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# Study and Evaluation of Watermarking in Video Frame with PSNR, MSE and NC Parameters

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**ABSTRACT:** Now a day's growing demand in technology world requires extra and compact form of digital data like image, audio and video. In video form, stored data quantity is in greater amount than any other form, but at the same time to maintain its security and authenticity is also important as modification in video data form, becoming simpler task with the help of video editor. Watermark in video helps out in such cases to secure the content in video. Developing a watermarking system, to embed the information within video streams is accomplished by using various algorithms which are spatial and frequency domains. Spatial domain includes bit error like methods are comparatively less efficient than frequency domain methods like DWT, DCT and SVD. By taking advantages of DWT and DCT algorithms and cancelling their disadvantages, combined approach of DWT and DCT make system reliable. Proposed system described combined approach having embedding and extraction algorithm in video. System compares three different videos on basis of three parameters PSNR, NC and MSE.

**KEYWORDS**: DWT and DCT transform, MSE, NC, PSNR, and Watermark

## I. INTRODUCTION

Safety the least bit whether or not it concerning business, commercial or it is able to be military cause have its vital role. We human beings constantly problem approximately our private record, industry individual contend with their records in secured format so that illegal user can't misuse it. In navy its very lots crucial to cozy records with right format and in field manner in any other case unauthorized consumer interference lead to such damage on the way to clearly tough to get better. We ought to don't forget all factors regarding security and their associated troubles as they are going to affect on our system if they may be no longer treated in time.

Video is come to be one of the most influential media inside the enjoyment enterprise, commercial paintings and in military cause. With the advancement in generation user required greater functions in video for quicker and simpler distribution. However problems on protection of video results in want of shielding it in opposition to manipulations and alterations in virtual statistics. To cope with such difficulty, a statistics hiding technique known as watermarking is one of the strategies. In video digital watermarking, a digital code, or watermark, is embedded right into a video. because of watermarking machine owner's proof get attached to the digital data. Anyhow if any misuse of it occurs it can get diagnosed by specific content material in multimedia gadgets [1]-[2]. Records hiding techniques called watermarking may be divided into two classes. One is spatial-domain technique and other is frequency-area. Watermarking is embedded in the photo pixels at once in case of spatial do- major. The most commonplace strategies are histogram-based totally and least-substantial bit (LSB) strategies in the spatial domain. Within the frequency area, the commonplace well-known strategies for data hiding are discrete cosine transformation (DCT)-based totally, discrete wavelet transformation (DWT). This paper focuses on blended method of DWT and DCT.

System is to implement such watermark gadget in which statistics is embedded into video streams. As video streams are easy to modify, consequently purpose specializes in protection motive of video. Now an afternoon's watermarking

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in video is as an alternative hard than picture. To come to be it less complicated task machine should use those algorithm and strategies that leads to less degradation video exceptional. At ultimate, devoted aim is to watermark video streams with the usage of recent techniques and methods for security cause.

## II. RELATED WORK

The information hiding strategies inside the H.264/AVC compressed video area is maximum important studies view in the beyond studies paintings they select the video criteria along with motion remedy GOP length and bitrates. The overall framework of records hiding is conceptualized with the aid of sequences of bits. Mapping rules, Bit aircraft substitute, unfold spectrum, Matrix encoding, histogram manipulation, and divisibility are various statistics illustration scheme to illustrate the idea of facts hiding [1]. Hardware implementation of watermarking machine in discrete cosine rework become proposed in 2013 yr. Proposed technique generates the watermark sequence through scrambling techniques and embedded into video the use of frequency domain DCT. It uses MPEG strategies for video compression. In assessment of results there may be comparison between processing speed, price of hardware and common sense gadgets. Discrete cosine rework set of rules is used for watermarking purpose [2]. Now in paper [3]-[4] have found in paper, concerning watermarking method for virtual photographs the use of DWT approach. Using the three degree DWT technique they embed the name of the game records into cover snap shots. Embedding and extraction methods are consisting of in it. Consequences are concluded with the aid of PSNR and MSE parameters. The proposed watermarking scheme is the usage of DWT and DCT. Technique is applied in frequency area wherein 2nd stage DWT decomposition is achieved which is followed through DCT implemented on DWT coefficients in excessive frequency band to offer compression robustness. Some research paper applied watermarking machine in MATLAB Simulink.

The idea in this paper is based totally on DWT set of rules. Discrete wavelet set of rules is used to implement digital watermark in video. Effects are evaluated underneath numerous varieties of attacks like rotation and sizing. PSNR and NC parameters are taken into consideration to decide whether applied system is strong. Watermarking has every other technique that is formatted on this paper. They focused on encryption of data as images and worked in compressed domain of images. JPEG-2000 images are main factor to carry out robust watermarking. Relation between payload capacity and image quality for different resolutions are described in this paper. In this paper, there is use of three watermarking schemes which are Spread Spectrum (SS), Scalar Costa Scheme (SCS-QIM), and Rational Dither Modulation (RDM).With the help of these schemes, study of the bit error rate of detection and the quality versus payload capacity trade-off [5]-[6]. Digital watermarking is done by using SVD and DWT algorithm in research paper [7]. It uses QR- quick response code technique. The image quality factors like MAE, MSE, RMSE, PSNR and NCC other quality measurement are discussed in this paper. In this QR code encoding process gives better result and get excellent performances. The proposed system in which video watermarking is using DWT-DCT-SVD combined algorithm approach. Paper focuses on non blind video watermarking algorithm. Results are discussed by taking into account of effect of scaling factor of image. Used algorithms are found to be good to evaluate quality of watermarked video. The result analysis describes that proposed system is robust [8].

Those methods provide a design framework for semi-fragile watermark- based authentication system. In this research work, they suggested such system that can achieve both objectives robustness and fragility which is discussed in paper [9]. Lattice and message authentication code are the basis of this paper. In this paper semi-fragile authentication model is briefly described. MSB-LSB decomposition with lattice code implementation is worked out in detailed manner. JAWS-Just another Watermarking System concept is discussed in Nebu Jhon Mathais paper. There is hardware implementation of watermarking system in which they covered time, area and cost as constraint [10].There is new technique of video watermarking in which blind compressed domain is considered Scrambling of multiple bit plane and watermarking in all frames like I, B and P frames in uncompressed domain giving higher computational penalty. System is robust against attack like filtering, frame averaging, rotational and scaling [11].

## III. PROPOSED ALGORITHM

Digital watermarking is classified into two categories. One is spatial domain method and other one is transform domain method. The embedding process is easy in spatial domain as compared to transform domain. But in case of

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robustness transform domain always gives better result than spatial domain. To achieve high efficiency advanced system follows transform domain. The implemented work involves use of two most preferred frequency domain based methodologies which are discrete wavelet transform and discrete cosine transform for video watermarking. DCT is effective transform because it has energy compaction property. In DCT solely few frequency components are accountable to explain the image. Here, original image is dividing into 8*8 blocks. For every input image DCT calculates its corresponding fre quency component. It provides three frequency element which are as follows low, mid and high. Low frequency components are most significant part of image and high frequency components can be easily removed through various attacks. Compression of images can effect on high frequency components. The watermark is embedded into middle frequency to avoid quality loss of reference video. Simultaneously, DWT approach makes our system robust and strong. DWT decompose image into four non-overlapping sub-bands. They are LL, LH, HL, and HH respectively which is known as first level de- composition of DWT. Watermark is embedded into LH and HL sub-bands to avoid the degradation of host video. DWT has multi-resolution property which makes it suitable to use as best algorithm for embedding purpose. As so much therefore in discussion, combined approach of DWT and DCT makes system most powerful than by using separate approach.

## IV. EMBEDDING ALGORITHM

**Embedded Algorithm:-**
To embed The Watermark the basic formula is
Watermarked Image = Cover Image + alpha* Watermark Image

Embedding is adding of two images with using proper algorithm. In above formula watermark image is multiplied with some parameter which is known as alpha. Value of alpha shows the intensity of watermark image into cover image. Higher value of alpha means higher intensity of watermark image into cover image.

A] Embedding Algorithm :- Embedding set of rules is proposed with diagram instance for the host video as proven in fig.1. Frame is extracted from given video on which watermarking is to be carried out. Embedding method is formatted in block diagram in fig.1. Watermark picture goes via DWT and DCT transforms from which middle frequency coefficients are altered by way of decrease frequency of DWT of reference video frame. Inverse DWT is implemented to embedding photograph to assemble the watermarked video streams.

Algorithm

1. Read and display the cover image or video frame from host video.
2. Read and display watermark image which is to be embedding into cover image.
3. Discrete Wavelet Transform on video frame.
4. Frame get decomposed into LL, LH, HL and HH band.
5. Apply Discrete Cosine Transform on watermark image.
6. Apply the Discrete wavelet transform on mid frequency of discrete cosine transform.
7. DWT has first level decomposition converting mid frequency of DCT into LH and HL band.
8. Embed the watermark into the LH and HL wavelet band.
9. Apply IDWT to construct watermarked video.
10. Read and display watermarked video.

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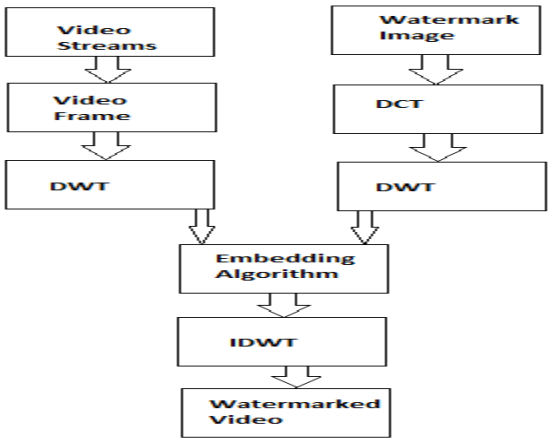


Fig.1 Block Diagram of Watermarking Algorithm

## V. EXTRACTION ALGORITHM

Now to extract the watermark, is contrary method of embedding. Hence alpha is eliminated from watermarked image to get authentic picture.
Watermark image= (Output Image-cover image)/alpha in which the parameter is known as embedding depth.
Extraction algorithm is proposed with diagram example for the host video as proven in parent. Image is extracted from given video on which watermarking is to be executed. Extraction process is formatted in block diagram in parent.
Algorithm

1. The watermarked body from watermarked video.
2. Apply discrete wavelet rework to watermarked body.
3. Watermarked frame is decomposed into LL, LH, HL and HH band.
4. Practice the discrete cosine transform to watermark picture followed by means of Discrete Wavelet Transform.
5. Extraction the watermark from LH and HL sub-band
6. Practice IDWT to reconstruct the watermark.
7. Watermark is extracted from watermarked video.

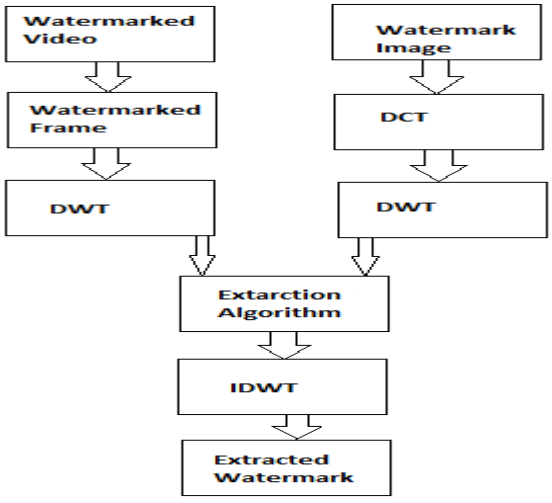


Fig.2 Block Diagram of Extraction Algorithm

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## V. SIMULATION RESULTS

Original frame is from host video and watermarked frame is from Water-marked video after embedding watermark image into original video. Original video and watermarked video both are shown in above figure. From figure, Watermarked video is get sort of degradation in quality. Due to watermark-ing process quality of host video get decreased. Simulation process is carried out using MATLAB R 2013a.Output obtained is in MPEG format. MPEG is motion picture expert group. Now to evaluate degradation of video quality some parameters are necessary with the help of them system can improve its performance. First video format is .mov. Second video is in .avi and third is .mp4 format. As video changes their respective parameters value also changed which are discussed in evaluation of parameters.

| Frame. no | NC | MSE | PSNR | PSNR in db |
|---|---|---|---|---|
| 1 | 1.6065e+04 | 61.9507 | 1.0579e+03 | 60.4887 |
| 2 | 1.6057e+04 | 66.4092 | 986.8514 | 59.8850 |
| 3 | 1.6034e+04 | 66.6609 | 983.1251 | 59.8522 |
| 4 | 1.5988e+04 | 66.8802 | 979.9011 | 59.8236 |
| 5 | 1.5941e+04 | 66.5280 | 985.0883 | 59.8695 |
| 6 | 1.5936e+04 | 66.7698 | 981.5214 | 59.838 |
| 7 | 1.5917e+04 | 66.8196 | 980.7901 | 59.8315 |
| 8 | 1.5905e+04 | 66.3754 | 987.3543 | 59.8895 |
| 9 | 1.5886e+04 | 66.3093 | 988.3375 | 59.8981 |
| 10 | 1.5879e+04 | 66.0990 | 991.4820 | 59.9257 |

Table 5.1: Evalution of Parameters for Video1.mov video

Below Tables shows calculation of NC, MSE, PSNR and PSNR in db for first ten frames in video. From below table, value of PSNR is high than value of MSE which shows that system can overcome noise. Signal power is greater than noise power. Normalized Coefficient ideal value is 1.

In the First table, video format is in .mov in which MSE value is greater than PSNR value. If value of PSNR is less than MSE value, in such case, system doesn't work efficient. Here, error is maximum than signal power which is not the ideal condition. MSE value must be less as compared to PSNR value. So there are again two videos to discuss relation between MSE and PSNR value.

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In second table .avi format is used to evaluate relation between NC, MSE and PSNR value. As per results, table shows large value of MSE but as compared to PSNR it has less value so output is considerable.
Proposed technique is simulated with the help of MATLAB R2013a. Results are discussed using three parameters - MSE, PSNR and NC.
MSE: Mean Square Error is additive error between watermarked and original image. The square of difference between original image and watermarked image gives mean square error. MSE is reciprocally proportional to PSNR. MSE is calculated by using below formula [3].

$$MSE = \frac{1}{MN}\sum_{y=1}^{M}\sum_{x=1}^{N}[I(x,y) - I^{'}(x,y)]\text{^}2$$

Where,
I(x,y) is original image and I'(x,y) is watermarked image
M & N are dimensions- height and width of image.

| Frame. no | NC | MSE | PSNR | PSNR in db |
|---|---|---|---|---|
| 1 | 5.6778e+03 | 40.5897 | 1.6146e+03 | 64.1613 |
| 2 | 5.6792e+03 | 40.5867 | 1.6147e+03 | 64.1619 |
| 3 | 5.6816e+03 | 40.5973 | 1.6143e+03 | 64.1596 |
| 4 | 5.6829e+03 | 40.6173 | 1.6135e+03 | 64.1554 |
| 5 | 5.6867e+03 | 40.7077 | 1.6099e+03 | 64.1361 |
| 6 | 5.6897e+03 | 40.7389 | 1.6087e+03 | 64.1294 |
| 7 | 5.6921e+03 | 40.6628 | 1.6117e+03 | 64.1457 |
| 8 | 5.6943e+03 | 40.7186 | 1.6095e+03 | 64.1337 |
| 9 | 5.6957e+03 | 40.8284 | 1.6052e+03 | 64.1104 |
| 10 | 5.6993e+03 | 40.8607 | 1.6039e+03 | 64.1035 |

Table 5.2: Evalution of Parameters for Video2.avi video

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PSNR: Peak Signal Noise Ratio is ration between maximum possible power of signal and power of corrupting noise that effects signal. Higher value of PSNR and lower value of MSE suggest that implementation of system is effective and robust. PSNR is calculated as follow [3].

$$PSNR = 10log\left(\frac{255^2}{MSE}\right)$$

| Frame. no | NC | MSE | PSNR | PSNR in db |
|---|---|---|---|---|
| 1 | 7.8464e+03 | 9.3947 | 6.9759e+03 | 76.8719 |
| 2 | 7.8537e+03 | 10.8270 | 6.0530e+03 | 75.6394 |
| 3 | 7.8540e+03 | 10.8537 | 6.0381e+03 | 75.6180 |
| 4 | 7.8548e+03 | 11.0392 | 5.9367e+03 | 75.4709 |
| 5 | 7.8553e+03 | 11.1323 | 5.8870e+03 | 75.3979 |
| 6 | 7.8564e+03 | 11.2623 | 5.8190e+03 | 75.2970 |
| 7 | 7.8583e+03 | 11.4684 | 5.7145e+03 | 75.1396 |
| 8 | 7.8596e+03 | 11.6223 | 5.6388e+03 | 75.0238 |
| 9 | 7.8605e+03 | 11.7872 | 5.5599e+03 | 74.9014 |
| 10 | 7.8609e+03 | 11.8797 | 5.5166e+03 | 74.8335 |

Table 5.3: Evalution of Parameters for Video3.mp4 video

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NC: Normalized coefficients give a measure of robustness of watermarking. Its peak value is 1. It is calculated using below formula [5].

$$NC = \frac{\sum_I \sum_J W(I,J).W'(I,J)}{\sqrt{\sum_I \sum_J W(I,J)}\sqrt{\sum_I \sum_J W'(I,J)}}$$

Where,
W (I,J) and W'(I,J) are original and extracted watermark.

## VI. CONCLUSION AND FUTURE WORK

Video is important virtual information in today's global world and in its security additionally. Advanced system described video watermarking in smooth and straight forward technique with most fulfilling use of efficient algorithm. In given device image is used as watermark data and watermark is executed in video. System has mixed approach of DWT and DCT set of rules for video watermarking. Multi-resolution belongings of DWT and strength compaction assets of DCT makes gadget sturdy and powerful. Algorithms that are taking part to embed and extract watermark from video works successively. Outcomes are evaluated and analyzed in three factors like-PSNR, MSE and NC to investigate the system. Excessive cost of PSNR this means that low fee of MSE suggests that system has excessive noise ratio with much less degradation excellent of host video. With these parameters assessment, it concluded system has better efficiency. Simulation process done with the use of MATLAB R2013a.

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