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Comparative Analysis of Video Watermarking Scheme Using Different Wavelets & SVD

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Abstract— **This paper proposes a comparative study of dual way authentication video watermarking method based on singular value decomposition and wavelet decomposition.For wavelet decomposition use different wavelets like haar,bi-orthogonal and a comparative analysis is made based on the robustness of watermarking.A detailed analysis of existing attacks in video watermarking are studied and effect of each attacks is evaluated.**

Keywords— **Bi-orthogonal wavelet transform,haar wavelet decomposition,singular value decomposition**

I. INTRODUCTION

Digital watermarking is the method of hiding the watermark(logo)inside the multimedia data which in later provide a proof of ownweship.However now a days digital contents are easily manipulated by unauthorised users and this will lead to serious copy right violation problems.So in order to provide a better way of authentication new methods are needed.

The dual way authentication in this paper using logo and QR image enable a better solution to the existing problem .More over the use of wavelet transform provide better robustness against various attacks in watermarking.Performance evaluation can be made based on existing parameters of quality measurements.

Existing methods of video watermarking[6],[7],[8] uses haar wavelet decomposition but the new method using bi-orthogonal has certain advantages because of the properties of bi-orthogonal wavelets like better smoothness.

II. BACKGROUND

A. Discrete wavelet transform(DWT)

Wavelet transform uses wavelet filters for transforming the image.Various filters include haar wavelet filter,Bi-orthogonal wavelet filter etc.In wavelet decomposition we are decomposing the image in to four subbands LL(lower),LH(Vertical),Hl(horizontal),HH(diagonal)subbands and for watermark embedding use only LL subband which is more sensitive and contain approximation coefficients.

B. Bi-orthogonal wavelet transform

Bi-Orthogonal wavelet transform is an invertible transform The property of exact reconstruction and symmetry are impossible in orthogonal case except for the Haar wavelet, whereas, both properties are possible in Bi-Orthogonal wavelets.It has the property of perfect reconstruction.They have two sets of low-pass filters (for reconstruction), and high-pass filters (for decomposition),so symmetric wavelet functions exist

C. Singular value decomposition(SVD)

SVD is a numeric analysis tool[9],[5] used for matrix reduction.Here, we are transforming the original matrix in to three matrices that have the same dimension as original matrix.

The singular value decomposition of an m×n real or complex matrix M is a factorization of the form follow in this equation[4]

$$M = U \sum V'$$

Where U - m × m real or complex unitary matrix

$\sum is$ m×n rectangular diagonal matrix with nonnegative real numbers on the diagonal,

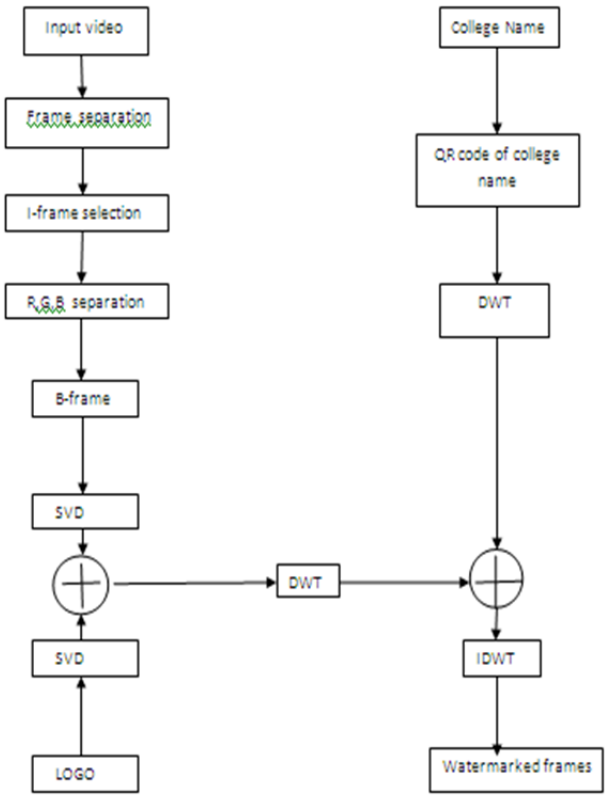
V'- n×n real or complex unitary matrix.

D. Quick response code(QR)

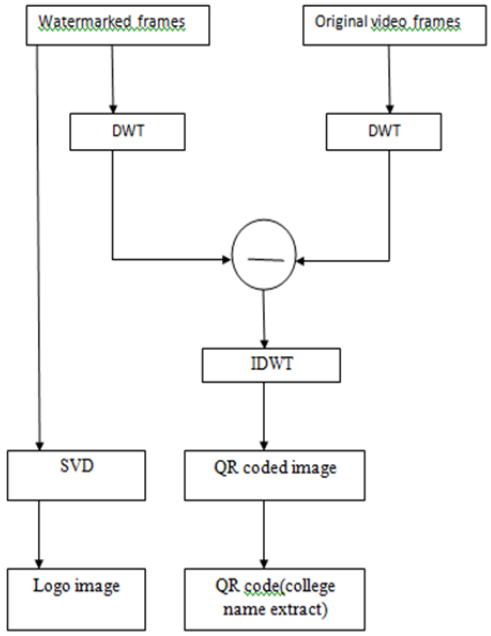
A quick response (QR) code[2],[3] is a two dimensional Barcode. Information is encoded in both the vertical and horizontal direction, thus holding up to several hundred times moredata than a traditional bar code . QR Codes holds a considerably greater volume of information than a 1D Barcode . QR Code can encode in many types of characters such as numeric, alphabetic character, Kanji, Kana, Hiragana, symbols, binary, and control codes.

III. Flow Chart

A. *Watermark embedding procedure*[10]



B. *Watermark extraction procedure*[10]



IV. Performance Evaluation

A. *Common attacks in video watermarking*

- Mean attack

  Here a mask of predefined size is taken and mean value of pixels in this mask is found.Then replace the original pixel value by this mean value.
- Median attack

  Perform median filtering of the matrix using default 3×3 neighbourhood
- Rotation attack

  Here the watermarked image is rotated by certain degree.
- Salt & pepper noise attack

  Salt & pepper noise is added to the watermarked frame
- Poisson noise attack

  This is also called short noise or electronic noise
- Gaussian noise attack

  This follow Gaussian distribution
- Speckle noise attack

  This is granular noises found in rough surfaces of images.
- Histogram equalization

  This is a method for image contrast adjustment.

B. *Performance evaluation parameters*[1]

- Peak signal to noise ratio(PSNR)
- Mean square error(MSE)
- Mean absolute error(MAE)
- Root mean square error(RMSE)
- Normalized cross correlation
- Cross correlation
- Structural similarity index matrix

V. Results

A. Quality measurement without attack(haar)
Here,for wavelet decomposition haar wavelet filters are used

B. Quality measurement without attack(bior)
Here,for wavelet decomposition biorthogonal wavelet filters used

C. Effects of attacks(haar)
Here,various type of attacks are added to the watermarked video frame and evaluate the reconstructed logo and cover images for various quality measurements.

D. Effect of attack(bior)

TABLE I: PERFORMANCE ANALYSIS IN CASE OF HAAR BASED VIDEO WATERMARKING

Frame No	PSNR	MSE	RMSE	MAE	NC	CC	MSSIM
1	40.9978	15.5028	3.9373	3.6765	1.0001	0.9413	0.992
2	40.9982	15.5015	3.9371	3.6741	1.0001	0.9427	0.9919
5	40.9897	15.5319	3.941	3.6709	1.0001	0.9362	0.9921
10	40.9743	15.5871	3.948	3.6778	1.0001	0.9457	0.9924
15	40.9763	15.58	3.9471	3.6762	1	0.9381	0.9922
20	40.9827	15.5568	3.9442	3.6687	1.0001	0.9363	0.9924
25	40.9589	15.6425	3.955	3.6767	1	0.9515	0.9926
30	40.969	15.606	3.9504	3.6785	1	0.942	0.9924
35	40.962	15.6314	3.9536	3.68	1.0001	0.9425	0.9925
40	40.9485	15.6799	3.9598	3.6853	1.0001	0.9523	0.9926
60	40.9617	15.6323	3.9537	3.6784	1	0.9519	0.9923

TABLE II: PERFORMANCE ANALYSIS IN CASE OF HAAR BASED VIDEO WATERMARKING[10]

Frame no	PSNR	MSE	RMSE	CC
1	41.0806	14.2782	3.7786	0.9213
2	41.0638	14.3217	3.7844	0.9283
5	41.0277	14.4439	3.8052	0.9530
10	41.0155	14.4802	3.8053	0.9608
20	41.0207	14.4624	3.8029	0.9551
40	41.0557	14.3413	3.7870	0.923
60	41.0170	14.4774	3.8049	0.9587

TABLE III: EFFECT OF ATTACKS (HAAR BASED VIDEO WATERMARKING)

ATTACK	PSNR	MSE	RMSE	MAE	CC	MSSIM
Mean	28.1161	101.12	10.05	5.1373	0.5744	0.8064
Median	34.6252	22.58	4.75	2.55	0.3065	0.9587
Salt & pepper	25.1168	201.74	14.2	3.562	0.3163	0.6551
Gaussian	19.92	667	25.82	37.51	0.327	0.1786
Poisson	26.63	142	11.93	8.98	0.2955	0.1925
Speckle	18.9076	842.79	29.03	24.04	0.3565	0.191
Rotation	12.482	3700	60	42.94	0.7357	0.1786
histogram eq.	15.35	1909.67	43.69	20.42	0.8912	0.6324

TABLE IV: EFFECT OF ATTACKS IN BI-ORTHOGONAL BASED VIDEO WATERMARKING)[10]

ATTACK	PSNR	MSE	RMSE	MAE	CORR	MSSIM
Mean	28.1505	100.3285	10.0164	5.1378	0.6249	0.7831
Median	35.2785	19.4367	4.4087	2.5584	0.2321	0.9343
Salt & pepper	25.1918	198.2863	14.0814	3.5625	0.2997	0.6427
Gaussian	19.9483	663.2051	25.7527	20.4122	0.3164	0.1938
Poisson	26.77	137.87	11.74	9	0.3012	0.487
Speckle	18.9196	840.45	28.9906	24.049	0.3467	0.19
Rotation	12.423	3751.2187	61.2471	42.9474	0.7243	0.1902
Histogram equ.	15.3792	1899.1249	42.5673	37.104	0.8832	0.6142

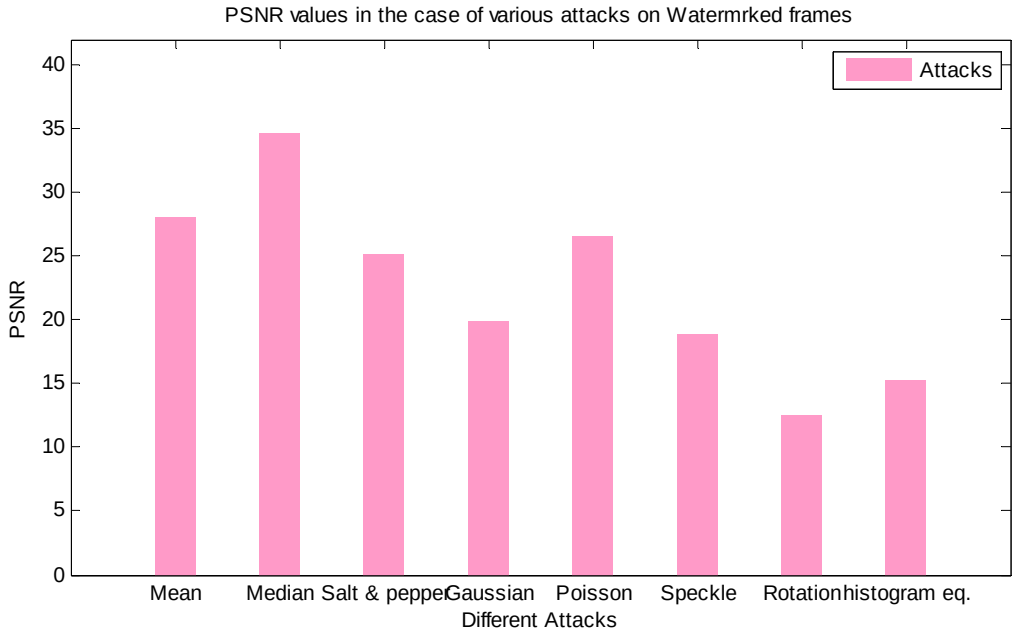


Fig1: PSNR Vs ATTACKS

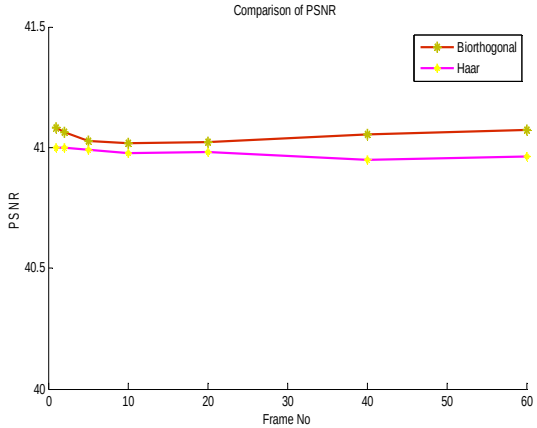


Fig2:Comparison of PSNR

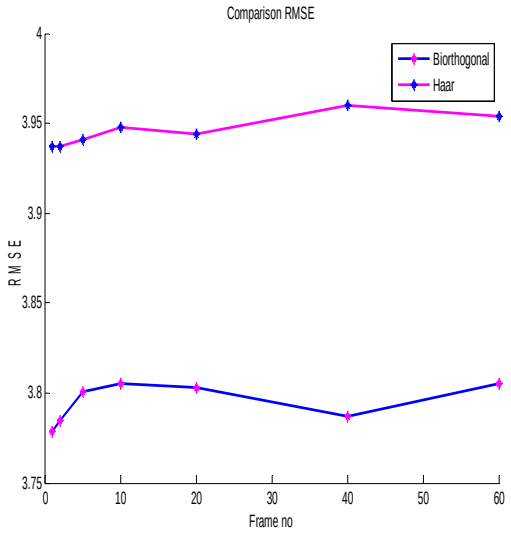


Fig3:Comparison of RMSE

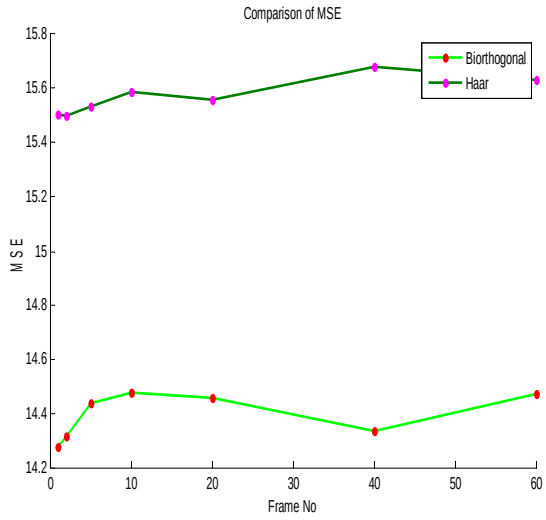


Fig4:Comparison of MSE

VI. CONCLUSION

This is a method that provides dual way authentication of video watermarking.From the comparative analysis of haar and biorthogonal based watermarking get a conclusion that bi-orthogonal based watermarking provide better performance in terms of quality measurements.The value obtained by taking various cover frames is not the same so cover image selection is important.In the case of MPEG compressed videos I-frames can be selected for watermark embedding.I-frame is the first frame among all extracted frames of a video.The analysis of effect of various attacks on watermarked frames implies a result that the video watermarking is more suspectable to geometric type of attacks.

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