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Robust Scheme of Digital Video Watermarking

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Abstract: ***Watermarking technique mainly used for copyright protection and owner authentication. Every day huge data are embedded in the digital media or in distributed over the internet. The data such distributed can be easily replicated without any error, and putting the rights of their owners at risk. Even when the encrypted for distribution, data can easily be decrypted and copied. The one way to discourage illegal duplication is to insert information known as watermark, in the potentially vulnerable data in such a way that it is impossible to separate the watermark from the data. Robustness to various attacks is the main consideration for watermarking scheme. The original image increases its robustness of the watermarking dependency but the same time we have to make sure that the watermark is imperceptible. The proposed algorithms have robustness against various attacks like dropping of the frames, averaging and collusion. The work is started with comprehensive investigation of modern technologies of watermarking, and noticed that none of the standing arrangements is proficient of resisting all the attacks. The objective of digital video watermarking is to increase the PSNR(peak signal noise ratio) and MSE(mean signal error). The process of this comprehensive video watermarking scheme includes in detail of watermark embedding, watermark pre-processing and also video pre-processing. The proposed scheme here has a high degree of invisibility. In this scheme, the embedded watermark can successfully survive after different attacks.***

Keywords: Frequency domain, spatial domain, video watermarking, DCT, DWT.

1. Introduction

Information hiding mainly divided into three processes - cryptography, stenography and watermarks. Cryptography is the process of converting information to the unintelligible form such that only the authorized person with a key can decipher it. Many advances were made in the field of communication have became rather simple to decrypt the cipher text. Hence the more sophisticated methods were designed to offer the better security than what cryptography could offer. Hence cryptography led to the discovery of stenography and watermarking techniques. Stenography is the process of hiding the information over a cover object such that hidden information cannot be perceived by the user. Thus even the existence of the secret information is not known to any attacker. Watermarking is closely related to the stenography, but in the watermarking process the hidden information is usually related to an cover object. Hence watermarking is mainly used for copyright protection and the owner authentication. Every day huge data are embedded in digital media or distributed over the internet. Such distributed data can easily be replicated without any error, putting the rights of their owners at risk. When encrypted for the distribution, data can be easily decrypted and also copied. To discourage illegal duplication is to insert the information which is known as watermark, in a potentially vulnerable data in such a way that which is impossible to separate the watermark from given data. These challenges are motivated the researchers to carry out there intense research in the field of watermarking. The watermark is a form, image or text that is impressed onto paper, which provides an evidence of its authenticity. Digital watermarking is the extension of the same concept. There are two types of watermarks they are visible watermark and the invisible watermark. In this work we are concentrated on implementing watermark on the image. For any watermarking scheme is its robustness to various attacks is its main consideration. The watermarking dependency on the original image increases its robustness but at the same time we have to make sure that the watermark is imperceptible. In this work an invisible watermarking technique (least significant bit) has been implemented. Attack is also implemented in the visible watermarked image by adding an random noise to the watermarked image. The watermarked images are compressed and then decompressed using the JPEG compression. Finally the noise is been removed and the images are separated from the recovered watermarked image.

2. Organization

The paper is organized as: section 1 discusses Introduction, section 3 discusses Related Work, section 4 discusses Proposed Work, section 5 discusses Results and graphs and section 6 discusses Conclusion.

3. Related work

Gandheet al[1], has proposed a system in which the invisible watermarking was performed by using Discrete Wavelet Transform. To get the invisible watermarking the alternate pixel value of the host video was replaced by the pixel value of watermark video/image. This type of watermarking provided a means of forensic analysis for combating media piracy.Video watermarking provided robustness to geometric attack such as rotation, cropping, contract altercation, time editing without compromising the security of the watermark. **AreeA.Mohammed and Jamal A.Husssein[2]**, has proposed digital watermarking is a helpful technology for providing copyright protection for valuable multimedia data. In particular, video watermarking deals with several issues those are unique to various types of media watermarking. This work deals with a method for embedding additive digital watermarks into uncompressed and compressed video sequences is presented in a spatial domain. The proposed method is adopted to exploit only the motion regions between frames using motion estimation technique. The method is tested on different types of video (compressed DVD quality movie and uncompressed digital camera movie). This scheme supposes to be robust against the attack of frame dropping, averaging, statistical analysis and lossy compression. **Chin-Chin Lai[3]**, has proposed a robust digital image watermarking scheme based on singular value decomposition (SVD) and a tiny genetic algorithm (Tiny-GA) is proposed in this work. The singular values are very stable and vary very little under various image processing operations or attacks. In the proposed scheme, the singular values of a cover image are modified by multiple scale factors to embed the watermark image. Since the values of scale factors determine the watermark strength; therefore, we use the Tiny-GA to search the proper values in order to improve the visual quality of the watermarked image and the robustness of the watermark. The image watermarking technique based on SVD and Tiny-GA has been proposed. The singular values of the cover image are modified to embed the watermark. The Tiny-GA offers a systematic way to consider the improvements of the scaling factors that are used to control the strength of the embedded watermark. With the proposed scheme, the embedded watermark can successfully survive after attacked by image-processing operations. **Jing Zhang et al[4]**, have proposed a video watermarking scheme of the state-of-the-art video coding standard H.264/AVC. 2-D 8-bit watermarks such as detailed company trademarks or logos can be used as inconvertible watermark for copyright protection. A grayscale watermark pattern was first modified to accommodate the H.264/AVC computational constraints, and then embedded into video data in the compressed domain. Experimental results showed that the algorithm can robustly survive the transcoding process and strong common signal processing attacks, such as bit-rate reduction, Gaussian filtering and contrast enhancement. **K.AitSaadi*et al*[5]**, have proposed a gray-scale pre-processing and robust video watermarking algorithm for the copyright protection application in the emerging video coding standard H. 264/ AVC. The watermark was first transformed by a Hadamard transform and modified to accommodate the H. 264/ AVC computational constraints before it were inserted into video data in the compressed domain. The approach leads to good robustness and high capacity of embedding by maintaining good visual quality of the watermarked sequences. The experimental results proved the capability to embed the watermark in short video sequences and the effectiveness of the algorithm against some attacks such as re-compression by the H.264 CODEC, transcoding, and some common processing. **Kareem Ahmed *et al*[6]**, have proposed a video watermarking scheme which depends on 2-level Discrete Wavelet Transform decomposition of each component of an RGB video frame. The schemes embed independent watermarks into different shots. A genetic algorithm was employed to match shots to watermarks. The scheme chooses between the HL1 of red or green or blue components of each frame based on a key and embed error correcting code into one of them.**Patrizio Campisi*et a*[7]*l***, have proposed a video watermarking method operating in the three-dimensional discrete wavelet transform (3D DWT) relying on the use of a novel video perceptual mask, applied in the 3D DWT domain. Specifically the method consisted in partitioning the video sequence into spatial-temporal units of fixed length. Then the video shots underwent a one level 3D DWT. The mark was embedded by means of a multiplicative approach using perceptual masking on the 3D DWT coefficients in order to trade off between the mark robustness and its imperceptibility. The mask proposed takes into account the spatial-temporal frequency content by means of the spatial-temporal contrast sensitivity function, the luminance, and the variance of the 3D sub bands which host the mark. **Reyes R. *et al*[8]** ,have presented a public video watermarking algorithm, whose robustness depended on the embedding energy. The proposed algorithm embedded a perceptually recognizable binary pattern, such as owner's logotypes. Firstly, the video sequences were segmented by each scene, and then the binary watermark pattern was embedded into Discrete Wavelet Transform (DWT) domain of the randomly selected scene blocks. To increase the security of the proposed scheme, the binary watermark pattern was mapped to a noise like binary pattern using a chaotic mixing method. Simulation results showed the watermark imperceptibility and robustness against several attacks. **Xinghao Jiang *et at*[9]**,have presented an efficient video watermarking scheme through modifying the third decoded luminance differential DC component in each selected macro block. The modification was implemented by binary dither modulation with adaptive quantization step. The proposed scheme was based on the observation that luminance differential DC components inside one macro block are generally space correlated, so the quantization step can be adjusted according to adjacent differential components, to utilize the properties of the human visual system (HVS). Experimental results showed that it can be implemented in real time with better visual quality. **Yan Liua and Jiying Zhao[10]**, have proposed a video watermarking algorithm based on the 1D DFT (one-dimensional discrete Fourier transform) and Radon transform. The 1D DFT for a video sequence generate an ideal domain, in which the spatial information was still kept and the temporal information was obtained. With detailed analysis and calculation, they choose the frames with highest temporal frequencies to embed the fence-shaped watermark pattern in the Radon transforms domain of the selected frame. The adaptive embedding strength for different locations keeps the fidelity of the watermarked video.

4. Proposed Work

This proposed work presented an efficient video watermarking technique using discrete cosine transform (DCT) to protect the copyright protection of digital images. The efficiency of the video watermarking technique is achieved with the aid of the following two major steps.
1. Watermark embedding process
2. Watermark extraction process

4.1 Watermark Embedding Process

Before embedding watermark pixels into the input video sequences, the following process should carry out to enhance the security of the hiding information as well as to improve the efficiency of our proposed approach. The process includes,

- Shot segmentation of video sequences
- Bit plane slicing of a grayscale image
- Pixel permutation
- Decomposition of an image using DCT

4.1.1 Shot segmentation of video sequence

The fundamental task of performing the video processing application like video indexing, video summarization, video watermarking and video retrieval is video shot segmentation. The original input video sequence is first segmented into non-overlapping units, called shots that depict different actions. Each shot is characterized by no significant changes in its content which is determined by the background and the objects present in the scene. Numerous researches are available in the literature for video shot segmentation using several techniques. Here, we have used Discrete Cosine Transform and correlation measure to identify the number of frames involved in each shot. At first, the first and second frame is divided into a set of blocks of sizes and DCT is applied to every block of the frame. The two-dimensional DCT for an input image X and output image you can be defined as:

$$Y_{pq} = \alpha_p \alpha_q \sum_{m=0}^{M-1}\sum_{n=0}^{N-1} X_{mn} \cos\frac{\pi(2m+1)p}{2M} \cos\frac{\pi(2n+1)q}{2N}, 0 \le p \le M-1$$

$$0 \le q \le N-1 \quad (1)$$

Where

$$\alpha_p = \begin{cases} 1/\sqrt{M}, & p = 0 \\ \sqrt{2/M}, & 1 \le p \le M-1 \end{cases};$$

$$\alpha_q = \begin{cases} 1/\sqrt{N}, & q = 0 \\ \sqrt{2/N}, & 1 \le q \le N-1 \end{cases}$$

Then, the correlation coefficient is computed in between the frame 1 and 2 using the following formula.

$$r = \frac{\sum_m \sum_n (X_{mn} - \bar{X})(Y_{mn} - \bar{Y})}{\sqrt{\left(\sum_m \sum_n (X_{mn} - \bar{X})^2\right)\left(\sum_m \sum_n (Y_{mn} - \bar{Y})^2\right)}} \quad (2)$$

where $\bar{X} = mean(X)$, and $\bar{Y} = mean(Y)$

After finding the correlation for the first and second frame, the same procedure is repeated for the consecutive frames presented in the video. Then, the frames within a shot can be identified by maximizing the cross correlation term which gives a measure of the degree of similarity between two frames of video.

4.1.2 Bit plane slicing of a grayscale image

Bit-Plane Slicing is a technique in which the image is sliced at different planes. Instead of highlighting gray level images, highlighting the contribution made to the total image appearance by specific bits might be desired. Imagine the image is composed of 8 bits, 1-bit planes ranging from bit plane1-0 (LSB) to bit plane 7 (MSB). In terms of 8-bits bytes, plane 0 contains all lowest order bits in the bytes comprising the pixels in the image and plane 7 contains all high order bits [14]. Often by isolating particular bits of the pixel values in an image we can highlight interesting aspects of that image. The high-order bits usually contain most of the significant visual information and the lower-order bits contain subtle details [15]. The advantage of doing this method is to get the relative importance played by each bit of the image. Figure 1 shows the Bit plane slicing concept.

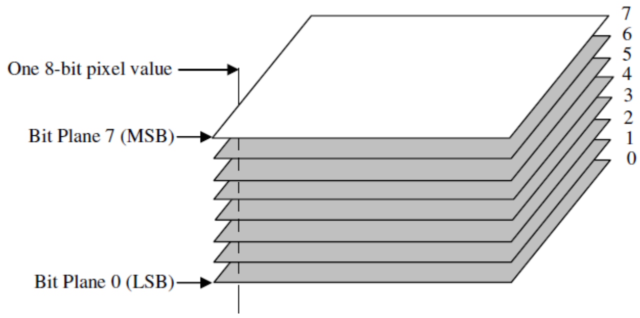

Figure 1 Bit plane slicing

4.1.3 Pixel permutation

After the bit plane slicing process, the sliced images are allowed to permute each pixel value to enhance the security of the hiding information. In this scheme, each group of pixels is taken from the image. The pixels in the group are permuted using the key selected from the set of keys. The size of the pixel group is same as the length of the keys, and all the keys are of the same length. If the length of the keys is more than the size of pixel group, the perceptual information reduces. In this, the group of pixels is taken along the row without the loss of generality, i.e., the column wise procedure would yield the same kind of results [16].

4.1.4 Decomposition of an image using DCT

Like other transforms, the Discrete Cosine Transform (DCT) attempts to de-correlate the image data. After de-correlation each transform coefficient can be encoded independently without losing compression efficiency.

4.2 The One-Dimensional DCT

The most common DCT definition of a 1-D sequence of length N is

$$F(u) = C(u) \sum_{x=0}^{N-1} f(x) \cos\left|\frac{\pi(2x+1)u}{2N}\right| \quad (3)$$

Where u = 0,1,….N-1

$C(u) = \sqrt{\frac{1}{N}}$ When u=0

$C(u) = \sqrt{\frac{2}{N}}$ when $u \neq 0$

For $u = 0,1,2,\ldots,N-1$. Similarly, the inverse transformation is defined as

$$f(x) = \sum_{u=0}^{N-1} \alpha(u) C(u) \cos\left[\frac{\pi(2x+1)u}{2N}\right], \quad (4)$$

For $x = 0,1,2,\ldots,N-1$. In both equations

$\alpha(u)$ is defined as

$$\alpha(u) = \begin{cases} \sqrt{\frac{1}{N}} & for \quad u = 0 \\ \sqrt{\frac{2}{N}} & for \quad u \neq 0. \end{cases}$$

4.3The two-dimensional DCT

The 2-D DCT is a direct extension of the 1-D case and is given by

$$C(u,v) = \alpha(u)\alpha(v)\sum_{x=0}^{N-1}\sum_{y=0}^{N-1} f(x,y)\cos\left[\frac{\pi(2x+1)u}{2N}\right]\cos\left[\frac{\pi(2y+1)v}{2N}\right], \quad (5)$$

For $u,v= 0,1,2,\ldots,N-1$ and $\alpha(u)$ and $\alpha(v)$ are defined in **(1)**. The inverse transform is defined as

$$f(x,y) = \sum_{u=0}^{N-1}\sum_{v=0}^{N-1} \alpha(u)\alpha(v)C(u,v)\cos\left[\frac{\pi(2x+1)u}{2N}\right]\cos\left[\frac{\pi(2y+1)v}{2N}\right], \quad (6)$$

For $x,y= 0,1,2,\ldots,N-1$. The 2-D basis functions can be generated by multiplying the horizontally oriented 1-D basis functions with vertically oriented set of the same functions. The basic functions exhibit a progressive increase in frequency both in the vertical and horizontal direction. The top left basis function of results from the multiplication of the DC component in its transpose. Hence, this function assumes a constant value and is referred to as the DC coefficient.

5. Watermark Embedding Steps

Let x[n] = x[n1,n2], 0<=n1 <N1, 0<=n2 <N2 be a two-dimensional (2-D) discrete sequence representing the luminance component of a sampled image with size N1 x N1 pixels. In the sequel we will always use vector notation (in boldface typesetting) to represent 2-D indexes. The watermark is generated as a DCT-domain signal employing a technique similar to the direct-sequence spread spectrum modulation schemes used in communications. In this paper, we will assume that the DCT is applied in blocks of 8 × 8 pixels. The detailed step by step explanation of embedding process is given below.

Input: Original video sequence $O_v[i,j]$, Grayscale watermark image $W_I[i,j]$

Output: watermarked video sequence $W_v[i,j]$

1) Segment the original input video sequence $O_v[i,j]$ into number of non-overlapping shots $S_s[i,j]$ using shot segmentation technique. Then, identify the number of frames $F_p[i,j]$ involved in each segmented shots $S_s[i,j]$ for embedding purpose.
2) Slice the grayscale watermark image $W_I[i,j]$ into 8 bit planes $S_I[i,j]$ using bit plane slicing.
3) Permute the sliced images $S_I[i,j]$ using pixel permutation technique to obtain the permuted grayscale image $P_I[i,j]$.
4) Extract the blue components $B_{F_p}[i,j]$ of all the partitioned frames for embedding the each sliced image $S_I[i,j]$ into the blue components of each frame.
5) Split the image into small blocks (8 x 8) and decompose the blue components $B_{F_p}[i,j]$ of each partitioned frame $F_p[i,j]$ into AC and DC coefficients by DCT.
6) Choose the low frequency sub-bands from the transformed frames to embed the permuted grayscale image $P_I[i,j]$.
7) Find the similarity matrix of the permuted image $P_I[i,j]$ to embed into the chosen coefficient. The embedding process should repeat for all blocks of DCT.

The block diagram of the watermark embedding process is shown in figure 2

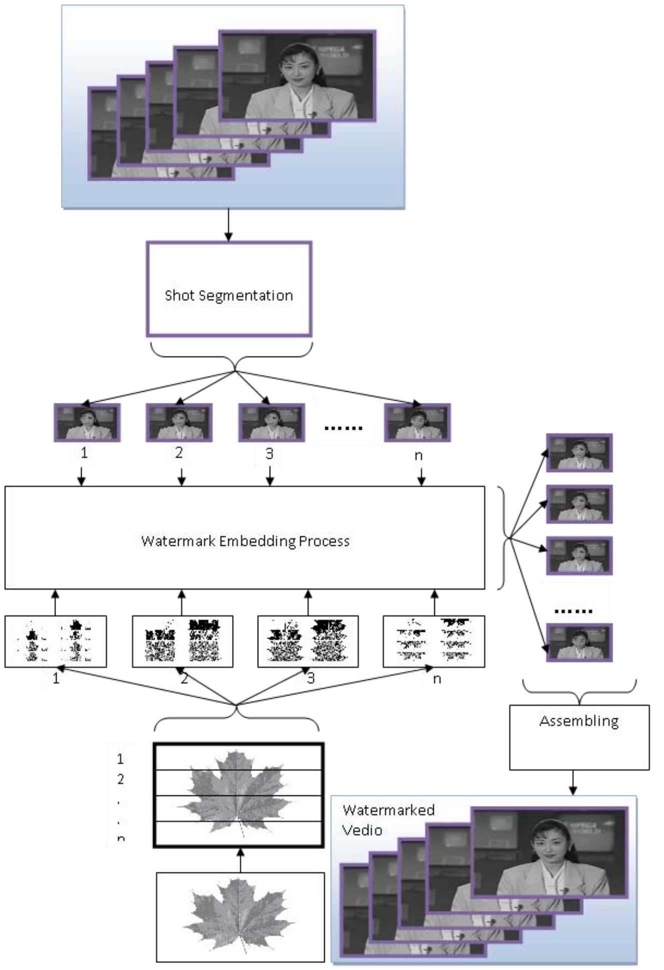

Figure 2 Watermark Embedding process

4.4 Watermark Extraction Process

Once a watermarked image is distributed, the rights holder should be able to verify the copyright information to prove his authorship and possibly trace illegal misuses. Block diagram different steps involved in the watermark verification process, which will be analysed throughout this paper.After embedding the grayscale watermark image pixels into the original video sequence, we have extracted the embedded watermark image without affecting the original video.

Watermark Extraction steps

Input: watermarked video sequence $W_v[i,j]$, size of the watermark image.

Output: recovered watermark image $W_I[i',j']$

1) Segment the watermarked video sequence $W_v[i,j]$ into a number of non-overlapping shot $S_s[i',j']$ using the shot segmentation technique. Then, identify the number of frames $F_p[i',j']$ involved in each segmented shots $S_s[i',j']$ for the extraction process.
2) Extract the blue components $B_{F_p}[i',j']$ of all the partitioned frames for extracting the embedded watermark pixels.
3) Decompose the blue components of the frames with the aid of the DCT into AC and DC coefficients.
4) Select the low frequency components from the transformed frames to extract the watermark grayscale image.
5) Extract the watermark pixels from the embedding part in a zig-zag manner from the each blocks with the aid of the following steps. If the embedded pixel value is greater than the mean pixel value, then the extracted pixel value is one. If it is lesser, then the extracted pixel is zero.

$$W_I[i',j'] = \begin{cases} 1, & E_p(i) > mean(E_p), \ where \ \ 0 < i < n \\ 0, & otherwise \end{cases}$$

6) Form the matrix with the size of the watermark image and the extracted pixels are placed in it to attain the watermark image.
7) Obtain the watermark image $W_I[i',j']$ by applying the reverse process of permutation and bit plane slicing.

The block diagram of the watermark extraction process is shown in figure 3

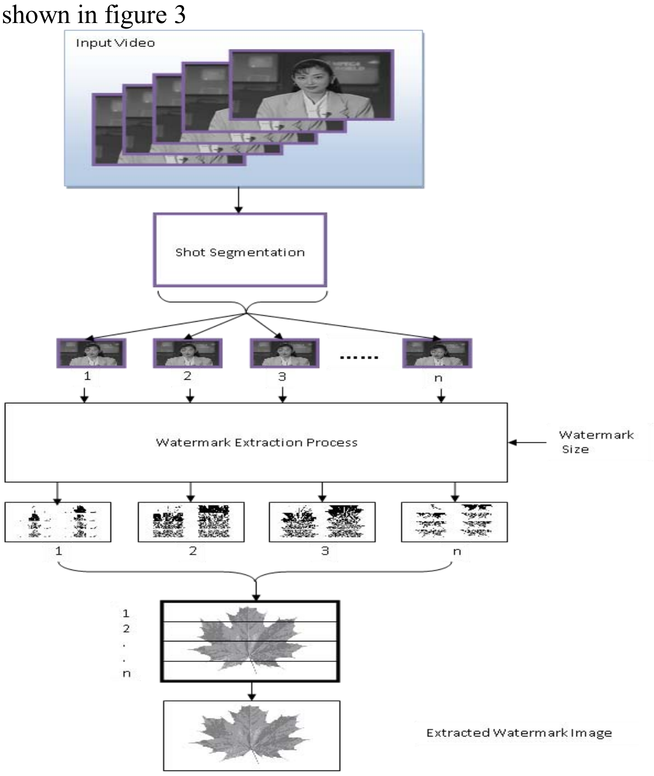

Figure 3: Watermark Extraction process

5. Results and Graphs

The proposed watermarking scheme is implemented in Matlab software. The image processing toolbox is used to develop the watermarking algorithm. The developed algorithm is simulated in a windows system with i5 processor. For the performance analysis the PSNR and MSE of the watermarked image are calculated. And for performance measure of watermarked image cross correlation of the input watermark and the output watermark images are calculated. Some of the results are given below.

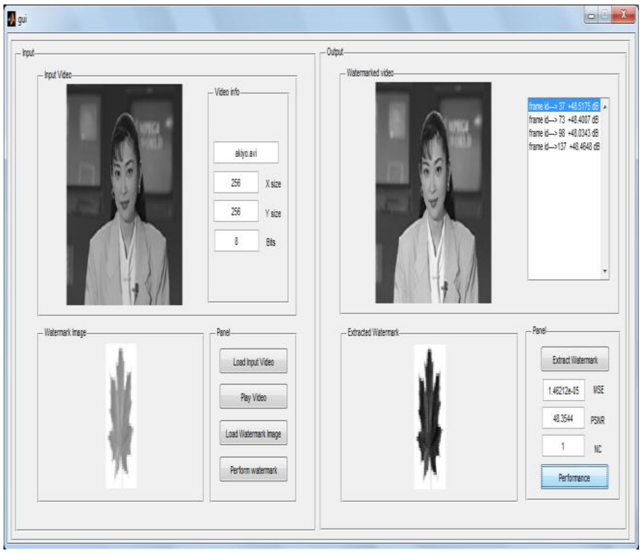

Figure 4: GUI

Table 1: Performance measure from fig 4

	Proposed	Existing
93	0.1567	0.1331
94	0.1879	0.1325
95	0.1896	0.1908
96	0.2144	0.1948
97	0.2458	0.2264
98	0.2697	0.2734
99	0.6981	0.4777
100	0.8494	0.5418

The table 1 shows the performance measure of the proposed video watermarking scheme, we are using the normalized correlation(NC) to measure the similarity of the extracted and the referenced watermarks to evaluate our scheme in the experiments. The NC value up to 0.5 and above is considered as watermark can be recovered and detected though it has been distributed by various attacks.

a)As per the fig 5 the DCT based watermarking scheme provides the better results then the existing method as it shows the performace measure for quality v/s NC values. As the quality increases NC value also increases.

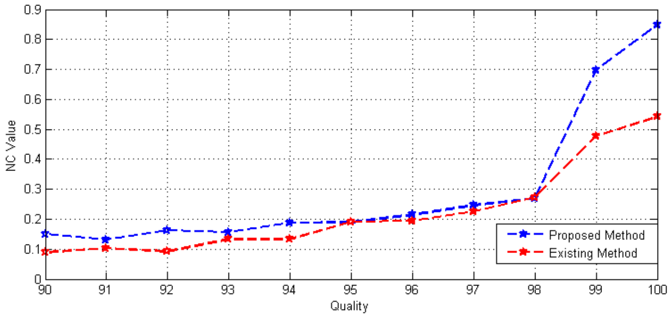

Figure 5: Performance Graph(Quality vs NC value)

b)The below graph gives the performance measure for DCT based watermark, as the quality increases the mean square(MSE) decreases our proposed work gives the better result then the existing.

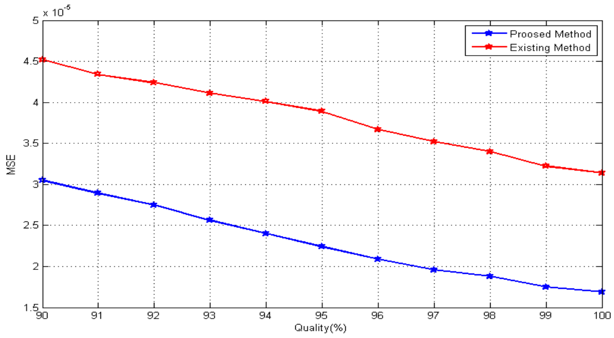

Figure 6: Performance Graph(Quality vs MSE)

c) The below fig 7 gives the performance graph to measure the peak signal noise ratio, in our proposed work as the quality increases peak signal noise ratio(PSNR) goes on increasing which results better then the existing work.

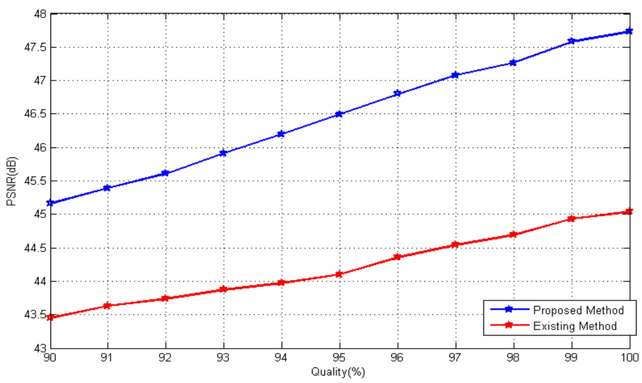

Figure 7: Performance Graph(Quality vs PSNR)

6. Conclusion and future scope

This work proposes an innovative scene based video watermarking scheme. The process of this comprehensive video watermarking scheme, including watermark pre-processing, video preprocessing and watermark embedding is described in detail. The proposed scheme here has a high degree of invisibility. In this scheme, the embedded watermark can successfully survive after different attacks. This proposed watermarking scheme can further be associated with different applications.

References

[1] Gandhe S.T., Potdar U. and Talele K.T., **"Dual Watermarking in Video Using Discrete Wavelet Transform"**, in Proceedings of Second International Conference on Machine Vision, pp. 216 - 219, 2009.7

[2] AreeA.Mohammed and Jamal A.Husssein, **"Efficient video watermarking using motion estimation approach"**,2009,Eighth IEEE/AIS International conference on Computer And Information Science.4

[3] Chih-Chin Lai ,**"A digital watermarking scheme based on singular value decomposition and tiny genetic algorithm"**, Digital Signal Processing, in 2011, pp. 1128-1134.2

[4] Jing Zhang, Anthony T. S. Ho, Gang Qiu, PinaMarziliano, **"Robust Video Watermarking of H.264/AVC"**, IEEE Transactions on Circuits and Systems II: Express Briefs, Vol: 54, No: 2, pp: 205 - 209, 2007.14

[5] K. AitSaadi, A. Guessoum, A. Bouridane, **"Efficient pre-processing watermark for robust video watermarking of H.264/ AVC"**, International Journal of Advanced Media and Communication, Vol: 4, No: 3, pp: 219-234, 2010.10

[6] Kareem Ahmed, Ibrahim El-Henawy and Ahmed Atwan, **"Novel DWT video watermarking schema "**, Machine Graphics & Vision International Journal archive, Vol. 18, No. 3, pp. 363-380, 2009.12

[7] Patrizio Campisi and Alessandro Neri, **"Perceptual Video Watermarking in the 3D-DWT Domain Using a Multiplicative Approach "**, Lecture Notes in Computer Science, Vol. 3710, pp. 432-443, 2005.15

[8] Reyes R., Cruz C., Nakano-Miyatake M. and Perez-Meana H., **"Digital Video Watermarking in DWT Domain Using Chaotic Mixtures"**, IEEE Latin America Transactions, Vol. 8, No.3, pp. 304 - 310, 2010.6

[9] Xinghao Jiang, Tanfeng Sun, Jianhua Li and Ye Yun, **"A Novel Real-Time MPEG-2 Video Watermarking Scheme in Copyright Protection"**, Digital Watermarking, Lecture Notes in Computer Science, Vol: 5450, pp:45-51, 2009.11

[10] XinxingJing,Yan Liu, Xi Chen, Ping Zhou, **"The Domain Block Video water marking Scheme based video sequences characteristics and DCT"**,2012.The 7th International Conference on Computer Science and Education. Austral