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Combined Analysis of Visual Cryptography using SVD Technique and Frequency Domain Watermarking Technique

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***Abstract*—The proposed method deals with the visual cryptography using a new combined technique called SVD technique with frequency domain watermarking technique. SVD technique and Frequency domain watermarking technique results in high PSNR, moderate the difficulty of the design and moderate time required for computation and compared to predictable VC techniques. In this paper Frequency Domain (FD) watermarking technique is used to prevent distorts attacks in the VC scheme. FD watermarking technique provides more authentications to secret image and it gives high robustness.**

Keywords— SVD, VC, Watermark, FD

I. INTRODUCTION

The visual cryptography was presented for binary images by Moni and Noar in 1994. Later, emerging in visual cryptography (VC) ,it is elaborate to gray scale images and color images. This paper involves segmenting binary images into transparent image; the original image is obtained by overlapping the transparent image in a specified manner. This technique requires a mathematical calculation process. Conventional technique was limited to the transmission of text documents and written documents which are overcome by new technology by sending gray scale images.

SVD is an image compression technique applied to visual cryptography to generate secret shares. Watermarking ideology is a data protecting concept in which an image is used to hide the secret data. Depending on the identification of secret data the Watermarking technique is classified as 1) Blind 2) Semi-blind and 3) Non-blind. Here type used for to protect the data is Non-blind Watermark method. In the Frequency domain methodology discreet wavelet transforms(DWT), discreet wavelet transforms Discreet cosine transforms [6] and DWT DCT SVD techniques can be used. This paper implements the Frequency domain Non-blind watermarking technique. Combined techniques namely DWT DCT and SVD is used to give high depth of image hiding.

II. LITERATURE SURVEY

In [1], Visual cryptography for grayscale images(GI) using optimization technique. Augmenting technique is achieved by taking the average of 4x4 blocks; this is applied to whole image to form an average image. The shares should be safeguard by putting in the host image using LSB watermark technique. One of the watermark ideology is a simple technique.

In [2].VC is applied to grayscale image, here image is converted into bit plane. To binary plane visual cryptography is applied. Here binary one is represented by [1 1] or [1 0] or [0 1], binary zero is represented by [0 0]. The lengthof the shares generated are not equal. This method gives less PSNR with distorted re-constructed image image quality is less; this method fails to extract the input message with good PSNR.

In [3], Author explains the concept of visual cryptography for images to get secure image. And author adds the concepts of VC to color images. This paper is concentrating on grayscale images and color images. Shares are constructed by considering the RGB color depth. The VSS(visual secret sharing) scheme is applied to expand the pixel and to maintain the good quality of reconstructed image.

III. IMPLANTATION VISUAL CRYPTOGRAPHY USING SVD TECHNIQUE AND FREQUENCY DOMAIN WATERMARKING

Implementation of proposed method is as shown in figure 1,

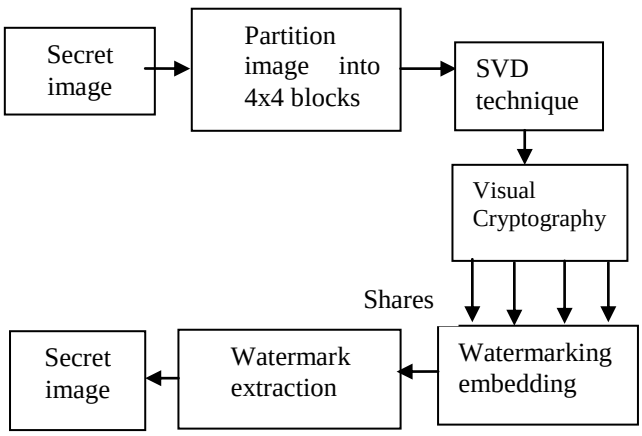


Fig. 1.Block diagram of visual cryptography and watermark technique

A. *Share generation*

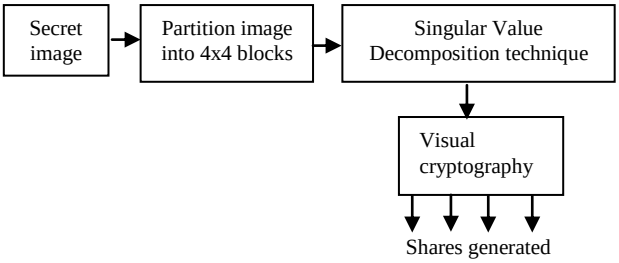
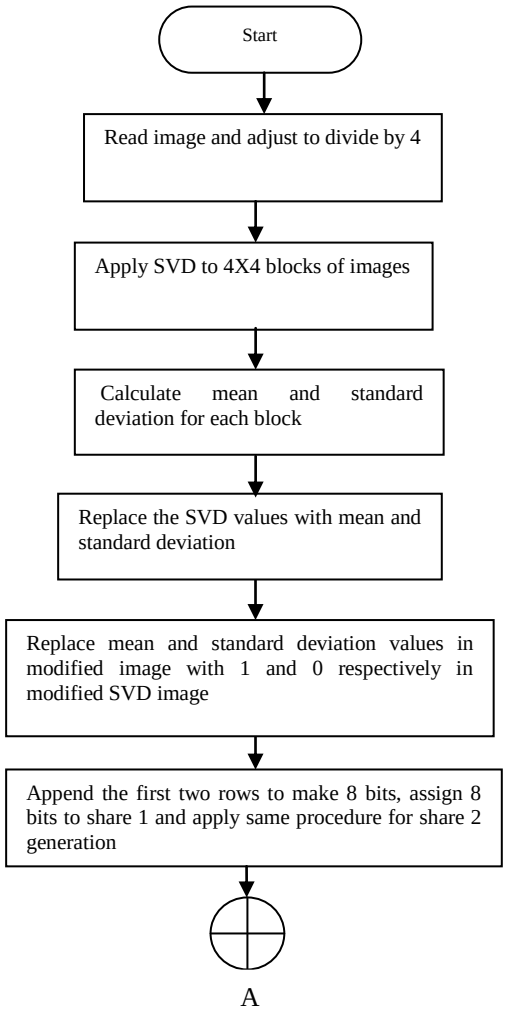


Fig. 2.Block diagram of share generation

Share generation includes the processing the secret image and partitioning this image and singular value decomposition (SVD) is applied to obtain mean and variance values to which VC is applied to obtain the shares. Here GI is considered and it is the secret image; this image has to be protected. To get the singular value decomposition, adjust the size of the image by appending the 0's so that image can be segregate by four . Segregate the data into 4x4 blocks and get decomposition of singular value

Find the mean and standard deviation of 4x4 blocks. Replace the SVD values with the mean and standard deviation values and assign to share1 and share2. μ and Std.D(standard deviation) values are converted to binary form and assign to share3 and share4.

B. *Flowchart for share genertion*



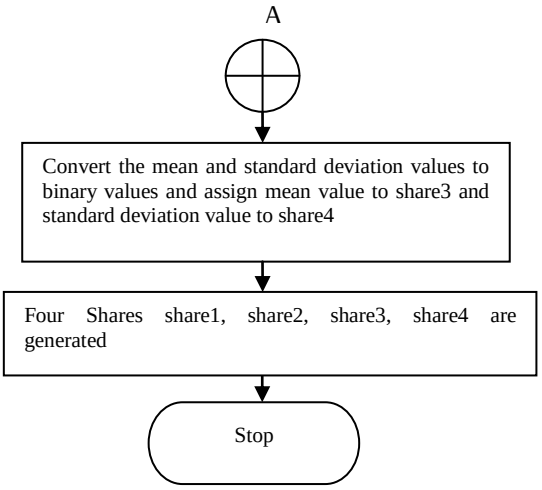


Fig. 3 Flowchart of visual cryptography

IV. Frequency Domain (FD) watermark technique

Watermark technique can be applied to images in time domain or in frequency domain. In time domain approach image is embedded directly by modifying the pixel values. Frequency watermarking technique can be achieved by using only DWT or DCT DWT or DCT, DWT and SVD transforms [4].

Watermark technique involves watermark embedding and watermark extraction. The block diagram represented in figure 3shows that cover image is first adjusted to the size of the secret image the cover image and secret image is applied to watermark embedder, the output of which is watermarked image. This watermarked image is moved in a network. Received watermarked image is applied to watermark extractor to get back the secret image.

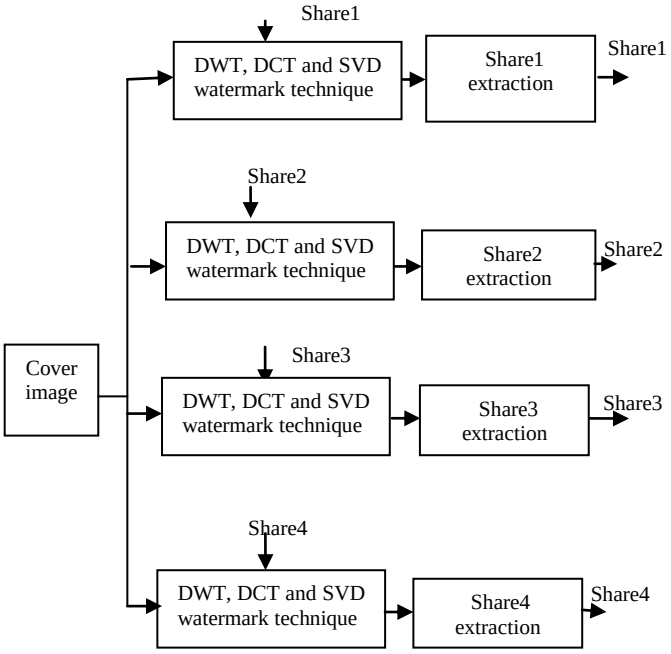


Fig 4: Block diagram of watermark technique

A. DCT

DCT transform a signal from time domain to frequency domain. The equations for the transformations are as shown below.

$$A(u,v) = \beta(u)\beta(v) \sum_{\substack{0 \le i \le m \\ 0 < j \le n}} P(i,j) * \cos(\pi(2i+1)u|(2*m)) * \cos(\pi(2j+1)v|(2*n)) \quad (1)$$

$$p(i,j) = \sum_{\substack{0 \le u \le m \\ 0 < v < n}} \beta(u)\beta(v)A(u,v) * \cos(\pi(2i+1)u|(2*m)) * \cos(\pi(2j+1)v|(2*n)) \quad (2)$$

DCT is mainly employed in jpeg compression method [6]; it gives a DC coefficients and AC coefficients. Most of the information is carried by DC value which is in a position of (0, 0) in the matrix. Generally DCT is applied to 8x8 matrices. Here it is applied for the 2x2 matrix.

B. DWT(Discrete wavelet transform.)

DWT gives the relation between time and frequency domain of signal. Applying DWT to an image gives four different bands among which three are high frequency bands and one is low frequency band. Most of the information is carried by low frequency band. So any operation/processing on image is carried by taking the low frequency band.

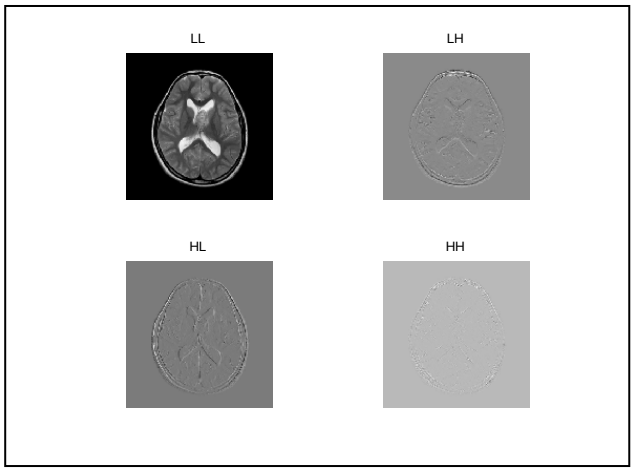


Fig 5: Frequency bands results from the DWT technique

C. SVD(singular value decomposion)

SVD is compression technique, SVD of an image gives three matrices among these two matrices are ortho-normal matrices and one matrix is diagonal matrix. Diagonal elements are called as singular values. The equation for SVD is as

$$X = P \sum Q^T$$

Not all the singular values are used to reconstruct the original information; few singular values are enough to reconstruct the information, there by compression is achieved.

V. FLOWCHART OF WATERMARK EMBEDDING

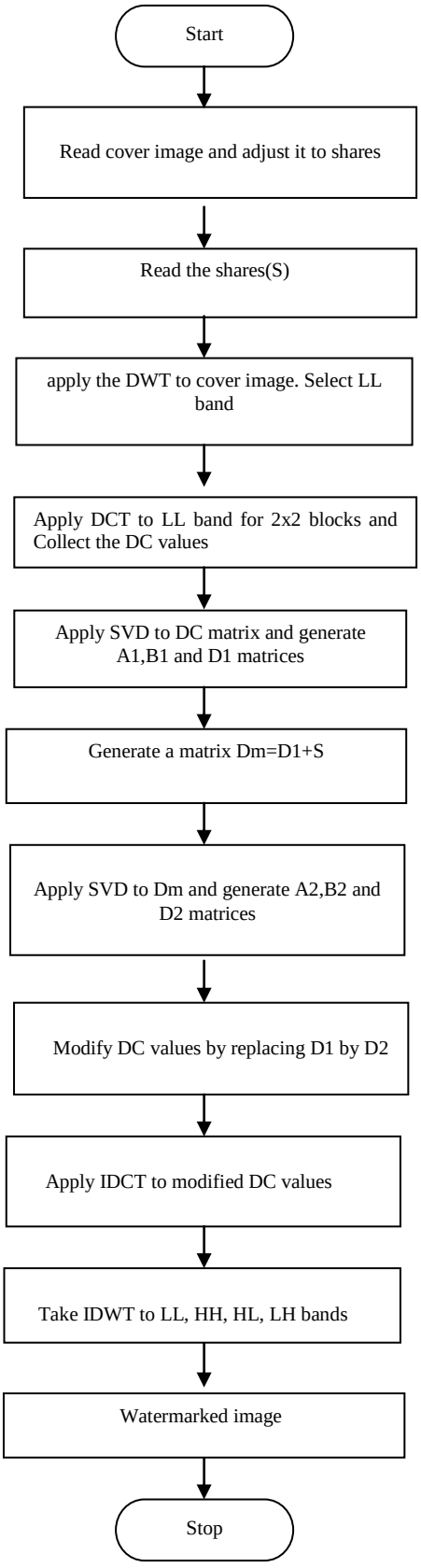


Fig. 6. Flowchart for watermark embedding

VI. FLOWCHART OF WATERMARK EXTRACTION

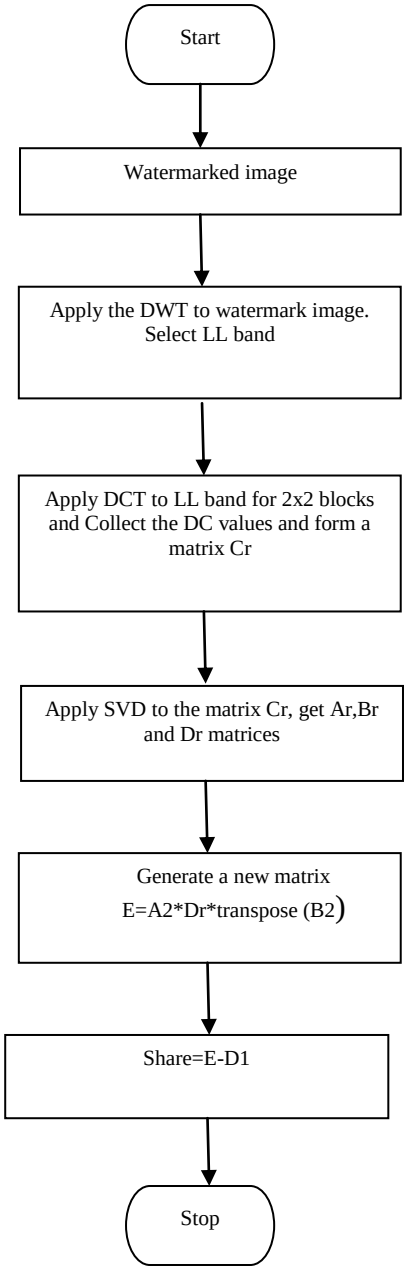


Fig. 7. Flowchart for watermark extraction

A. *Steps involved in watermark extraction*

- Apply DWT of the watermarked image Sm get the 4 different frequency bands named as HH, LL, LH and HL bands.
- Select LL band and Perform 2x2 DCT on LL band.
- Collect the dc values and form a new matrix called Cr, which contains DC coefficients.
- Perform SVD to matrix Cr results 3 matrices named as Ar, Br,
- Generate a new matrix E=A2*Dr*transpose (B2)
- Share reconstructed is given by S=E-D1.

VII. Results and Analysis

The experimental results are obtained by running in Matlab v8.1 and the results are shown below.

A. *Shares generation using Visual cryptography*

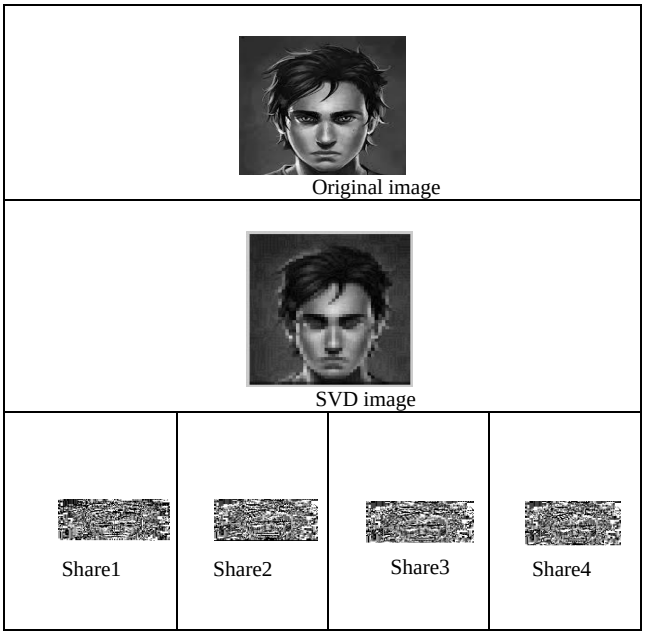


Fig. 8. Share generation using SVD technique

B. *Watermark embedding*

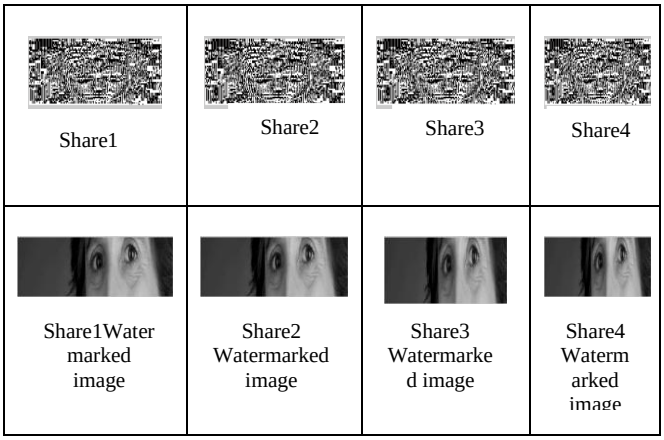


Fig. 9. Embedding secret image on watermark image

C. Watermark extraction

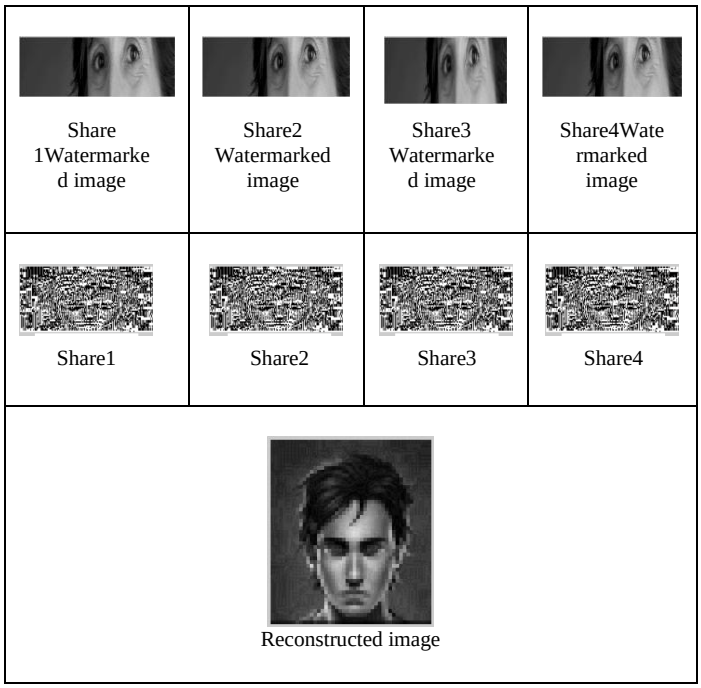


Fig. 10.extraction of shares and reconstructing original image

Propose method is applied for different images and resulting psnr is as shown in tabel I.

TABLE I: Reconstructed images PSNR

Name	MSE(Reconstructed image)	PSNR(Reconstructed image)in dB
Lena.BMP	160.2165	27.0176
Boat.BMP	145.5494	26.5007
Coins.BMP	222.8715	24.6503
Barbara.BMP	261.3148	23.9592
Boy. Jpg	222.8715	22.4953

TABLE II: Time elapsed for program completion

Name	Elapsed Time (seconds)
Lena.BMP	27.66 S
Boat.BMP	26.54 S
Barbara.BMP	28.66 S
Coins.BMP	26.5 S
Boy,jpg	28.193 S

CONCLUSION

Here the combined analysis of visual cryptography and the watermarking technique is done. Here new technique is implemented where in SVD method is combined with VC to obtain good image quality with higher PSNR. This method is simpler compared to other techniques and takes less computation time. New approach DCT, SVD and DWT based Watermarking technique discussed gives good results in terms of image quality, noise resistance, PSNR, compared to conventional methods.

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