An Assessment Of Video Quality Using Watermark

Jyothi Lakshmi.S [1], Smitha S [2]

Post Graduate Student, Computer Science and Engineering, KMEA College, Ernakulam, Kerala [1]

Assistant Professor, IT Department, KMEA College, Ernakulam, Kerala [2]

Video applications are much prevalent because of their recurrence in use on web these days. The watermarking can be utilized to appraise the video quality by assessing the watermark debasement. The image watermarking strategy for the video quality estimation is established on a 3-level discrete wavelet change (DWT). Here also propose a quad tree decomposition of video for watermarking embedding algorithm to keep the balance between watermarks intangibility and its capacity to adapt up to errors. The watermark is inserted into the tree structure of a image with fitting implanting quality chose by measurably examining the attributes of the image. The correlated DWT coefficients over the DWT subbands are classified into Set Partitioning in Hierarchical Trees (SPIHT). Those SPHIT trees are again decomposed into an arrangement of bitplanes. The insertion and extraction of the watermark in the cover video is discovered to be less difficult than other technologies. The True Detection Rates (TDsssR) determine the video quality by comparing extricated watermark and original watermark. The exactness of the quality estimation is made to approach that of Full-Reference measurements by referring True Detection Rate. In this manner proposed plan has great computational effectiveness for practical applications.

Keywords: **—Quad tree decomposition, DWT based watermark embedding, HVS masking, SPIHT tree structure, Watermarking based image quality estimation.**

Watermarking is the process of hiding digital information in a carrier. The hidden information may or may not contain any relation with the carrier. Digital watermarks could be used to verify the authenticity or integrity of the carrier signal. Here we are using the embedded watermark to estimate the quality of the video. Video quality is a feature of a video passed through a video transmission or processing system, any video degradation occuring is measured against the original video. The quality can be estimated by using objective metrics. This metrics classification depends on the amount of information available on the original image, the received image, or whether there is an image present at all. Full Reference (FR) metrics evaluate the quality difference by comparing the original video signal against the received video signal.

In this scheme, the watermark embedding strength is estimated by analyzing the quality degradation characteristics of the cover video and no iterative adjustment loops are used, which appreciably improves the computational efficiency. The HVS masking are used to guide the watermark embedding process. This scheme is based on watermarking and tree structure in the DWT domain. The Set Partitioning in Hierarchical Trees (SPIHT) has become one of the most popular image and video coding method. Its efficiency which is accomplished by exploiting the inherent similarities between the sub bands in the wavelet decomposed image. Both the DWT and SPIHT provide a good summarization of local region characteristics of an image which is important for watermark embedding. Here all the correlated DWT coefficients across the sub bands are grouped together using the SPIHT tree structure. The scheme is experienced in terms of PSNR, SSIM and under JPEG compression.

The rest of the paper is organized as follows. Section II specify the literature review. Section III and Section IV present the proposed watermark embedding scheme in detail. Section V describes the watermark extraction and quality evaluation scheme. Section VI concludes the paper and discusses future work.

II LITERATURE REVIEW

In [11], introduce a practical quality-aware image encoding, decoding and quality analysis system. Here use a reduced-reference image quality assessment algorithm based on a statistical model of natural images and a previously developed quantization watermarking-based data hiding technique in the wavelet transform domain. An effective way for digital watermarking, copyright protection, a process which embeds (hides) a watermark signal in the host signal to be protected is suggest in [2]. A new method introduce for assessing perceptual image quality. Here proposed SSIM indexing approach, which are analyses on structural similarity of the images. It depends on the image formation point of view and also for quality estimation scheme in [7]. Here [8], explains challenges in the video watermarking. LSB replacement does not provide robustness therefore it is not applicable for digital watermarking. Using different techniques it is easy to extract LSB embedded watermarks. The DCT domain watermarking, is extremely challenging to JPEG compression and random noise. In case of wavelet domains, this is highly resistant to both compression and noise. There will be minimal amounts of visual degradation. Also suggest HVS masks are tremendously preferred to analyze video sequences of frames to embed watermark.

III THE PROPOSED WATERMARK SYSTEM

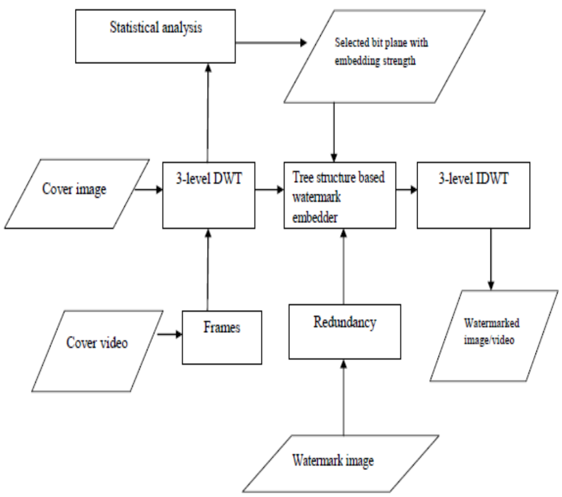

Fig 1 Watermark embedding process

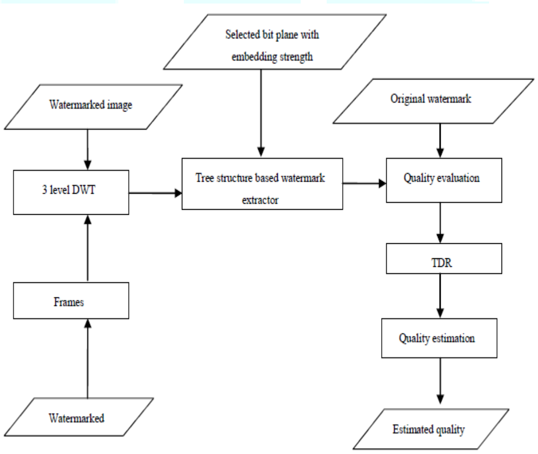

Fig 2 Watermark extraction and quality estimation.

Watermarking is used to estimate the quality of video. Select the cover medium as video and also select watermarking input as image. The watermark video has to convert into frames. Then each frame will experience, decomposition, embedding and extraction. The watermark embedding strength is estimated by analyzing the quality degradation of the cover image. The HVS masking are used to guide the watermark embedding process. The correlated DWT coefficients are grouped together using the SPIHT tree structure. The DWT decomposed image is further decomposed into a set of bitplane images. The binary watermark bits are embedded into the selected bitplanes. After the watermark embedding, the inverse 3-level DWT is applied to achieve the watermarked image. To estimate the degradation of the image quality, extract watermark from the watermarked image. By evaluating the original watermark with the extracted watermark consequences the quality degradation information. The TDR of the extracted watermark will be calculated to evaluate the degradation of the watermark. The quality degradation of the image will be estimated by mapping the TDR to a quality value referring to the "Ideal Mapping Curve".

Cover Image and Watermark Acquisition and Preprocessing

Digital video is a succession of still images, and a lot of image watermarking techniques can be extended to video in a straightforward manner. The cover video is selected and then it is coverted into frames. Also select a text image for watermarking with a particular image size, which will be later converted into grayscale image. The length of the original watermark sequence denoted as *len*. For the accuracy of watermark bit extraction at the receiver side, every bit in the real watermark is repeated a few times to get a redundant watermark sequence for watermark embedding. In this proposed scheme, set *Redundancy=3* and the real watermark sequence is repeated *Redundancy-1* times to get the redundant watermark sequence with *Redundancy* * *len* bits long.

SPIHT Tree generation and Data Embedding

The tree structure based watermark embedder is designed to embed the binary watermark bits into the selected bitplanes of the selected DWT coefficients of the selected trees. The tree structure based watermark embedder has three functions, forming the tree structure, selecting the trees and the DWT coefficients for the watermark embedding and embedding the binary watermark bits into the selected bitplanes of the selected coefficients.

The Formation of the Tree Structure: The tree structure is formed by categorizing the DWT coefficients with inherent similarities across all the DWT subbands. The correlated coefficients build up the parent-descendants relationship and form a tree.

The Selection of Trees and DWT Coefficients: For the applications of the watermarking based quality estimation, it is desirable to embed watermark throughout the cover image so that, even the watermarked image is locally tampered, the extracted watermark can still reflect the quality degradation of the cover image. According to the length of the watermark sequence, the trees for watermark embedding are chosen using the position separation key. To keep the embedded watermark invisible and limit the image quality degradation caused by the watermark embedding, the watermark bits are not embedded into the LL subband of the DWT decomposed image and the watermark bits are not embedded into the bitplanes higher than 5, where the least significant bitplane is bitplane 1. The watermark bit assignment is denoted as A_{wb} = [a1,a2, a3], where a1, a2 and a3 are the number of watermark bits to be embedded in the DWT level 1, 2 and 3 in every selected tree. For watermark embedding, the redundant watermark sequence is divided into W_{seg}.

$$\omega_{segs} = \left\lceil \frac{Redundancy * len}{\sum A_{wb}} \right\rceil = \left\lceil \frac{Redundancy * len}{a_1 + a_2 + a_3} \right\rceil \quad (1)$$

where *len* is the length of the watermark sequence.

To minimize the quality degradation of the cover image caused by the watermark embedding, two strategies are used for the tree selection:

(a) The trees selected from the three DWT orientations are non-overlapping in position.

(b) The trees are selected throughout the DWT decomposed image.

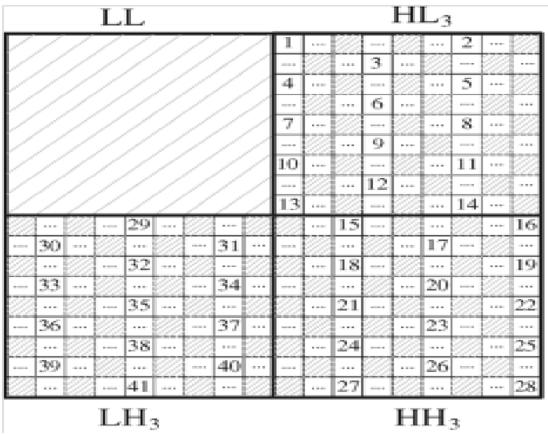

Fig 3: The tree selection from the three DWT orientations.

The watermark embedding: The binary watermark bits are embedded into the selected bitplanes of the selected DWT coefficients. Here, the watermark bit denoted as ω, the DWT coefficient bit on the selected bitplane represent as c and the watermarked DWT coefficient bit as c_ω. Then, the watermark bit will be embedded using the following

$$c_\omega = \begin{cases} c, & if\ c = \omega \\ \omega, & if\ c \neq \omega \end{cases} \qquad (2)$$

Here the schema is based on watermarking and tree structure in the DWT domain. The Set Partitioning in Hierarchical Trees (SPIHT) is most efficient way to exploit the inherent similarities across the subbands in the wavelet decomposed image. The DWT and SPIHT together provide a good summarization of local region characteristics of an image. All the correlated DWT coefficients across the subbands are grouped together using the SPIHT tree structure. The DWT decomposed image is further decomposed into a set of bitplane images. Then, each DWT coefficient is decomposed into a sequence of binary bits. The binary watermark bits are embedded into the selected bitplanes of the selected DWT coefficients of the selected trees. The HVS masking is used to guide the bitplane selection. The higher frequency DWT subbands and less significant bitplanes are more sensitive to distortions, and vice versa. Therefore, the robustness of the watermark depends on the selection of bitplanes for watermark embedding and the percentages of the watermark bits embedded into the three DWT levels. Thus, for different selected trees, the watermark embedding strengths are different.

The watermark embedding mainly consists of three steps. Shown in Fig 5.

(1) At first decompose cover image using 3-level DWT which results the DWT decomposed image. The 3-level DWT decomposed subbands are denoted as shown in Fig. 4.

(2) Then embed the watermark with embedding strength based on SPIHT the tree structure. The output of the watermark embedder is the watermarked DWT image.

(3) After that apply 3-level IDWT to the watermarked DWT image to obtain the watermarked image.

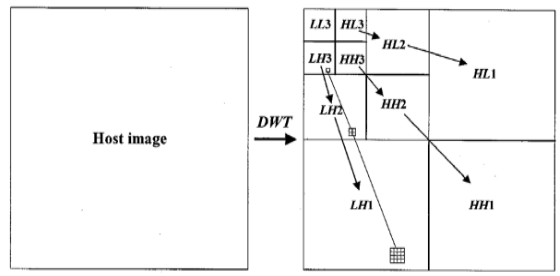

Fig 4: 3-level DWT Decomposition

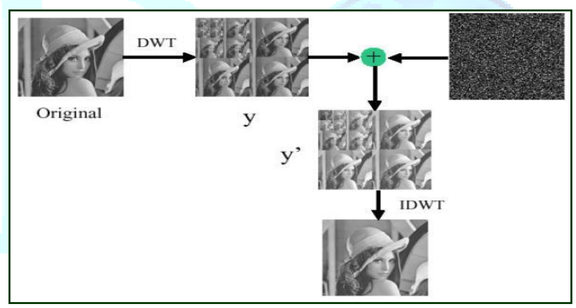

Fig 5: The watermark embedding

IV WATERMARK EMBEDDING STRENGTH

The watermark embedding strength is mainly controlled by the observed watermark bit assignment and the bit plane selection.

I. The observed watermark bit assignment

The watermark bit assignment is denoted as A_{wb} = [a1,a2,a3]. According to the image content complexity, the watermark bits are assign to the 3 DWT levels in the selected tree using the following steps:

- Analyze the content complexity of the cover image and calculate a complexity index.
- Categorize the test images into different groups according to their complexity indices.
- Assign watermark bits to the 3 DWT levels of the cover image. The watermark bit assignment will be the same for all the selected trees in one image and may be different for different images.

The content complexity of the cover image is assessed using the following equation

$$complexity = \sum_{i=1}^{n} (N_i * 2^i) \quad (3)$$

Here the quad-tree decomposed images are achieved using the threshold T_{int}=0.17, where the maximum intensity value of the cover image is not bigger than 1.

(a) The complexity indices are divided into 6 groups. One integer index is associated with one group.

$$Gindex = \begin{cases} 1, & V_c > t_1 \\ 2, & t_1 \geq V_c > t_2 \\ 3, & t_2 \geq V_c > t_3 \\ 4, & t_3 \geq V_c > t_4 \\ 5, & t_4 \geq V_c > t_5 \\ 6, & t_5 \geq V_c > 0 \end{cases} \quad (4)$$

where Gindex is the group index, V_c is the complexity index. t_1 ,t_2 ,t_3 ,t_4 ,t_5 and t_6 are the empirical grouping thresholds. These thresholds may be different for different distortions.

(b) With the group indices, the watermark bits are assigned to the images.

$$A_{wb} = \begin{cases} [27\ 0\ 0], & Gindex = 1 \\ [19\ 7\ 1], & Gindex = 2 \\ [13\ 12\ 2], & Gindex = 3 \\ [8\ 15\ 4], & Gindex = 4 \\ [1\ 16\ 4], & Gindex = 5 \\ [0\ 8\ 4], & Gindex = 6 \end{cases} \quad (5)$$

And

$$\sum A_{wb} = \begin{cases} 27, & when\ Gindex = \varepsilon[1,2,3,4] \\ 21, & when\ Gindex = 5 \\ 12, & when\ Gindex = 6 \end{cases} \quad (6)$$

Using the equation $W_{seg} = \lfloor Rlen / \sum A_{wb} \rfloor$ trees are selected for the watermark embedding. The Rlen represents the length of the redundant watermark sequence. Images having different complexity value so the number of selected trees, W_{seg} and the position separation key, N_{sep} , may be different.

The HVS Masking:

The four factors greatly affect the behavior of the HVS mask are band sensitivity, background luminance, edge proximity and texture sensitivity. The product of the four factor results the human visual system masking. For each DWT sub band, indiviual HVS mask are generated. Therefore calculate nine HVS mask generated for a single image. In this proposed tree structure each HVS mask is mapped into bit plane indices based on the distribution of the HVS mask.

(a)Band sensitivity or frequency masking:

$$M_F(l,\theta) = M_1(\theta).M_2(l) \quad (7)$$

Where

$$M_1(\theta) = \begin{cases} \sqrt{2}, & if\ \theta = 2 \\ 1, & o.w \end{cases} \quad (8)$$

$$M_2(l) = \begin{cases} 1, & if\ l = 1 \\ 0.32, & if\ l = 2 \\ 0.16, & if\ l = 3 \end{cases} \quad (9)$$

$$\theta = \begin{cases} 1, & for\ HL\ blocks \\ 2, & for\ HH\ blocks \\ 3, & for\ LH\ blocks \end{cases} \quad (10)$$

(b) Background luminance:

$$M_L(l,i,j) = 1 + I(l,i,j) = \begin{cases} 2 - \frac{1}{256} I_{LL}\left(\left\lceil \frac{i}{2^{L_e-l}} \right\rceil, \left\lceil \frac{j}{2^{L_e-l}} \right\rceil\right), & if\ I(i,j,k) < 0.5 \\ 1 + \frac{1}{256} I_{LL}\left(\left\lceil \frac{i}{2^{L_e-l}} \right\rceil, \left\lceil \frac{j}{2^{L_e-l}} \right\rceil\right), & o.w \end{cases} \quad (11)$$

(c) Spatial masking or edge proximity

$$M_E(l,i,j) = \sum_{k=0}^{L_e-l} \rho \sum_{\theta=1}^{3} \sum_{x=0}^{1} \sum_{y=0}^{1} \left[I_{k+l}^{\theta}\left(x + \left\lceil \frac{i}{2^k} \right\rceil, y + \left\lceil \frac{j}{2^k} \right\rceil\right) \right]^2 \quad (12)$$

Where ρ is a weighting parameter and the suggested value for ρ is presented in the following equation.

$$\rho = \begin{cases} \frac{1}{4}, & if\ k = 0 \\ \frac{1}{16^k}, & if\ o.w \end{cases} \quad (13)$$

(d) Texture sensitivity

$$M_T(l,i,j) = \mathrm{var}\left\{ I_{LL}\left(x + \left\lceil \frac{i}{2^{L_e-l}} \right\rceil, y + \left\lceil \frac{j}{2^{L_e-l}} \right\rceil\right) \right\} \quad (14)$$

where $x = \{0,1\}$ and $y = \{0,1\}$.

Finally the HVS mask calculated

$$M_{HVS} = \alpha \cdot M_F \cdot M_L \cdot M_E^{\beta} \cdot M_T^{\gamma} \quad (15)$$

where M_{HVS} denotes the HVS mask; α is a scaling parameter. The value for α is 1/2, which implies that intensity variations having values lower than half of $M_F.M_L.M^{\beta}_E.M^{r}_T$ are assumed invisible. The suggested value for β and r is 0.2. The binary watermark bits are not embedded in the LL subband. Therefore, one HVS mask calculated for one DWT subband. So for a single frame there will be nine HVS mask generated.

V EXTRACTION & QUALITY ESTIMATION

The image group index transmitted from the sender side is used to retrieve the watermark bit. The bitplane indices for watermark extraction are obtained by calculating the HVS masks of the distorted watermarked image. In one tree, the bitplane indices for all the DWT coefficients on each DWT level are averaged. This strategy effectively reduces the watermark extraction error caused by the bitplane selection in the watermark extraction scheme. Recall that *Redundancy=3*. The extracted redundant watermark sequence is used to recover the three distorted watermarks. Then, the three distorted watermarks are compared bit by bit and the watermark is extracted using equation.

$$\omega_e(i,j) = \begin{cases} 1, & N_1 \geq N_0 \\ 2, & N_1 < N_0 \end{cases} \quad (16)$$

Where $\omega_e(i, j)$ is the extracted watermark bit with coordinates (i,j), N_1 is the number of extracted 1 s and N_0 is the number of extracted 0 s. Then, the extracted watermark is compared with the original watermark bit by bit and the True Detection Rates (TDR) is calculated using equation

$$TDR = \frac{Number\ of\ correctly\ detected\ watermark\ bits}{Total\ number\ of\ watermark\ bits} \quad (17)$$

The image quality is estimated by mapping the calculated TDR to a quality value by referring to a mapping function.

$$\hat{Q} = f(TDR) \quad (18)$$

where $\hat{Q}$ is the estimated quality, $f(\bullet)$ is the mapping function, which is the "Ideal Mapping Curve". When the calculated TDR is mapped onto the "Ideal MappingCurve", it could possibly lie between two neighboring TDR values on the curve. In this case, linear interpolation is used to estimate the image quality.

VI CONCLUSION

The proposed scheme has good computational efficiency to estimate the video quality. Based on the tree structure, the binary watermark is embedded into the selected bit planes of the selected DWT coefficients with watermark embedding strength. The watermark embedding strength is assigned to an image by pre-analyzing its content complexity in the spatial domain and the perceptual masking effect of the DWT decomposed image in the DWT domain. To reduce the loss of video quality, watermark is not embedded in the approximation sub band during watermark embedding. In future work, the proposed scheme will be further developed to estimate the quality of an video distorted by multiple distortions.

ACKNOWLEDGE

I am thankful to Mrs. Smitha S, assistant professor of Information Technology Department, KMEA kerala for her keen interest and guidance in my paper

REFERENCES

[1] Wang, Dong Zheng, Jiying Zhao, Member, IEEE, Wa James Tam, and Filippo Speranza, "Adaptive Watermarking and Tree Structure Based Image Quality Estimation",IEEE Transaction On Multimedia, vol. 16, no. 2, February 2014.

[2] A. Mishra, A. Jain, M. Narwaria, and C. Agarwal, "An experimental study into objective quality assessment of watermarked images," Int. J. Image Process., vol. 5, no. 2, pp. 199–219, 2011.

[3] A. Shnayderman, A. Gusev, and A. Eskicioglu, "An SVD-basedgrayscale image quality measure for local and global assessment," IEEE Trans. Image Process., vol. 15, no. 2, pp. 422–429, 2006.

[4] A. Watson, Q. Hu, and J. McGowan, "Digital video quality metric based on human vision," J. Electron. Imag., vol. 10, pp. 20–29, 2001.

[5] I. J. Cox, M. L. Miller, J. A. Bloom, J. Fridrich, and T. Kalker, "Digital Watermarking and Steganography". San Mateo, CA, USA:MorganKaufmann, 2008.

[6] Vaishali S. Jabade ," Wavelet Based Digital Image Watermarking Techniques"Assistant Professor Vishwakarma Institute of Technology, Pune, India.

[7] Zhou Wang, Alan Conrad Bovik,, Hamid Rahim Sheikh, and Eero P. Simoncelli, "Image Quality Assessment: From Error Visibility to Structural Similarity",IEEE Transaction On Image Pro.cessing, vol. 13, no.4,April 2004.

[8] Gopika V Mane, G. G. Chiddarwar, "Review Paper on Video Watermarking Techniques", International Journal of Scientific and Research Publications, Volume 3, Issue 4, April 2013.

[9] Mauro Barni, Franco Bartolini, and Alessandro Piva, "Improved Wavelet-Based Watermarking Through Pixel-Wise Masking", IEEE Transaction On Image Processing, vol. 10, no.5,May 2001.

[10] I. J. Cox, M. L. Miller, J. A. Bloom, J. Fridrich, and T. Kalker, "Digital Watermarking and Steganography". San Mateo, CA, USA:MorganKaufmann, 2008.

[11] Z.Wang, G.Wu, H. R. Sheikh, E. P. Simoncelli, E. H. Yang, and A. C. Bovik, "Quality-aware images," IEEE Trans. Image Process., vol. 15,no. 6, pp. 1680–1689, 2006.