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Discrete Wavelet Transform Technique for Digital Image Watermarking: A Review

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Abstract— This paper deals to review a watermarking coding and decoding technique for image security. Here DWT technique is used for coding because of DWT have wide range of functionalities. Two images are considered, one as a host image and second as a watermark image. Then the extraction of image is done to get back the watermark image. This all is done under DWT technique. This paper simply reviews the DWT Technique , its enhancement, its challenges and also result analysis on MATLAB tool by calculating PSNR, SSIM and SSR values of extracted image.

Keywords— watermarking, DWT, PSNR, SSR, SSIM.

I. INTRODUCTION

Now-a-days use of internet is increasing day by day. With the fast advancement in technology, speed of data over networks has crossed the bars. There is urgent need to preserve the copyright of individual's creation, which is done by using digital image watermarking. There has been significant interest in watermarking in recent years mainly because of two reasons, one is digitization of documents and second is rapid and untroubled traffic over internet. Digital data offers many advantages and new potentials to the user. There is different type of digital watermarking such as picture, audio or video. Several different digital watermarks can be embedded in one signal(picture, audio or video) at that time, and if the signal is copied, then the existing information with it will also be copied and carried in the copy. This is all about digital image watermarking. This paper future is discussed on the wavelet based technique.

II. DESCRITE WAVELET TRANSFORM

Digital watermarking techniques can be classified into the spatial domain and frequency domain according to the domain used for embedding watermark. DWT is most important technique of Frequency (Transform) Domain Watermarking Frequency domain watermarking is more powerful than spatial domain technique due to embedding of watermark into the altered frequency coefficients of the transformed image.

Discrete Wavelet transform (DWT) is a mathematical tool for hierarchically breaking an image into three spatial directions, such as horizontal, vertical and diagonal. It is useful for processing of non-static signals. The transform is based on mini waves, called wavelets, of variable frequency and short duration. Wavelet transform provides both frequency and spatial description of an image. Wavelets are created by translations and dilations of a fixed function called main wavelet. This section inspects worthiness of DWT for image watermarking and gives advantages of using DWT as against other transforms.

Decompositions are shown as below**:**

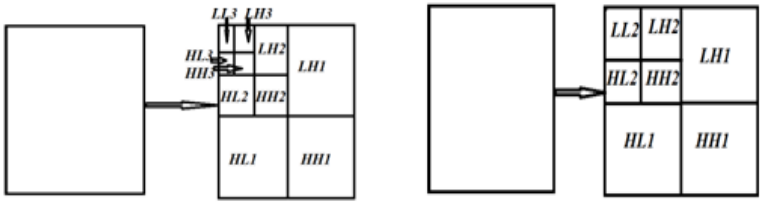

Fig.1 DWT decomposition at 3-level(left), 2-level(right)

Some of the beneficial characteristics of DWT are like

- High compression efficiency
- Error resilience and lossless color transformations
- Lossless encoding
- Embedded lossy to lossless encoding
- Better resolution and standard etc.

III. ENHANCEMENT OF DWT

In last few years there is a need of enhancement in the watermarking techniques for image security or others. This enhancement could be done by adding some techniques into exist techniques. For DWT some are given below:

A. SVD

SVD(single value decomposition): Singular value decomposition is a very powerful numerical analysis tool used to analyze the matrices. In this transformation, a matrix is decomposed into three matrices that should be of the same size as original matrix. SVD transformation maintains both non-symmetric and one-way properties, usually not obtainable in DCT and DFT transformations. Using SVD in digital image processing has advantages like the size of the matrices from SVD transformation is not fixed and can be a square or a rectangle; singular values in a digital image are less affected if general image processing is performed and singular values contain intrinsic algebraic features of image. The singular values of host image are remodeled to embed the watermark image by utilizing multiple singular functions. Watermark is embedded and extracted by adjusting value between selected coefficients and actual output trained by support vector regression we obtain. SVD factorization is done on different non-overlapping blocks by taking wavelet transform. Watermarks are originated by singular value of different block .

B. FUZZY LOGIC

Fuzzy Interface System (FIS): FIS is used to calculate the local variance of the particular image block. The evaluated variance is fed to the FIS. Every input is disputed of three membership functions min, medium, max based on the variance allocated among the subsets as smooth, slightly rough and rough, appropriately.The gain is due to the three membership functions. It is important to clear that this approach enables adjustment of gain so as to best matchup with the image properties. In order to calculate and acurate the amount of gain for a particular block, the fuzzy logic rules and the membership function were created, using intuition logic and some features of HVS. Some rules of fuzzy logic are:

1. If the image block is smooth i.e. having low variance, then the gain is minimum.
2. If the image block is slightly rough i.e. medium variance, then the gain is medium.
3. If the image block is rough i.e. high variance, then the gain is maximum.

D is calculated for the hybrid o/p set using a weighted average defuzzification method given by using equation

$$D = \sum Zj\ Cj \,/ \sum Zj$$

Where Cj is center of the subsequent set of rules j, and Zj is the extent to which rule is fired. It can be observed from the graph that gain varies according to the variance of the block.

C. SVM

Support Vector Machine (SVM) is a novel machine learning method introduced by Vapnik. SVM has been successfully applied to numerous classification and pattern recognition problems. SVM is claimed to lead enhanced generalization properties. In recent years, SVM has been used for digital watermarking. SVMs are easier and better to use than traditional neural network models. The idea of SVM is to construct a mapping model from input data to output data which are also defined as features for input data and targets for output data. There are two data sets in classification, i.e., training data and testing data. Each training data contains several features and one target. After SVM learns using the training data, SVM can produce a model to predict the corresponding target of the test data. Yuanhai Shao developed multiwavelet based digital watermarking with support vector machine technique

D. ANN

Artificial Neural Network (ANN) An artificial neural network (ANN) is a mathematical model or computational model that is inspired by the structure and/or functional aspects of biological neural networks. A neural network consists of an interconnected group of artificial neurons, and it processes information using a connectionist approach to computation. They are usually used to model complex relationships between inputs and outputs Chuan-Yu Chang et. al. [32] introduced copyright authentication for images with a full counter-propagation neural network (FCNN). Most attacks do not degrade the quality of detected watermark image as FCNN has storage and fault tolerance. Chen Yong Qiang devised an optimal image watermark algorithm using synergetic neural network. Quan Liu et. al. [33] designed and realized meaningful digital watermarking algorithm based on Radial Basis Function (RBF) neural network. RBF Neural network is used to simulate human visual system to determine watermark embedding intensity.

IV. REVIEW ON DESCRITE WAVELET TRANSFORM

- M. Barni et al. [11] have developed an improved wavelet-based watermarking through pixel-wise masking. It is based on masking watermark according to characteristics of HVS. The watermark is adaptively added to the largest detail bands. The watermark weighing function is calculated as a simple product of data extracted from HVS model. The watermark is detected by correlation. Victor et al. [12] have developed an algorithm that relies upon adaptive image watermarking in high resolution sub-bands of DWT. Weighting function is the product expression of data extracted from the HVS model.
- N. Kaewkamnerd and K.R. Rao [13] developed a wavelet based image adaptive watermarking scheme. Embedding is performed in the higher level sub-bands of wavelet transform, even though this can clearly change the image fidelity. In order to avoid perceptual degradation of image, the watermark insertion is carefully performed while using HVS. Bo Chen and Hang Shen [14] developed a new robust fragile double image

watermarking algorithm using improved pixel-wise masking model and a new bit substitution based on pseudo-random sequence. The method embeds robust and fragile watermark into the insensitive part and sensitive part of wavelet coefficients making two watermarks non- interfering.

- Peng Liu and Zhizhong Ding [15] proposed a blind image watermarking scheme based on wavelet tree quantization. The largest two coefficients are selected as significant coefficients and the difference between them is taken as significant difference. A watermark bit is embedded by comparing the significant difference with an average significant difference value and maximum difference coefficients are quantized. Zhao Dawei et al. suggested a chaos-based robust wavelet- domain watermarking algorithm. They apply wavelet transform locally and embed watermark based on chaotic logistic map.

V. RESULT ANALYSIS

Two images are considered for result analyzing the performance of proposed algorithm. Here first is the host image and second is watermark image which is a secret image. In fig.2 we have a host image which is a original color image.

Fig.2: original color image(host image) Fig.3: watermark image

In fig.3 we uses a watermark image which is used to embed in the original image. This is a secret image.
Result analysis by using DWT technique of image watermarking. Here this is a watermarked image i.e. secret image or a watermark image is embedded into original color image.

Fig.4: watermarked image by DWT Fig.5: Extracted watermark image

In Fig.5 the extracted watermark image is that which is the result of extraction process of DWT. Some parameters are calculated of this watermarked image listed in the below given table.

TABLE 1 CALCULATED PARAMETERS OF EXTRACTED IMAGE BY DWT

	Salt & pepper noise	**Poisson noise**
PSNR	21.6345	26.7208
SNR	18.2894	23.3758
SSIM	0.8415	0.8415

VI. CONCLUSION

Digital watermarking technique is processing very fast and various researches focused on various field field for security of data. This paper emphasizes dwt image watermarking techniques which concerned with security of image. And this paper reviews the DWT technique, its enhancement techniques and at last compute the parameters PSNR, SSR, SSIM with respect to the salt & pepper noise and Poisson noise

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