A LITERATURE STUDY OF ROBUST COLOR IMAGE WATERMARKING ALGORITHM

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Abstract: Digital Watermarking is a technology which is used to identify the owner, distributor of a given image. In recent years, digital watermarking plays a vital role in providing the appropriate solution and various researches have been carried out. In this paper, an extensive review of the literature related to the color image watermarking is presented together with compression by utilizing an assortment of techniques. The proposed method should provide better security while transferring the data or messages from one end to the other end. The main objective of the paper is to hide the message or a secret data into an image which acts as a carrier file having secret data and to transmit to the intention securely. The watermark can be extracted with minimum error. In terms of PSNR, the visual quality of the watermarked image is exceptional. The proposed algorithm is robust to many image attacks and suitable for copyright protection applications.

Key Words: Watermarking, Discrete wavelet transform, Discrete Cosine Transform, PSNR, MSE.

1. INTRODUCTION:

DIGITAL image watermarking has become a necessity in many applications such as data authentication, broadcast monitoring on the Internet and ownership identification. Various watermarking schemes have been proposed to protect the copyright information. There are three indispensable, yet contrasting requirements for a watermarking scheme: robustness, invisibility and capacity. Therefore, a watermarking scheme should provide a trade-off between these features [1].

Due to the advancement of digital multimedia tools the storage and distribution of multimedia content is become very easy. Issues on security have emerged and there is a vital need for protecting the digital content against counterfeiting, piracy and malicious maniple. **Watermark**--A visible or invisible signature embedded inside an image to show authenticity or proof of ownership. The hidden watermark should be inseparable from the host image, robust enough to resist any manipulations while preserving the image quality. Thus through watermarking, intellectual properties remains accessible while being permanently marked. This digital signature approaches use in authenticating ownership claims and protecting proprietary hidden information, discourage unauthorized copying and distribution of images over the internet and ensure a digital picture has not been altered [2].

In the past few years, several researches are performed in the digital watermarking by a huge number of researchers. In this paper, we present a comprehensive review of extremely important researches on Digital image watermarking together with their contrast enhancement. The popular literature existing in the digital image watermarking is categorised and reviewed comprehensively. Here, we present a wide-ranging review of image watermarking, which is robust against diverse attacks.

2.LITERATURE REVIEW:

Hamidreza Sadreazami et.al: Author's proposes "Multiplicative Watermark Decoder in Contourlet Domain Using the Normal Inverse Gaussian Distribution" A novel watermark decoder in the contourlet domain. It is known that the contourlet coefficients of an image are highly non-Gaussian and a proper distribution to model the statistics of the contourlet coefficients is a heavy-tailed PDF. The proposed watermark extraction approach is developed using the maximum likelihood method based on the NIG distribution. Closed-form expressions are obtained for extracting the watermark bits in both clean and noisy environments. Experiments are performed to verify the robustness of the proposed decoder. The results show that the proposed decoder is superior to other decoders in terms of providing a lower bit error rate. It is also shown that the proposed decoder is highly robust against various kinds of attacks such as noise, rotation, cropping, filtering, and compression [1].

Pratibha Sharma et. al: " Digital Image Watermarking Using 3 Level Discrete Wavelet Transform". In this paper author's presented digital image watermarking based on 3 level discrete wavelet transform (DWT) is presented & compare it with 1 & 2 levels DWT. In this technique a multi-bit watermark is embedded into the low frequency sub-band of a cover image by using alpha blending technique. Performance of method for different value of scaling factor is analyses & compare by using statistical parameters such as peak-signal-to-noise-ratio (PSNR) and mean square error (MSE) [2].

Zhao Jian et.al has proposed "A Watermark Technique Based On Extended Shearlet And Insertion Using The Largest Information Entropy On Horizontal Cone". Author's proposed the algorithm in which firstly, 1-level extended discrete shearlet transform decomposes the test image into directional components on horizontal cone; each directional component reflects directional features and textured features differently. Next, the directional component whose information entropy is the highest is selected to carry watermark. Compared with related algorithms based on DWT and DCT, the proposed algorithm tends to obtain preferable invisibility when it is robust against common attacks [3].

D.V.N.Koteswara Rao et.al has proposed a "ROBUST IMAGE WATERMARKING TECHNIQUE USING DCT & WAVELET PACKET DENOISING". Author proposed a joint DWT-DCT Transformation algorithm for digital image watermarking. Presented method is tested by most of the common image processing attack such as: different size of Gaussian filtering as an enhancement attack, adding salt and paper noise, scaling with two common factors: 50% and 75%, cropping, and compression attack. Specially, in case of adding noise and enhancement attack, proposed method show a significant improvement in robustness compare to previous DWT-DCT based method [4].

Mustafa Osman Ali et.al "INVISIBLE DIGITAL IMAGE WATERMARKING IN SPATIAL DOMAIN WITH RANDOM LOCALIZATION" author's implemented new algorithms for embedding and extracting watermark. Author's algorithm works on spatial domain of digital images where it can embed invisible watermark. A secret key is used to embed and extract watermark. The watermark, according to the secret key, locates in a random manor vertically or horizontally across the base-image [5].

AKHIL PRATAP SINGH et. al has proposed "WAVELET BASED WATERMARKING ON DIGITAL IMAGE". Author's proposed a robust watermarking technique based on DWT (Discrete Wavelet Transform) is presented. In author's proposed technique the insertion and extraction of the watermark in the grayscale image is found to be simpler than other transform techniques. Proposed watermarking technique on digital images based on discrete wavelet transform is analyzing by various factors like PSNR's and MSE's [6].

N.Koteswara Rao et.al has proposed a "TWO LEVEL DCT AND WAVELET PACKETS DENOISING ROBUST IMAGE WATERMARKING". Firstly apply block based DCT on this approximation image, then a pseudo random noise sequence is added into its high frequencies. For detection, we extract the approximation image from the watermarked image, then the same pseudo random noise sequence is generated, and its correlation is computed with high frequencies of the watermarked approximation image. In proposed method author's obtained the, higher robustness of embedding the watermark in low frequency. Robustness of the author's proposed technique against many common attacks such as JPEG compression, additive Gaussian noise and median filter is evaluated & Compared with related works, author's proposed method proved to be highly resistant in cases of compression and additive noise, while preserving high PSNR for the watermarked images [7].

Koyi Lakshmi Prasad et.al has proposed "A HYBRID LWT-DWT DIGITAL IMAGE WATERMARKING SCHEME USING LSVR AND QR-FACTORIZATION". In this proposed article author's present an efficient and hybrid approach that integrates features of lifted wavelet transform (LWT) and discrete wavelet transform (DWT) based on linear support vector regression (LSVR) and QR-factorization for watermarking. Precisely the integrated hybrid approach produces less distortion rate. The experimental results are analyzed with other models and offers high reliability on watermark embedding and authenticity along with less computational cost [8].

Kaiser J. Giri et.al has proposed "A ROBUST COLOR IMAGE WATERMARKING SCHEME USING DISCRETE WAVELET TRANSFORMATION". A number of schemes and algorithms have been proposed and implemented using different techniques. The effectiveness of the technique depends on the host data values chosen for information hiding and the way watermark is being embedded in them. However, in view of the threats posed by the online pirates, the robustness and the security of the underlying watermarking techniques have always been a major concern of the researchers. In this paper author's presents a secure and robust watermarking technique for color images using Discrete Wavelet Transformation. The results obtained have shown that the technique is robust against various common image processing attacks [9].

H. Sadreazami et.al has proposed: "A Robust Multiplicative Watermark Detector for Color Images in Sparse Domain": A blind multichannel multiplicative color image watermarking scheme in the sparse domain

is proposed. In order to take into account the cross correlation between the coefficients of the color bands in the sparse domain, a statistical model based on the multivariate Cauchy distribution is used. The statistical model is then used to derive an efficient closed-form decision rule for the watermark detector. Experimental results and theoretical analysis are presented to validate the proposed watermark detector. The performance of the proposed detector is compared with that of the other detectors. The results demonstrate the improved detection rate and high robustness against the commonly used attacks such as JPEG compression, salt and pepper noise, median filtering, and Gaussian noise [10].

D. Kannan et.al has proposed: "An extensive research on robust digital image watermarking techniques: a review" Digital watermarking is a probable solution for digital content owners that offer security to the digital content. In recent years, digital watermarking plays a vital role in providing the probable solution and numerous researches have been carried out. In this paper, an extensive review of the prevailing literature related to the image watermarking is presented together with classification by utilizing an assortment of techniques. In addition, a terse introduction about the digital watermarking is presented to get acquainted with the vital information on the subject of digital watermarking [11].

Chun-Shien Lu et.al has proposed: "Denoising and Copy Attacks Resilient Watermarking by Exploiting Prior Knowledge at Detector" methodology is to exploit prior knowledge available at the detector side and then use it to design a "nonblind" embedder. We prove that the proposed scheme can resist two famous watermark estimation-based attacks, which have successfully cracked many existing watermarking schemes. False negative and false positive analyses are conducted to verify the performance of our scheme. The experimental results show that the new method is indeed powerful [12].

Jayshri Patel et.al has proposed: "Efficient Reversible Watermarking Technique with Contrast Enhancement for Color Images" histogram bin shifting based reversible data hiding algorithm for color images has been proposed. In this technique binary bits are embedded directly by addition and subtraction in two highest bin chosen and this process is repeated in modified histogram. Embedding of binary secret data is done on the each color component (Red, Green, and Blue) of color images. Secret Binary data bits are embedded in random permutation manner to secure the data from unauthorized receiver. Extraction of embedded binary bits is done by inverse algorithm of embedding process & proposed algorithm provide high embedding capacity with low distortion of original quality of image which may be used in different medical, military and satellite application [13].

Ante Poljičak et.al has proposed: "The Influence of Image Enhancement Filters on a Watermark Detection Rate" image enhancement before detection not only improves overall detection rate, but also enables the use of higher threshold values, which in turn gives better detection performance with smaller probability of false positive detection. Furthermore, we conclude that unsharp filtering is more appropriate than blind deconvolution since it gives slightly better results with considerably faster computation. The type of enhancement filtering should be chosen according to the type of the attack on a watermarked image [14].

Hao-Tian Wu et.al has proposed: "Reversible image watermarking on prediction errors by efficient histogram modification" A reversible data hiding algorithm is proposed, in which the efficiency of modifying a pair of histogram bins is considered. Multiple pairs of histogram bins can be further selected for data embedding in sequence, while pre-process of pixel values is performed to prevent the possible overflow and underflow. Embedding with the prediction errors is investigated with a new prediction scheme. In each of the four prediction modes, a large amount of prediction errors can be produced from the host image. Moreover, all combinations of the four modes to generate a number of histogram pairs are enumerated to obtain the best performance. Blind extraction and recovery are enabled by embedding a pre-computed location map and other overhead information into the watermarked image. Promising experimental results are obtained on a variety of test images. Compared with the existing algorithms, the image content is better preserved in high payload data hiding [15].

Gou xin-ke et.al has propsoed: "Study on Algorithm of Digital Image Watermarking Based on DWT". Watermarking algorithm using digital watermarking technology based on the discrete wavelet (DWT) multi-resolution decomposition algorithm. Three-level wavelet decomposition is employed so that images are divided into three serial sub-graphs with high frequency band and one sub-graph with low frequency band. Since low-frequency information is more sensitive to human eyes than high-frequency information, watermarking is embedded into the high-frequency coefficients of the wavelet image. In our experiment, watermarking information is embedded into the original images by Matlab simulation [16].

Dr. H. B. Kekre et.al has proposed: "Robust Watermarking Technique using Hybrid Wavelet Transform Generated from Kekre Transform". This paper presents a novel image watermarking technique using Kekre's algorithm to generate hybrid wavelet transform DKT_DCT from Kekre transform and Discrete Cosine Transform. In the proposed technique, 256x256 hybrid transform is generated using 16x16 Kekre

transform and 16x16 DCT whereas, 128x128 hybrid wavelet transform is generated using 32x32 Kekre transform and 4x4 DCT matrix. Generated DKT_DCT transform is applied to host and watermark in three different ways: column wise, row wise and full transform. Performances of these three ways of applying transform are compared against various image processing attacks namely image cropping, image compression, adding noise and image resizing attacks [17].

Mehmet Utku Celik et.al has proposed: "Lossless Watermarking for Image Authentication: A New Framework and an Implementation" We present a novel framework for lossless (invertible) authentication watermarking, which enables zero-distortion reconstruction of the un-watermarked images upon verification. As opposed to earlier lossless authentication methods that required reconstruction of the original image prior to validation, the new framework allows validation of the watermarked images before recovery of the original image. This reduces computational requirements in situations when either the verification step fails or the zero-distortion reconstruction is not needed. For verified images, integrity of the reconstructed image is ensured by the uniqueness of the reconstruction procedure [18].

Pranab Kumar Dhar et.al : "An Efficient Image Watermarking System Based on Error Correcting Codes in DCT Domain" This paper proposes a new watermarking system for digital images using efficient systematic linear block codes (SLBC) in discrete cosine transform (DCT) domain. The proposed watermarking system using SLBC generates a code sequence of {0, 1} that provides error correction capabilities and then replaces it with a binary watermark sequence of {-1, 1}. This achieves more robust invisible image watermarks and requires a small storage unit for binary sequence numbers. The generated watermark sequence is then used as an input for our proposed watermarking system which consists of watermark embedding process and watermark detection process. Experimental results indicate that the invisible watermark embedded with the proposed system are very robust against various kinds of attacks such as white Gaussian noise, JPEG compression, median, and mean filtering, by showing similarity values ranging from 0.7 to 0.8 [19].

A.F.ElGamal et.al : "**Block-based Watermarking for Color Images using DCT and DWT**" . This paper presents the hybrid image watermarking algorithm for color images based on Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT). The cover image is converted from RGB color space into YCbCr color space, then the luminance component is partitioned into non-overlapping blocks of pixels according to the number of bits of the original watermark; and DCT conversion is performed for each block separately. After DCT transformation, the DWT is performed and vertical component, LH is taken out for embedding the watermark. Finally, the watermark information is embedded using new mathematical formula. Simulation results show that this method is imperceptible and robust with respect to a wide variety of conventional attacks like noise addition, filtering, cropping and JPEG compression [20].

Xiangguang Xiong et.al has proposed : "A New Robust Color Image Watermarking Scheme Based on 3D-DCT" .In this paper, for color image copyright protection application, a new and blind color image watermarking algorithm based on quantitation method in three dimensional discrete cosine transform (3D-DCT) is proposed. Firstly, the original RGB color image is divided into non-overlapping blocks sized $8 \times 8 \times 3$, and then performs 3D-DCT transform on each block. Secondly, embed a bit watermarking signal into each block's 3D-DCT direct-current (DC) coefficient by quantization method. The results show that the proposed scheme has very good imperceptibility and robustness against the common image processing attacks. Compared with similar algorithm, the proposed scheme has better robustness performance for most attacks [21].

Karnpriya Vyas et.al has proposed: "Implementation of Digital Watermarking Using MATLAB Software" Digital watermarking holds significant promise as one of the keys to protecting proprietary digital content in the coming years. It focuses on embedding information inside a digital object such that the embedded information is in separable bound to the object. The proposed scheme has been implemented on MATLAB, as it is a high level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numerical computation. We wanted to know about how one can embed information in an image such that he can later claim the ownership of that image by extracting back the embedded information. Hence, "copyright protection" of images was our main motivation in starting this project. This paper includes, Implementation of several watermarking algorithms and examines them in terms of how they meet the requirements of different applications and general requirements of watermarking [22].

Haweez Showkat et.al : " SVD-DWT Based Digital Video Watermarking Using Fused Images and Low-Middle Frequency Bands". In this paper we proposed a Graphical User Interface (GUI) based SVD-DWT Video Watermarking using Fused Images and Low-Middle frequency bands. In this work, two watermark images are used in fused manner using wavelet fusion. The basic approach used in this work is to utilize the benefits of Singular Value Decomposition (SVD) and Discrete Wavelet Transform (DWT). For embedding watermark Low and Middle frequency bands are used as they provide more robustness against geometric attacks such as cropping, rotation etc. The performance of the proposed algorithm has been evaluated using two parameters such as Peak Signal to Noise Ration (PSNR) and Correlation Coefficient (CC) under various noise attacks like Gaussian and

Salt & Pepper Noise attacks, geometric attacks – rotation and cropping. The simulation results shows that proposed method has better results as compared to SVD-DWT hybridization, DWT and SVD approaches [23].

3. PROBLEM FORMULATION:

The field of watermarking has undergone through research over the last few decades and lot of work has been reported in the paper. However the pace at which the multimedia data is increasing, there is definitely a need to have more secure & robust watermarking algorithms & techniques. The techniques presented so far are mostly utilizing gray scale images or monochrome digital content, however since most of the organizations and business concerns nowadays mostly use color data such as logos, tags and labels, which demands the equal focus towards the design of schemes for color data as well. After studying different approaches we still there is need of an approach which may provide better result i.e. reduces the mean square error (MSE) & high PSNR as compared to the other conventional algorithm.

Tab 1. Set of selected researches and their works.

S.NO	AUTHOR'S	EXISITING ALGORITHM	YEAR	PURPOSE	PERFORMANCE PARAMETER
1.	Hamidreza Sadreazami et.al[1]	Watermark Decoder using Contourlet Domain.	2016	Image Watermarking	PSNR, MSE
2.	Koyi Lakshmi Prasad et.al [8]	Hybrid LWT-DWT	2016	Digital image watermarking	PSNR, TAF
3	Zhao Jian et.al [3]	Extended Shearlet transform.	2015	Image watermarking	PSNR, MSE, BER
4.	Xiangguang Xiong et.al [21]	3D-DCT	2015	Watermarking	PSNR, MSE
5.	Pratibha Sharma et. al [2]	3 level discrete wavelet transform.	2013	Digital image watermarking	PSNR , MSE

4. PROPOSED WORK:

After analyzing several techniques we proposed technique first compress the message image by using the compression algorithm and then the compressed data is then embed into the cover image using the proposed watermarking technique we proposed a new novel watermarking technique with compression of color images by properly analyzing the image data to identify the significant portion of the image for embedding the watermark. Later on during the extraction phase, reverse process is used to extract the watermark. After that lossless compression watermarked image is obtained for high security. The proposed technique results are measured in terms of PSNR & MSE.

5. CONCLUSION:

Digital image watermarking with lossless compressed watermarked is a rising research area that has received great attention from the research community over the past decade. In this paper, a comprehensive survey of the significant researches and techniques existing for digital watermarking has been studied. Here, existing researches that are robust against attacks are analyzed. An introduction about the digital watermarking and its applications has also been presented and the existing researches are organized according to the techniques implemented. This survey paves the way to the budding researchers to know about the numerous techniques available for digital image watermarking & compression of color images. With the help of my proposed technique significantly hide the message or a secret data into an image.

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