function f in equation (4). the algorithm for the above proposed method is presented in the following .During the compression ,F is given as input to the MPEG-4 encoder .as it is stated earlier ,the MPEG-4 encoder expresses the frames of F as the sequence of I-,P-,B-frames . we consider the set of I-frames for embedding the data bits. we present our proposed data scheme in Algorithm

c. Data extraction procedure

the data extraction is an inverse process of data embedding .we extract the data bits using the function S'and restore the modified coefficients using the function g ,when b_i≥[K(i)/2]-1 . we present our proposed data extraction and restoration using the algorithm 2.

Algorithm 2: Data extraction scheme:

Input: I, the set of I-frames with embedded data

Output: the set of restored I-Frames, and the extracted Data: Ï'

forall the I_i€ I do
    Extract the $C^{i\wedge}$ from I_i;
    Partition $C^{i\wedge}$ →{C'_1,C'_2,……C'_l}
    foreach $C_j^{'}$€ $C^{\wedge I}$ do
        consider D_K(1≤k≤9) sets of C'_j as shown in figure 2;
        begin
            extract the data bits when b_k≥[K(k)/2]-1 using the function S' in equation (5);
            Restore the modified coefficients using the function g in euation (6);
        end
        Let the resultant block be E_j';
        De-quantize the elements of E_j' as follows :
        for i_1← 1to 8 do
            for i_2← 1to 8 do
                $R_j(i_1,i_2)=E_j'(i_1,i_2) \times Q(i_1,i_2)$;
            end
        end
        $R_j'(i_1,i_2)$= IDCT(R_j');
    end
    combine all the R_j' blocks to get the $R^{i\wedge}$
        $R_j^{\wedge}$←{R'_1,R'_2,……..R_l'};
    Restore the $R^{i\wedge}$ back to I_i={$R^{i\wedge}$,C_b^i,C_r^i}
end

III. RESULTS AND DISCUSSION

We use various QCIF formatted videos in our experiment, including MissAm, Akiyo, CarPhone, SalesMan, etc. Some of the test videos are shown. The frame size of all these test videos is 176 X 144 pixels. We compress these test videos by the standard MPEG-4 encoder. The widely used measurement for evaluating the visual quality of Stegovideo (Watermark) is PSNR (peak signal to noise ratio). The PSNR for each YUV channel of a frame is given by the equation (7).

$$PSNR = 10\log_{10}\frac{255^2}{MSE}, (dB) \qquad (7)$$

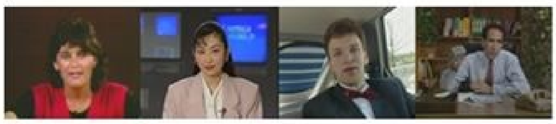
where

$$MSE = \frac{1}{MN}\sum_{x=1}^{M}\sum_{y=1}^{N}(f_{x,y} - f'_{x,y})^2 \qquad (8)$$

and $f_{x,y}$, $f'_{x,y}$ are the pixel values at eh coordinate (x,y) of original and distorted (embedded) video YUV channels respectively, each of size M X N. As we stated before, the PSNR do not capture the HVS properties. We propose to use the quality metrics PSNR-HVS-M [23], while evaluating the visual degradation of the distorted image/video. Especially, these HVS based measures very much suitable to assess the visual quality when the data is embedded into the DCT domain.

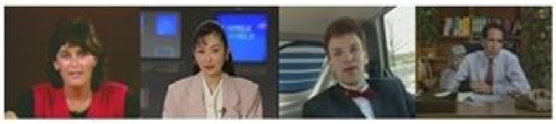
$$PSNR - HVS - M = 10\log_{10}\frac{255^2}{MSE^{HVS-M}}, (dB) \qquad (9)$$

Another measurement used for evaluating the performance of the data embedding scheme is High Embedding Capacity. We define the embedding capacity as the number of bits that can be embedded into a single Y^i. The tabulated results are shown in table 2. From our experiment results it is evident that the proposed scheme achieves almost the triple embedding capacity of C.C.Chang etal. Scheme. The quality interms of PSNR HVS M is better. Hence our proposed scheme outperformed in both the embedding capacity and visual quality.



(a)MissAm (b)Akiyo (c) CarPhone (d)SalesMan

Figure 4. The four original I fremes of various test videos



(a)MissAm (b)Akiyo (c) CarPhone (d)Salesman

Figure5. The embedded I frames of test videos

The embedded I frames of various test video sequences are shown in figure 5.

Table-2 : Results of test videos

	c.c chnag et.al scheme		proposed scheme	
	capacity	PSNRM	capacity	PSNRM
MissAm	3561	32.0302	10611	30.1791
MotherDoughter	3559	32.0302	10458	31.5511
Claire	3548	32.0302	10455	30.5992
Bridge(far)	3538	32.0302	10440	30.0912
Suzie	3547	32.0302	10416	31.6482
Highway	3526	32.0302	10398	30.5934
GrandMother	3534	32.0302	10266	31.197
Silent	3549	32.0302	10122	33.2746
Akiyo	3525	32.0302	10191	31.7589
Table	3521	32.0302	10095	31.0394
CarPhone	3506	32.0302	10053	32.6085
Foreman	3522	32.0302	9765	33.1772
Soccer	3527	32.0302	10011	31.8507
SalesMan	3506	32.0302	9987	33.2789
Hall	3492	32.0302	9804	32.3012
Coastguard	3481	32.0302	9813	32.0685
News	3445	32.0302	9576	32.5057
Bridge(close)	3382	32.0302	9471	32.1145
Container	3431	32.0302	9387	31.6479
Tempete	3431	32.0302	8505	36.2613
Bus	3132	32.0302	7944	34.0252
Football	2999	32.0302	7314	34.0712
Mobile	2983	32.0302	5952	37.7698

IV. CONCLUSION

When the data is embedded in the DCT domain, the distortions introduced cannot be captured by the PSNR alone. The combination of HVS based measures could provide a good measure of visual quality. Improving the HVS based measures by maintaining the acceptable range of PSNR could be the better measure of overall visual quality and high embedding capacity in DCT domain. The proposed reversible data embedding scheme which embed the data into middle frequency components of a quantized dct block. Triple the embedding capacity by improving the visual quality in terms of HVS based measures.

V. REFERENCES

[1] I. Abboud. Reducing of blocking e ect in image and video coding by three modes of adaptive ltering or interpolating. Damascus University Journal, 22(2):45-64, 2005.

[2] I. Avcibas, B. Sankur, and K. Sayood. Statistical evaluation of image quality measures. Journal of Electronic Imaging, 11:206-223, 2002.
[3] M. Awrangjeb and M. S. Kankanhalli. Lossless watermarking considering the human visual system. In T. Kalker, I. Cox, and Y. Ro, editors, Digital Watermarking, volume 2939 of Lecture Notes in Computer Science, pages 329-336. Springer Berlin / Heidelberg, 2004.
[4] M. Celik, G. Sharma, A. Tekalp, and E. Saber.Reversible data hiding. In Proceedings of International Conference on Image Processing, volume 2, pages 157 -160, 2002.
[5] Sagar G, Amberker BB, "A DCT based reversible data hiding scheme for mpeg-4 video," In: Proceedings of international conference on signal, Image and Video Processing (ICSIVP) 2012, IIT Patna, pp 254–259, Jan 2012.
[6] C.-C. Chang, C.-C. Lin, C.-S. Tseng, and W.-L. Tai.Reversible hiding in DCT-based compressed images. Inf. Sci., 177:2768-2786, Jul 2007.
[7] I. Cox, M. Miller, J. Bloom, J. Fridrich, and T. Kalker. Digital Watermarking and Steganography. Morgan Kaufman, 2008.
[8] K. Egiazarian, J. Astola, N. Ponomarenko, V. Lukin, F. Battisti, and M. Carli. Two new full-reference quality metrics based on hvs. In Proceedings of the International Workshop on Video Processing and Quality Metrics, pages 22-24, Scottsdale, USA, Jan 2006.
[9] J. Fridrich and R. Du. Lossless authentication of MPEG-2 video. In ICIP'02, pages 893{896, 2002.
[10] J. Fridrich, M. Goljan, , and R. Du. Lossless data hiding for all image formats. SPIE, Electronic Imaging 2002, Security and Watermarking of Multimedia Contents IV, 4675:572-583, 2002.
[11] B. Furht. A survey of multimedia compression techniques and standards. Part I: JPEG standard.Real-Time Imaging, 1:49-67, Apr. 1995.
[12] S. Gujjunoori and B. B. Amberker. A DCT based reversible data hiding scheme for mpeg-4 video. In Proceedings of International Conference on Signal,Image and Video Processing (ICSIVP) 2012, pages 254-259, IIT Patna, Jan. 2012.
[13] C.-T. Hsu and J.-L. Wu. Dct-based watermarking for video. IEEE Transactions on Consumer Electronics,44(1):206-216, feb 1998.
[14] F. Jessica, G. Miroslav, and R. Du. Invertible authentication watermark for jpeg images. In Proceedings of International Conference on Information Technology: Coding and Computing.,pages 223-227, apr 2001.
[15] S. W. Jung, L. T. Ha, and S.-J. Ko. A new histogram modification based reversible data hiding algorithm considering the human visual system. IEEE Signal Processing Letters, 18(2):95-98, feb. 2011.