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Watermark Extraction and Validation in Images Using Hybrid Techniques

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ABSTRACT
A hybrid watermarking technique for the purpose of protection of multimedia data from copyright and integrity violation. The content providers are more concerned for proper creation and distribution. Different watermarking algorithms are used in various applications, they are mainly used for authentication. Mainly watermarks are digital signals, patterns inserted in digital images. For the protection of Intellectual Property Rights and authentication digital watermarking schemes are used like Integer wavelet transform and singular value decomposition. LWT authenticate the image and SVD for the watermark image.
The pixels which are compressed based on the pseudorandom are distributed in wavelet domain. It is done by embedding watermark on singular values of (LL) sub band. Discrete Wavelet Transform is not that efficient so Integer Wavelet Transform is implemented. Now the original image is extracted by separating watermark image from watermarked. Then watermark validation is done for validating the extracted watermark.

Keywords:- Integer wavelet transform, singular values, lifting scheme, watermarks.

I. INTRODUCTION

In order to maintain the authenticity and data integrity of image, watermarking schemes are used. The main goal for embedding watermarks is to solve the problem of unauthorized copying and tampering. It depends upon the application and the needs of the user.

Some embedding algorithm and a pseudo noise pattern are used for inserting watermarks as a plain-bit sample or a digital signal into the source data. The low-value bits of picture pixels hides the embedded information. Other value domains are inked inseparably with the source of the data structure.

Watermarking can be classified as-one done spatially and the other in the transform domain. There are mainly two transforms which are used for the carrier image, and for the watermark to be embedded in the carrier.

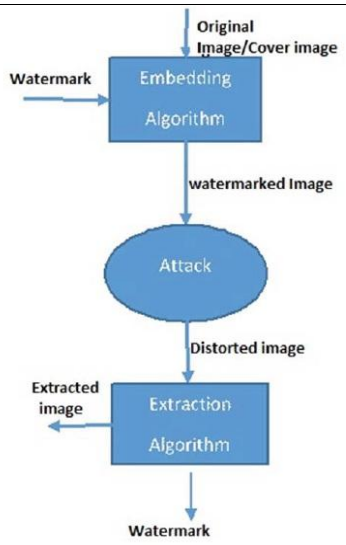

Figure 1: Diagram representing digital watermarking system

II. RELATED WORKS

S. Kurshid Jinna [1], in their research work they had use location map free watermarking. The location of data embedded in the image is detected using location map, as it indicates the pixel positions of data. But in this

scheme the watermark extraction can be achieved without using location map. Bytes are used instead of bits for embedding process. Integer LWT of the image is performed by preprocessing original image, which then decomposes image into components known as the coefficient. Coefficients such as vertical, diagonal and horizontal coefficients. The watermark embedding is done using horizontal and vertical bands. The difference between neighboring pixels pairs are taken for embedding data in bytes. This process continues, till all bytes are and unsuitable pairs are checked and is omitted. Then diagonal coefficients are combined. Now watermarked image is obtained using this process.
For the extraction process reverse is done without any loss of data. For lossless coding, the finite precision numbers are used for the representation of transform coefficients. When both the techniques are compared, it is concluded that IWT is better than DWT because it make use of shorter data length. Without making any changes like rounding off errors.

Ms.K.Thaiyalnayaki [2], according to their research work, the most of the linear least-squares problems can easily be solved using SVD (Singular value decomposition) for variety of applications, it computes pseudo-inverse of a matrix and analyze multivariate. SVD tool is widely applied in many research fields and is a very important tool in linear algebra, fields like principal component analysis, data compression and canonical correlation analysis.

They have proposed an architecture for embedding and detection process in their research work. Two watermark images and a host image are used in which SVD is applied in which watermarked image can be obtained by adding singular values of host image and watermark images.

Sumalatha Lingamgunta [3], In their research work, wavelet filtering operations can effectively be implemented using lifting scheme which improves the processing speed of WT. The lifting scheme is used for designing non-separable wavelets. It is also used on the Cohen, Daubechies and Feauveau biorthogonal wavelet in their paper with two vanishing moments (CDF (2, 2)).

One advantage of this scheme is that there is no loss of information through forward and inverse transforms.Other advantage, is that it is suitable for reversible data hiding and also retains the perfect reconstruction property. While the disadvantage is that during watermark embedding truncation of the floating point values of the pixels may result in a loss of information.
Prashant Kaushik [4], In this research paper, the main aim of their research work is to achieve invisible watermarks. They make use of three techniques in combination because each method have its own limitation so for overcoming these all the three are combined and implemented.

These three techniques are DWT, DCT and BFO. Peak signal to noise ratio (PSNR), IF (image fidelity), NCC (normalized cross correlation) are used for estimating the performance.

High value of PSNR and NCC indicates good embedding of message. NCC is used for validating the image as correlation between the original message and recovered message.

The embedding is done in such a way that the watermark should remain invisible which is decided by a gain factor that decides or tell the depth of message hiding and retrieval also. In this way it recovered from any type of attack during transmission of image.

Robustness of watermarked image is guaranteed by high value of PSNR and in accordingly gain factor is selected between the PSNR and NCC.

The third method i.e. BFO minimize the objective function value. Gaussian noise, salt & pepper noise, speckle noise and Poisson noise, etc. all these noises are added and by using above process the message is successfully recovered.

SVD in image processing applications are:

1. The image SVs (Singular Values) are stable, in a sense that no great variance will take place in SVs when some noise or disturbance is added to the image

2. SVs show the algebraic image properties.

Md. Maklachur Rahman1[5], In this research paper hybrid technique for watermarking is formulated using DCT, DWT, and SVD.

According to Rehman, the watermark can be embedded to the host image by applying zigzag process for rearranging the image then supply DWT and DCT to high bands. To these high band SVD technique is applied. Side by side the same process is followed for the watermark image. The water image is taken and is embed to other one with the help of a key. Further, construct the modified SVD matrix then the inverse process of DCT and DWT is applied and at last for arranging the original image inverse zigzag process is used.

In the process of extraction of watermark, zigzag process, DWT, DCT, SVD in this manner techniques are applied to watermarked image. All highs band are considered for computing the singular values.Using the key value, the SVD matrix is constructed. At last the watermark image is extracted using the inverse DCT and DWT.

Habibollah Danyali [6], In their proposed method K-level DWT and SVD is applied to the original image as well as to the watermark image. The SVs of image is mapped to numbers [0-255].Original image and the watermark image are converted to semi-binary arrays using SVs of each sub band. Then apply inverse SVD but before that convert it real no Watermark image is obtained by applying K level inverse DWT at last.

P.Tejaswini [7], this research paper includes new blind watermarking scheme. In the watermarking system, there exist two groups.

The first one is spatial watermarking, it uses time domain of an image for watermark insertion, and the second group is frequency watermarking, which uses the frequency domain. The frequency domain is more resistant to attacks. The frequency domain transformations, includes discrete wavelet transformation (DWT) and discrete cosine transformation (DCT).These are popular because they are used in compression schemes of the JPEG. The evaluation of the proposed method is done by analyzing correlation coefficients of watermark and subjective image against different attacks.

III. TECHNIQUES

Mainly there are two ways to perform watermarking, i.e. in spatial domain and frequency domain.

***Spatial Domain**:*

The simplest of doing in spatial domain is to flip lowest order bit of pixel. It is used for superimposing the watermark symbol over a picture. Over varied pixels of the images this technique adds some fixed intensity value for the watermark.

Singular Value Decomposition:

In image processing, SVD is a numeric analysis algebra that is used in many applications. In this, the selected band is decomposed in three metrics. For embedding the watermark a singular value matrix is used, and for the secret key generation other two matrices are considered. A characteristic equation is generated whose degree is equivalent to image's column or row dimensions.

R.Liu and T.Tan [9], they added the watermark to decomposed cover image with scale coefficient α. This was successful because SVD possess high singular values.

Another approach is to apply SVD in different blocks of cover. The main thing that must be taken into consideration is that dimension of watermark must be equal to the block size.

Merits:

1. This technique is more robust and resist to some types of attacks.
2. As singular values shows intrinsic algebraic properties of image so degradation is much lesser.
3. A size of dataset is relatively low as it contains fewer values.

Demerits:

1. Picture cropping can remove watermark from the image.
2. When the colors are separated from a colored image then watermark appears.

Frequency Domain:

It make use of transform coefficient of the image. The image is transformed to frequency domain method like DWT. In this method coefficient is to be modified but not the value of the pixel value. It is complex and also highly computational but robust than spatial. The watermarked image can be obtained using inverse transform.

Lifting Wavelet Transform:

Wavelet transform in terms of wavelet basis is the decomposition of a signal. It is known as the lifting-based wavelet transform because it is constructed on spatial wavelets. It make use of low- pass and the high - pass wavelet filter for breaking it in a sequence of smaller filters. After that it then converted to upper, lower triangular matrices and diagonal matrix which are in alternating sequence with constants.

The lifting scheme shows the relationship between reconstruction filter pairs having same low or high-pass filters.

The alternative approach to DWT is LWT which transforms the image in frequency domain. Lifting wavelet is the fast wavelet transform [22]. This technique makes use of split and merge rather up and down sampling in each level. The wavelet filter filters out polyphase components in parallel, which produces much better result than DWT approach which make use of up and down sampling.

Merits:

1. Lifting wavelet possess good reconstruction of image as, the it aliasing effect is low and is more smooth.
2. Use of this techniques reduces loss in information.
3. Requires less memory and less computation

Demerits:

It becomes difficult to take decisions on coefficient values as small values represent
large coefficients.

Hybrid SVD-LWT:

This hybrid form enhances the characteristics of the image such as robustness and fidelity.

In the decomposition, first the filter coefficients are converted to lifting coefficients namely predict, update and scaling. After that a set of samples is obtained by splitting original image. Further, for approximation are applied sampled original image is treated with lifting coefficients Merits:

1. Easy to retrieve watermark, it also improves the intactness.
2. The watermark is spreaded throughout the spectrum.
3. The computational complexity is half in comparison DWT.

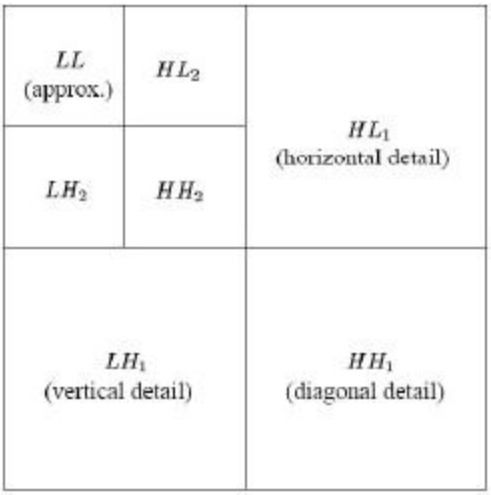

Figure 2: The three level DWT decomposition

IV. ANALYSIS

Based on LWT-SVD the PSNR concluded that there is an improvement in fidelity of the watermarked image. It is an highly efficient technique. As the improvement in PSNR value is seen and there is also an improvement in the CRC values. This is a desirable property which indicates the high quality of image after watermarking and retrieved watermark's strength. LWT helps in getting a good reconstruction. Also fidelity is maintained by SVD which helps in reconstruction the watermark more efficiently. The non- fixed orthogonal bases of SVD and fixed-orthogonal bases LWT are combined that made watermarking invariant to all types of intentional attacks in digital image processing.

IV. CONCLUSION

The purpose of authentication of the carrier image is fulfilled by SVD and lifting based discrete wavelet transform based system. The affected area or tampering can be detected by comparing the logo with the original.

Unlike other methods this is a scheme, involving two transforms acting on the carrier and the logo or watermark to be embedded.

The algorithm for watermarking embedding and extraction has been developed and evaluated. The IWT-SVD scheme is robust and secure as it can manage different type of attacks.

High robustness can be achieved by modifying Singular Values of the host image in IWT domain against attacks. The selection of the best value of the scaling factor can be achieved by making tradeoff between PSNR of the watermarked image and finding the correlation between extracted watermark and the original data.

For medical imaging and remote sensing applications IWT technique is very useful because it produces lossless image.

Watermarking embedding scheme can be extended to include encrypted watermarks and the extraction algorithm can also be extended to perform watermark validation

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