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Blind Robust Digital Video Watermarking Scheme using Hybrid Based Approach

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Abstract— **Video Watermarking is one of the important area in the field of piracy. Now a day's huge amount of digital data is spread over the internet, so its challenge to provide security to those digital data such as video, audio, images and text file. Video watermarking is a one of the way to provide security to digital data such as video which limit the chance of piracy. This new Video watermarking Schemes is highly Robust against various types of attacks and also used hybrid approach. In this paper, we introduce the Robust Digital Video Watermarking techniques Based on hybrid approach which give better result against various attacks that performed on watermarked video thereby improve NC and PSNR values. The PSNR calculate using this approach is off 52.39db.**

Keywords— **SWT, PCA, SVD, GA, PSNR, NC**

I. INTRODUCTION

Video watermarking means embedding a special pattern that identifies the author or creator of the video. Robust invisible video watermarking techniques differ in terms of the domain in which the watermark is embedded or detected, their capacity, real-time performance, the degree to which all three axes are incorporated, and their resistance to particular types of attacks. The watermark should exist in each frame so that it must be possible to detect a watermark in a single frame extracted from the video.

The world is going digital and digital multimedia files are produced, stored and distributed easily across the globe. Due to easy distribution of digital data the ownership and copyright of multimedia files are not usually protected. The main driving force is concern over copyright; as multimedia contents are available in digital form, the ease with which perfect copies can be made may lead to large-scale unauthorized copying, and this is of great concern to the music, film, book, and software publishing industries. Hence, Digital watermarking has been proposed in recent years as a means of protecting digital multimedia contents on the ownership dispute.

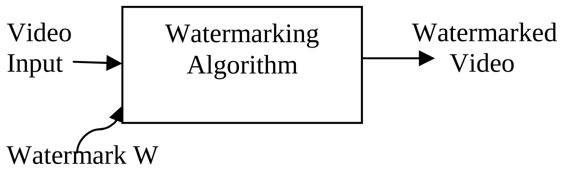


Fig.1 Watermark Embedding

A. Video Watermarking Application

Digital video watermarking has huge application

- Copyright Protection
- Source tracking
- Broadcast Monitoring
- Fingerprinting
- Video Authentication.
- Tamper proofing
- Content authentication
- Media digital rights management (DRM) in content supply chain
- Security

B. Video Watermarking Attack

The attacks on video watermarking are frame dropping, frame averaging, Gaussian Noise, Salt and Peeper Noise, Poisson Noise, Weiner Filter, Median Filter, Adjustment, OrdFilter, Local Var, and Threshold attack.

C. Properties of Digital Video Watermark

For digital watermarking of video, the different characteristics of the watermarking are given below.

- Invisibility: The digital watermark that we embed should be invisible to the human eyes. So that attacker does not aware the presence of watermark.
- Robustness: robustness refers to the Attack that should be performing on watermarked video and analyze how it shows the resistant to various type of attack. A video watermark is highly robust then it can say that it having more resistant power. High robustness preserves the quality of video.
- Perceptible: A digital watermark is called perceptible if the presence of that mark is noticeable. Achieving the Imperceptibility is great task for researcher.
- Capacity: capacity refers to the length of the embedded message into digital video.
- Fidelity: It is the similarity at the point at which the watermarked content is provided to the customer that count weather video given to the customer is degraded or not. A watermark is said to be high fidelity if degradation it causes is very difficult for a viewer to see.
- Computational Cost: it refers to the cost or time required for embedding and extracting the watermark from the digital video. For better working digital video watermarking scheme computational cost should be minimized.
- Interoperability: it refers, the watermark should remain in video even the compression and decompression operations are performed on that video.

- Blind/informed detection: in the Informed watermarking schemes the detector requires access to the original video. In Blind watermarking Detectors do not require any original information.
- False positive rate**:** A false positive refers detection of watermark information from a digital media such as video, image that does not actually contain that watermark.

II. Implementation

The proposed methodology is identify that Digital watermarking is important one in the field of Piracy protection and from the work of many researchers various methods for video watermarking was proposed But all this method cannot shows the high robustness against several possible attacks. And also there is a need to improve the Peak signal to noise ratio (PSNR) and Normalized Correlation value. The proposed schemes use to combine several existing algorithms and build a Hybrid approach for Digital video watermarking. The Proposed scheme shows high robustness against several attacks such as JPEG coding, Gaussian noise, Salt and Peeper Noise, Poisson Noise addition, Histogram, frame averaging, contrast adjustment and many more. Also In the proposed scheme, there is chance to improve in PSNR and NC values. For the watermark detection no original video is required. Using this perceptually invisible robust watermarking achieved.

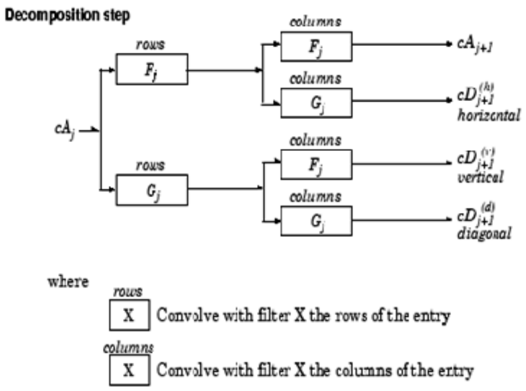
The proposed system contain following algorithms.

- Discrete Stationary Wavelet Transform 2-D
- Principal Component Analysis
- Singular Value Decomposition
- Genetic Algorithm

A. Discrete Stationary Wavelet Transform 2-D

It is called as 2D-SWT. The classical DWT suffers a drawback: the DWT is not a time-invariant transform. This means that, even with periodic signal extension, the DWT of a translated version of a signal X is not, in general, the translated version of the DWT of X.This kind of two-dimensional SWT leads to a decomposition of approximation coefficients at level j in four components: the approximation at level j+1, and the details in three orientations (horizontal, vertical, and diagonal).

The following fig 2 describes the basic decomposition step for images:



Fig,2. 2D-SWT

B. Principal Component Analysis

Principal Component Analysis (PCA) is a process or method which uses an orthogonal transformation procedure to change a set of observations of possible correlated variables into a set of values of uncorrelated variables which we called as principal components. PCA highlights the similarities and dissimilarities of the data. Since patterns in data are difficult to find in data of high dimension, graphical representation is not available, PCA is a powerful tool for examining data. It plots the data into a new coordinate system where the data with maximum covariance are plotted together and is known as the first principal component.

The purpose of embedding the watermark in the video frame while the PCA based watermarking scheme allowed to select the appropriate area of PCA coefficients for embedding and we could analyzed that it is always possible to watermark a color video file without affecting its perceptual quality [16].

C. Singular Value Decomposition

Singular Value Decomposition (SVD) is mathematical technique for diagonal matrices in that the transformed domain consists of basis states that are optimal. The singular value decomposition of a *complex* matrix *X* is given by (1)

$$\mathbf{X = U\ S}\ \boldsymbol{V} \qquad (1)$$

Where U is an $m \times m$ real or complex unitary matrix, S is an $m \times n$ rectangular diagonal matrix with nonnegative real numbers on the diagonal, and V is an $n \times n$ real or complex unitary matrix. The diagonal entries of S are called the singular values of A and are assumed to be arranged in decreasing order the columns of the U matrix are called the left singular vectors while the columns of the V matrix are called the right singular vectors of A. Singular value of the matrix shows the luminance of a video frame layer while the corresponding pair of singular vectors specifies the geometry of the video frame layer. [15]

D. Genetic Algorithm

In the area of Soft Computing, Genetic algorithms play an important role in an optimization technique. In this we use this technique to optimize the performance of our proposed scheme. GA is inspired by Darwin's theory that is Survival of the Fittest. For solving the problem as a GA problem, the fitness function, and GA operators should defined. In GA-based optimizations, there is a population from this we have to select things of our use then perform the crossover on it and then calculate the fitness by using fitness function. Fitness of the thing is defined as success of the thing in their entire life cycle. The main aim is too defined as an objective function that indicates the fitness of any possible solution. In the life cycle of GA-based optimization processes, there is three GA operators known as reproduction, crossover, and mutation, are applied to the chromosomes repeatedly which is a finite-length string. And by this way find the fittest chromosomes. Fig. 3 shows the. GA based optimization process

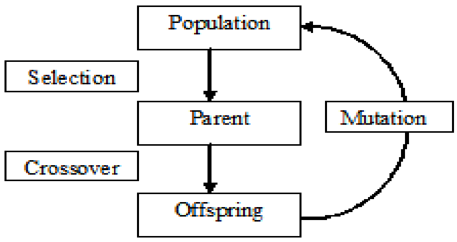


Fig.3.GA based Optimization Process

The Stages to proposed decision support system are as follows.

Stage1: Take Video Clip as an Input which is to be watermarked.

Stage 2: Divide the video into frames.

Stage 3: Take watermark image as a input.

Stage4: For each Frame Apply Following

a) Apply 2D-SWT which decomposed the video frame into four part LL, LH, HL, and HH
b) . Apply 2D-SWT on watermark image.
c) Apply SVD on LL part of the video frame followed by PCA.
d) Apply SVD on LL part of watermark image followed by PCA.

Stage 5: Embed Watermark into the video frame.

Stage 6: Apply Attack on watermarked to check the robustness. Then Apply Genetic Algorithm which calculates the fitness compares it with some threshold if it less then goes to stage 3.

Stage 7: Apply Attack and Extract watermark from Watermarked frame. Check PSNR and NC values

Stage 8: Construct the Watermarked Video.

The following fig 4 shows the Proposed Video Watermarking Scheme

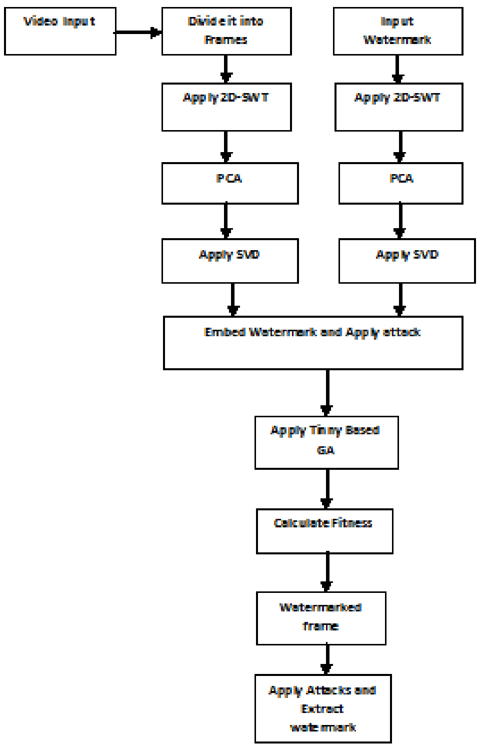


Fig. 4. Proposed Video Watermarking Approach

III. EXPERIMENTAL RESULTS

All algorithms, including proposed technique, are implemented on Windows 7 PC having Intel Core-i3 2.93 GHz processor, 2GB RAM and run using MATLAB 2011. We have considered a various Avi format Video file in this experiment to embed watermark image.

For evaluating the performance of any watermarking system, Peak Signal to Noise Ratio (PSNR) is used as a Common measure of the visual quality of the watermarking system. To calculate the PSNR, first the Mean Square Error (MSE) between the original and watermarked frame is computed as follows:

$$MSE = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}\left[I(i,j) - I'(i,j)\right]^2$$

PSNR*:* The Peak-Signal-To-Noise Ratio is used to deviation of the watermarked and attacked frames from the original video frames and is defined as:

$$PSNR = 10\log_{10}\frac{255}{MSE}$$

NC: The normalized coefficient (NC) gives a measure of the robustness of watermarking and its peak value is 1. Where *W* and *W* represent the original and extracted watermark respectively. After extracting and refining the watermark, a similarity measurement of the extracted and the referenced watermarks is used for objective judgment of the extraction fidelity.

$$NC = \frac{\sum_i\sum_j W(i,j)\cdot W'(i,j)}{\sqrt{\sum_i\sum_j W(i,j)}\sqrt{\sum_i\sum_j W'(i,j)}}$$

The original sampled frame and its corresponding watermarked frame are shown in Fig. 2. The measured PSNR is 52.39db and the watermarked frame appears visually identical to the original. The value of PSNR is Constant over all the tested frames which means that the error between the original and watermarked frames is very Low so high visual quality is obtained. Fig. 3 shows the original watermark and the extracted watermark where no Attacks were applied. The measured value of NC is 1 i.e. the extracted watermark is identical to the original and exact extraction is obtained.

By comparing the proposed method with previous methods [we find that the proposed scheme registered a constant PSNR equal to 52.39db which is greater than the PSNR reported by Mostafa, Wang,

Table 1 show the PSNR Comparison of proposed video watermarking with previous watermarking schemes

Table 2 show the PSNR and NC values against various attacks.

Table 3 show the PSNR and NC values for 10 frames

Fig.5 shows graph of PSNR and NC values vs. Frames

Table 1: Comparison of Proposed method

Algorithm	PSNR(db)
Mostafa [20]	39.0693
Wanag [21]	32
Yassin [12]	44.0975
Yassin [22]	47.1078
Proposed	52.39

Table 2: PSNR and NC values against various attacks

Attack class	PSNR(db)	NC
Gaussian Noise	28.74	0.4986
Histogram	29.03	0.83
Average	33.70	0.8971
Median Filter	36.92	0.9782
Salt and Peeper Noise	29.32	0.5510
Weiner filter	33.27	0.8701
Rotation	33.85	0.9404
Adjustment	28.92	0.9531
OrdFilt	28.28	0.877
Specal Noise	28.54	0.4446
Poisson noise	30.77	0.7147
None	52.39	1.00

Table 3: PSNR and NC values against various attacks for 10 frames

Attack Class:- Gaussian Noise										
Frame No.	1	2	3	4	5	6	7	8	9	10
PSNR	28.64	28.65	28.63	28.62	28.64	28.72	28.70	28.74	28.83	28.72
NC	0.4796	0.4792	0.4776	0.4725	0.4750	0.4885	0.4795	0.4986	0.5060	0.4840

Attack Class:- Histogram										
Frame No.	1	2	3	4	5	6	7	8	9	10
PSNR	28.94	28.95	28.98	28.96	28.99	28.97	28.97	29..00	28.99	29.03
NC	0.85	0.85	0.84	0.85	0.84	0.85	0.85	0.84	0.84	0.83

Attack Class:- Average										
Frame No.	1	2	3	4	5	6	7	8	9	10
PSNR	33.29	33.53	33.52	33.35	33.51	33.35	33.55	33.54	33.51	33.70
NC	0.8733	0.8874	0.8866	0.8771	0.8864	0.8767	0.8887	0.8879	0.8866	0.8971

Attack Class:- Median Filter										
Frame No.	1	2	3	4	5	6	7	8	9	10
PSNR	36.45	36.56	36.76	36.73	36.69	36.75	36.78	36.74	36.71	36.92
NC	0.9727	0.9739	0.9764	0.9760	0.9755	0.9762	0.9766	0.9761	0.9757	0.9782

Attack Class:- Salt and Peeper Noise										
Frame No.	1	2	3	4	5	6	7	8	9	10
PSNR	29.28	29.28	29.20	29.21	29.15	29.33	29.17	29.32	29.32	29.31
NC	0.5284	0.5468	0.5353	0.5357	0.5239	0.5516	0.5257	0.5457	0.5510	0.5497

Attack Class:- Weiner filter										
Frame No.	1	2	3	4	5	6	7	8	9	10
PSNR	32.87	33.09	32.92	32.93	32.89	32.90	33.27	33.05	33.05	33.05
NC	0.8439	0.8591	0.8473	0.8480	0.8452	0.8456	0.8701	0.8561	0.8565	0.8557

Attack Class:- Rotation										
Frame No.	1	2	3	4	5	6	7	8	9	10
PSNR	33.69	33.77	33.80	33.67	33.85	33.60	33.85	33.60	33.71	33.30
NC	0.9338	0.9377	0.9382	0.9340	0.9404	0.9297	0.9401	0.9322	0.9345	0.9193

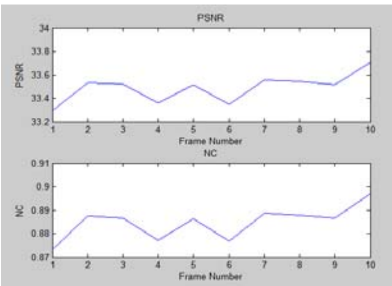
Attack Class:- Adjustment										
Frame No.	1	2	3	4	5	6	7	8	9	10
PSNR	28.53	28.58	28.58	28.67	28.70	28.75	28.74	28.74	28.86	28.92
NC	0.9329	0.9367	0.9367	0.9423	0.9436	0.9465	0.9463	0.9463	0.9520	0.9531

Attack Class:- OrdFilt										
Frame No.	1	2	3	4	5	6	7	8	9	10
PSNR	28.24	28.23	28.26	28.27	28.23	28.28	28.27	28.23	28.26	28.25
NC	0.8730	0.8687	0.8735	0.8755	0.8697	0.877	0.8766	0.8704	0.8738	0.8725

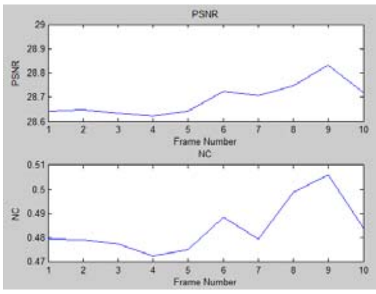
Attack Class:- Specal Noise										
Frame No.	1	2	3	4	5	6	7	8	9	10
PSNR	28.48	28.45	28.57	28.55	28.458	28.455	28.46	28.54	28.54	28.53
NC	0.4453	0.433	0.4653	0.4510	0.4304	0.4254	0.4352	0.4446	0.4439	0.4415

Attack Class:- Poisson noise										
Frame No.	1	2	3	4	5	6	7	8	9	10
PSNR	30.71	30.75	30.76	30.75	30.60	30.77	30.599	30.76	30.76	30.74
NC	0.7302	0.7309	0.7353	0.7356	0.7191	0.7147	0.7165	0.7307	0.7330	0.7275

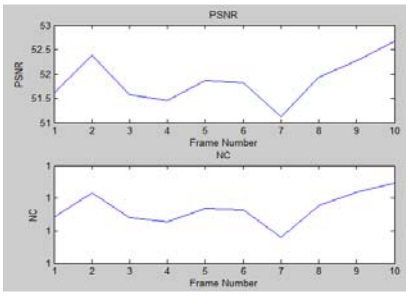
Attack Class:- None										
Frame No.	1	2	3	4	5	6	7	8	9	10
PSNR	51.61	52.39	51.57	51.46	51.85	51.81	51.12	51.94	52.27	52.67
NC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00



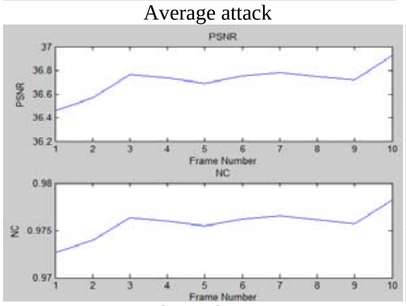
Average attack



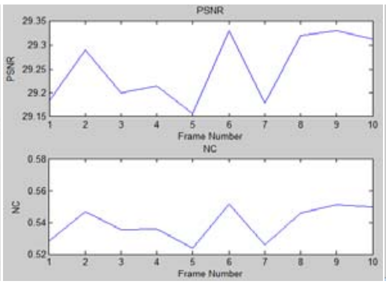
Gaussian Noise



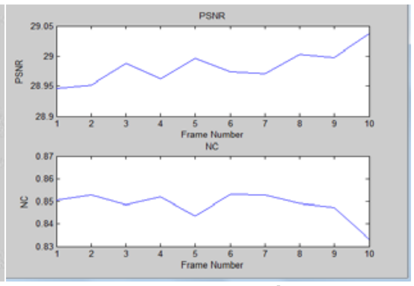
None



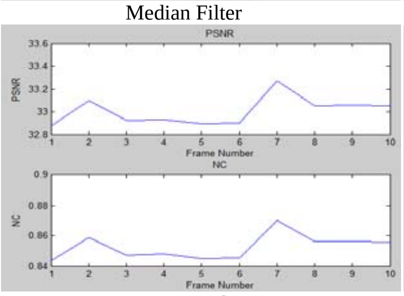
Median Filter



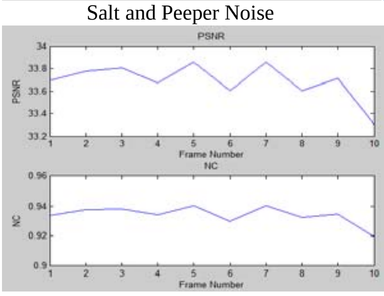
Salt and Peeper Noise



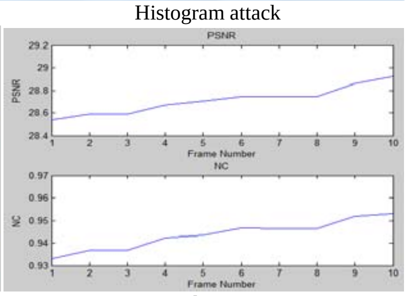
Histogram attack



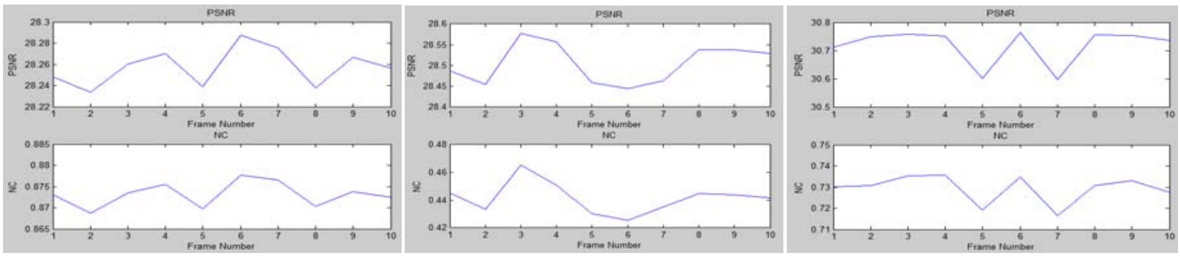
Weiner Filter



Rotation



Adjustment



OrdFilter Specal Poisson Noise

Fig. 5.Graphs of PSNR and NC against Frames

IV. CONCLUSIONS

This paper proposed a Hybrid based Digital video Watermarking system which identifies that this System is More Robust against various types' attacks. Various methods for video watermarking were used different algorithms. All these method has its own impact factor. In this we use the concept of Genetic Algorithm and combine it with all existing algorithms for getting a new hybrid approach of Video Watermarking which having high PSNR, NC value

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