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A Review of Different Secret Image Watermarking Technique

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***Abstract*— In this paper, we discussed several different techniques use on digital image watermarking.The enlargement of internet and availability of the network incomputer now adays provide facility of multimedia data during passing information over the transmission medium. In this regularly developing society of the internet if using the traditional digital image watermarking technology doesn't have the capability to provide security from intentionally or may unintentionally attacks. So multimedia data received conveniently without suffering the losses of information. The repercussion of these application create moderation and distribution of the illegal information easily for the uncertified parties. The technique of digital watermarking come into existence to vanquish these authentications issue. So watermarking is one of the solution come to salvage for protection from the unlawful operation like forgery, duplicity, modifying data content, copyright-violation. The digital based content can be protected by using watermarking. So digital watermarking is basically an embedding or hiding data technique. This data may in form of image, audio, text or video. In this paper we point two categories of digital image watermarking via spatial domain and frequency domain. We mainly focused to describe variety of techniques applied on digital image. The comprehensive set of experimental results through variety of the watermarking techniques on digital image, which is showing that their proposed method has superiority and provide improved performance of the watermarking algorithms in comparison with the previously proposed methods. These approaches having the ability to withstand against variety of image processing attacks such as salt and pepper noise, JPEG compression, Gaussian noise, some filtering attacks as median filtering, Conv filtering (Gaussian filtering and sharpening), some geometric structure distortion attacks as bending cropping, resizing and rotating. These schemes output performed to measure imperceptibility and its Robustness with Signal to Noise Ratio (PSNR) and Normalized Cross Correlation (NCC) values.**

***Index Terms*— image watermarking , PSNR, Gaussian filtering.**

I. INTRODUCTION

The digital watermarking (data hiding) [15][16][18] is a concept to inserting or hiding the information as a copyright. This information's in a digital file such as video, image, text and audio etc. in a manner that it should not create degradation in real host image without discernible changes in the file itself. It pinched a lot of attention [19][20]as a solution of several problems.Many of the methods were already put forward to increase the required quality factor of the watermark data. Now researches start to utilize evolutionary techniques for this digital based watermarking [40][41]. Because of expeditious enlargement of personal digital based data over internet medium. The planting activity of supplementary statistics into an image to build assertion about the image. These extra statics is known as a watermark. Approaches on the technique of watermark is introduced in [21]. The digital content will remain safe by using watermark[22][44]. This is because of the application of the digital image watermarking such as authenticity of the data and copyright, identification of the original user, protection from delicacy and automated monitoring [22]. The watermarking technique can be categorized into two domains, one is spatial and another one is frequency domain. The strength of the watermark as robust, semi-fragile and fragile. The visibility of the watermark as blind or Non-blind [21], transparency, capacity to hide data, payload of watermark, robustness are the requirements of the watermark.It is now very susceptible to being a copy by duplicate owner and after copying it become difficult to separate copied content from the real image. Its identification code may be invisible or visible type, from the both types the visible type of the watermark can be remote without difficulty from the main cover of the digital image[49]. But remote the invisible type of the watermark is very difficult from the cover of the digital image. This feature of the invisible watermark due to the integral multiple component of the host image after inserting watermark.

In transformation domain the adopted technique of watermarking is Discrete Wavelet Transform (DWT) [2][13][24],Discrete Fourier Transform (DFT) [29], Discrete Cosine Transform (DCT) [25][26] and Singular Value Decomposition (SVD) [27][28][30][33] Fast Fourier Transform (FFT), Curve Let Transform (CT), Counter Let Transform (CLT) etc. But utilizing DWT and SVD concept rather than any other concept are known to have gained more popularity [31]. When this transformation applied the watermarked data are inserted in the transformed coefficient of the real image. Then the watermark data finial recovered by utilizing inverse transformation of these coefficient.For the strong protection against the unwanted copyright several methods are now using with best possible security for digital products like image, video, data or audio significantly [1].The robustness may increase threw introducing in low valued coefficient with respect to all attacks. The main motive of digital image watermarking to insert watermark information with better imperceptibility as well as robustly on the cover image.This paper is discussed into following sections. In II section we point categories of thedigital image watermarking. In III section we point the requirements, applications and attacks of digital image watermarking. In IV section different technique of watermarking discussed. Then we conclude this paper in section V.

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II. CATEGORIES OF DIGITAL IMAGE WATERMARKING

Algorithm ofwatermarking are categorized into spatial domain and frequency domain technique.

A. Spatial Domain Technique

In this domain technique the required watermark is designed on the original cover image by modifying its characteristics or pixels [35] i.e. to inset the watermark into Least Significant Bit (LSBs) of the host image. It is simple to implement but it become fain under some image processing attacks as rescaling, compression, cropping etc.

- *Frequency Domain Technique*

In frequency domain, the watermark is inserted into the transformed coefficient of the host image after applying DCT, DFT and DWT or combined DWT-DCT [37]. In comparison to the spatial domain, this frequency domain is more effective and having more robustness [36].

III. APPLICATION, REQUIREMENTAND ATTACKS OF DIGITAL IMAGE WATERMARKING

In this section we introducing the review of some common application, requirement and attacks on watermark[18].Digital based content can be safe by watermarking [22][44].

A. *Application*

Some applications of watermark are

- Original Owner Identification

The traditional form of identification of real ownership was visual mark can be easily copied but now invisible watermark using to overcome this issue of fake watermark.

- Publication Monitoring & Copy Control

Tracking of illegal distribution is possible because the real owner can be recovered by unique data in watermark.A significant role is played by digital based image in the age of information technology [6].

- Monitor Broadcasting

It can confirm the content which is supported to transmit [21][38].

- Fingerprinting

Set of fingerprint hosted in a single image.

- Temper Detection

Fragile watermark is now using for temper detection.

- Copyright Protection

In situation of fake ownership this watermark used as evidence.

- Medical Purpose

The designing of watermark which contain all necessary information of patients is possible [39].

- **Image or Content Authentication & Description**

The inserted watermark contain detailed information as labeling & captioning etc. [14][34][47].

- Convert Communication

By embedding unique image secretly exchanging of message is possible.

B. *Requirements*

The inserted watermark has to provide some common requirements as

- Robustness

It shows the resistance ability against various attacks. If the watermark designed under low frequency component of the image, it should be much robust against geometric distortion, filtering and compression. If watermark build under high frequency component, it should be with-stand against gamma correction, brightness adjustments, cropping and histogram equalization [21].

- Perceptual Transparency

It should be imperceptible to human eyes & its quality doesn't affect under signal processing attacks [8].

- Non-Blind versus Blind

Non-blind utilize both the secret key & original image, Blind utilize secret key, Semi-Blind utilize bit sequence of watermark & secret key.

- Payload

It should be enough for retrieval of the inserted watermark[45].

- Capacity

It showing majority of information contained by watermark[5].

C. *Attacks*

The attacks can be categorized into two form as

I. Intentionally: It is applied with exact aim of destroying or copy the secret information.

II. Unintentionally: It impaired by processing the data by mistake such as compression or enhancement the image [3].

Some types of attacks are:

- Geometric Attack

It include affine transform [12] as scaling, rotation and translation. Mosaic attacks and Pixel jittering etc.

- Cryptographic Attacks

It deal with cracking the security of unique data, it includes oracle attacks. For hiding information of multimedia content using digital image watermarking is very useful way associated with trouble of copyright protection [7].

- Removal & Interference Attacks

It include compression, de-noising, quantized noise, re-modulating, collusion noise storms and averaging image.

- Simple Attacks

It include cropping, addition of noise and conversion into analog or wavelet based compression.

- Protocol Attacks

It contain IBM attacks which are known as inversion, fake to original attacks, deadlocks.

- Disabling Attacks

It is used for destroy correlation between watermarked & original image. It includes cropping, geometric attacks, rotation at fix point and insertion of pixel in image.

IV. DIFFERENT TECHNIQUE ON DIGITAL IMAGE WATERMARKING

In this section we discussed some recent researches briefly which are applied on the digital image watermarking as Literature Study.

Huailin Dong et. al[1] in 2015 put forward a discrete wavelet transform, discrete cosine transforms with singular value decomposition based optimized watermarking technique. The resultant by the multiplication of the left singular vector values and a matrix with the singular valued type matrix of its binary watermark data. These resultant are inserted into the resultant from the multiplication of the same left side singular vectored value with the DCT based matrix singular values. These matrices are related to the coefficient of the LL3 sub-band from the host image by using the concept of MSFs (Multiple scaling factors).

By utilizing chaotic firefly algorithm which have logistic map with objective type functions, the MSF is optimizing. These functions are actually linear combination of the required term like robustness and imperceptibility. Now the researchers start using an evolutionary algorithm for watermarking such as Genetic Algorithms (GA) [40][41], algorithms of Particles Swarm Optimization (PSO) [10] and bacteria foraging optimization algorithm [42] etc. So it is now not a big deal to get that evolutionary algorithm which is using to resolve the issues related to the optimization MSFs [43]. This paper provide the solution of the issue related to joining SVD with micro-genetic algorithm and lead to false positive rate [Z-12]. So this technique can be proved its robustness against 8 various image processing related operations.

Ramandeep Kaur et. al [9] in 2014 has been presented an exhaustive survey on the several digital image watermarking techniques based on usually DCTR, DWT and hybridization with the concept of SVD. After this survey it is concluded that a bulk of researches is going on this hybridizing the transformation techniques with SVD field. Some model likes in DWT-SVD, DCT-SVD and DCT-DWT-SVD are scout in prospect to decrease the mean square error and increasing the required PSNR values in between original and watermarked image. Sufficient exploration has been done already and still running in the spreading field. Things like analysis of the principle component, extracting features related to the hybridization transformation etc. still growing to improve the performance parameter.

HinaSaxena et. al[48] in 2014 use DWT-DCT-SVD based scheme with semi-blind reference algorithm of digital watermark. A trigonometric function is using to progress of this algorithm. This scheme can be withstanding in opposition to the various attacks related to processing an image. To correlated the singular value of the real image and the watermark contend image, this trigonometric functions are useful.

Firstly, a concept of DWT is put in on the real host image to spilt it into 4 different frequency bands as LL, LH, HL and HH. Then because of the higher frequency, the singular values of the coefficient of DCT transformed image is being revise by utilizing the singular values of the coefficient of the DCT transformation but for watermarked image now. Then this revision utilization to redesign the watermarked host image to give a proof of its authentication, the recovery process is applied on the same watermarked image using inverse SVD.

Y. Shantikumar Singh et. al[4] in 2013 present a survey on DCT, DWT and SVD hybridization techniques on the digital image watermarking. In this paper spatial and frequency domain are two methods mainly described. In spatial domain, by changing the pixel values of the original host image watermark can be designed. In frequency domain, the watermark is designed into the transformed coefficient of the host image. From both of the domain the spatial domain is very simple during its implementation time whereas the frequency domain provides more robustness and hiding capacity in apposite to the several attacks. So a detailed survey on different techniques for digital image watermarking is found in this paper.

Any Tun et. al [7] in 2013 put forward an effective solution to shielding from unauthorized reproduction of the digital multimedia data. On LWT (Lifting Wavelet Transform) and DCT based new digital image watermarking technique is proposed in it to preserve copyright of image. To decomposition of the real image into 4 different sub-bands. Firstly, LWT is put in an application then DCT is evaluated on the sort out sub-bands of LWT coefficient. Now the watermark is implanted in this DCT component of the chosen LWT sub-band of the original cover image.

Keta Raval et.al [3] in 2013 proposed a DCT-DWT based transformation algorithm for digital image watermarking. To build it firstly, the image taken as watermarked image is decomposing by using DWT concept and then pick the suitable frequency band to insert watermark in it. Then DCT put in for resembling and remodeling in its real form. Now fix it on particular position to make the complete image IDCT and IDWT transformed to achieve the watermarked image. Same procedure applied for recovery of the watermark but now the image is real host image.

ArisMarjuni et. al [6] in 2013 put forward an improved DCT based scheme with FWHT (Fast Walsh Hadamard Transform) for authenticating the image. In this scheme before put in DCT coefficients FWHT is applied first for high visual quality of the watermarked image low signal coefficients are expected. It is discovered that depending on the level distortion the watermark can be improved.

Nallagarla Ramamurthy et. al[5] in 2012 provide comparison between two novel approaches to build watermark image into the real host image using the quantization concepts. Which are related to the BPNN (Back Propagation Neural Network) and DFIS (Dynamic Fuzzy Interference System). To insert and recover the watermark and to use the weighting function for same the BPNN and DFIS is utilizing respectively. Against the image processing attacks like salt & pepper noise, rotating the image, filtering

and JPEG compressing attacks etc. this algorithm proved its robustness as well as imperceptibility.

Xiangui Kang et. al[12] in 2003 provide a composite image based watermarking technique on blind based DWT-DFT algorithm. Which can be withstand in apposite to the affine transformation as well as JPEG compression attacks. 2-D interleaving with synchronization method as a newly watermark inserting strategy is utilized in this paper to get better robustness.

Comparison of different algorithms with their intrinsic features, variety of embedding & extraction technique on digital image watermarking listed in this Table-I

Table-I: Variety of Algorithms on Digital Image Watermarking Scheme.

Reference No.	Researchers	Year	Methodology	Results	
				PSNR (dB)	NCC
1	Huailin Dong et. al	2015	DWT-DCT-SVD and Chaotic Firefly Algorithm	50.73	1.00
2	Ayesha Shaik et. al	2015	SVD Decomposition &Tabu-Search	51.05	0.99
48	HinaSaxena et. al	2014	DWT-DCT-SVD using Trigonometric functions	53.56	0.99
7	Amy Tun et. al	2013	Combined LWT-DCT method	46.76	0.97
3	Keta Raval et. al	2013	DCT-DWT Algorithm	21.04	0.90
6	ArisMarjuni et. al	2013	FWHT-DCT Scheme	21.43	0.84
49	Chunto Wang et. al	2012	Hidden Markov Model in Wavelet Domain based Watermarking	38.40	0.99
33	Chin-Chin Lai et. al	2010	DWT-SVD Decomposition based Watermarking	51.14	0.93
46	Ning Bi et. al	2007	Multiband Wavelet & Empirical Mode Decomposition based Watermarking	45.00	BER-3.89
8	Kyung-Su Kim et. al	2007	DWT-SVD based Blind Image Watermarking	41.06	0.78
12	Xiangui Kang et. al	2003	DWT-DCT Composite based Watermarking	42.50	0.73
47	Yiwei Wang et.al	2002	Wavelet based Watermarking	41.80	0.98

Ayesha Shaik et. al[2] in 2015 put forward a new watermarking scheme based on Tabu Search. The meta-Heuristic concept is called as Tabu Search. In this concept for designing and building the watermark image, changing the singular value of the original image data by utilizing MSFs (Multiple Scale Factor). This building process has been done on the diagonal matrix rather than on the one constant value. By utilizing Tabu Search, these multiple scaling factor obtained in this paper. This Tabu Search is also helpful for discovery of the optimal scaling factor associated with anti-cycling type memory under various attacks related to the image processing operation like JPEG compression, rotating watermark data on real image and average or medium filtering. All these experiment are executed on the data set of standard benchmark exhibit this presented algorithm and Walsh Hadamard Transform [32]. This Meta-Heuristic based Tabu Search proved its robustness and it get correlation value very close to 1 (almost similar) by comparing the watermark containing image to the watermark recovered image. So it demonstrates its better performance compared to the recently reported similar schemes.

Ning Bi et. al [46] introduced a multiband wavelet transformation and empirical mode decomposition based watermarking technique with blind image concept. In the traditionally used watermarking technique the two-band type of wavelet transformation concept is used in which on the coefficients of the wavelet, the selected bits of the watermark are inserted directly. But in this presented paper on the mean trend of the sub-image, the middle frequency in the wavelet domain is selected to inserting the required bits of the watermark. To obtain more robustness as well as perceptually invisibility in the form of its performance, selected suitable multiband wavelet transformation filter and required dilation factor. So it is analyzed that in front of currently announced watermarking algorithm. It expressed better performance.

CONCLUSION

In this paper, we have reviewed some of recent schemes, many watermarking schemes with their intrinsic feature, inserting and extraction forms are briefly described in section IV which revealed some advantages by using DCT, DWT, DFT and SVD for digital image watermarking. Categories of digital image watermarking are briefly described in section II. Along with these, some applications, requirements and types of attacks have been presented in section III. So there is large amount of literature for digital based watermarking, which showing some approaches tends to decrease noise and provide security to the secret data for purpose of fulfill required applications. We revealed the fact that the content of the host image utilizing to provide better invisibility and robustness to the scheme. It is concluded that from the above observation several model of digital image watermarking in DCT, DWT, DFT and SVD along with joint DCT-SVD, DWT-SVD and DCT-DWT-SVD domain are utilizing to minimize the mean square error and give improved PSNR, NCC values in order to enhance the performance.

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