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A Secure and Robust Image Watermarking Technique Based on DWT-DCT and Implemented Various Attacks on it

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ABSTRACT: Digital watermarking is the technique for hiding digital information in any type of form of multimedia data like image, audio, video, etc. Digital watermarks are basically used for the purpose of verifying the integrity and genuineness of multimedia information and also used to avoid fraud and forgery. In this paper, we explain an hardly noticeable and a robust DWT-DCT digital image watermarking technique. The technique watermarks a given digital image by the process of a Discrete Wavelet Transform (DWT) and the Discrete Cosine Transform (DCT).Also, different types of attacks has been applied on the watermarked image in order to examine the robustness of the algorithm. Performance analysis results show that the two technique enhanced the performance of the image.

KEYWORDS: Digital Image Watermarking, Image Copyright Protection, Frequency-Domain, Discrete Wavelet Transform (DWT), Discrete Cosine Transform (DCT),Attacks.

I. INTRODUCTION

The growth of efficient digital image copyright protection technique has recently become an vital and compulsory requirement in the multimedia field due to the ever-increasing illegal operation and reproduction of original digital objects. The new technology of digital watermarking has been investigated and advocated by a lot of specialists as the best technique for such type of multimedia copyright safety difficulty. It is expected that digital watermarking have been a wide-span of practical applications for example medical imaging, image databases, and video-on-demand systems and many more [1].

Basically, Domain of watermarking method is classified into two parts based on spatial domain and another is on the basis of frequency domain [2]. In spatial domain watermarking, the watermark or secret data is embedded by modifying or changing the pixels value of the cover image directly. The benefit of the spatial domain techniques is that they can effortlessly apply to every image [3]. In other way, the major advantages of pixel based technique are that they are conceptually so simple and as well as have low computational complexities and so are broadly used in Image watermarking where real-time presentation is a main concern. Though, they also consists some of main limitations. The necessity for absolute spatial synchronization has lead to high susceptibility to de-synchronization attacks; and watermark optimization is hard by using only spatial analysis method. In frequency domain watermarking the watermark or secret data is embedded for the robustness of the watermarking method. There are basically three major technique of data transmission in frequency domain as Discrete Cosine Transform, Discrete Fourier Transform and Discrete Wavelet Transform. The main strong point offered by transforming domain method is that they can also take the benefit of special properties of alternating domains to address the limits of pixel-based technique. Normally, transform domain technique need higher computational time. In transform domain technique, the watermark is embedded distributive in on the whole domain of an original information. Cover Image is first transformed into

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frequency domain by transformation method. The transformed domain coefficients are then changed to store up the watermark data. The inverse transform is lastly applied to get the watermarked Image [4].

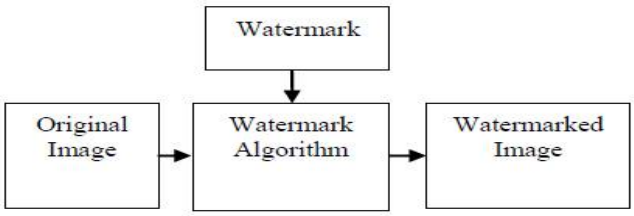

Figure 1: Diagram of a watermarking Technique [5]

II. RELATED WORK

In the year of 2011 [6] **Peng Zheng, Weihua Wang, Juan Wang** proposed a hybrid watermarking technique combining a robust and a fragile watermark, and therefore joining copyright security and content verification. As a consequence this approach is as well as at the same time resistant in opposition to tampering and copy attacks. Their contribution is setting up the connection in between fragile watermark and robust watermark. They take use of DCT coefficients to insert watermark data. The experimental outcomes show that their proposed method can resist tamper as well as copy attacks at the same time.

In the year of 2012 [7] **Navnidhi Chaturvedi, Dr. S. J. Basha** proposed the two methods, one is DWT and another technique is DWT-DCT. On contrasting both techniques they get the PSNR value for DWT that is 51.466dB & for other technique which is DWT-DCT, the PSNR value they find is 58.39dB. So they have concluded that DWT-DCT method is better than DWT technique only.
In the year 2016, **P.Srilakshmi ,Ch.Himabindu** [8] shares the interesting thoughts on Image watermarking with path based selection using DWT & SVD. In this paper, the robustness of the proposed methodology has been verified over a variety of attacks (speckle noise, salt & pepper noise, brightness, Gaussian noise, rotation & contrast) has been verified.
At last, In the year of 2016 [9] **Maruturi Hari Babu Ch. Hima Bindu, K.Veera Swamy** proposed a technique that is "A secure and Invisible Image Watermarking Scheme Based on Wavelet Transform in HSI Color Space". The proposed method is confirmed with a variety of resolutional images. According to this paper I have made my research problem in my work and improved the image quality. I have also checked the robustness of Watermarked Image by adding noise like Salt and Pepper, Speckle Noise,Gausssian Noise, Brightness and measure the different Parameters like PSNR, MSE, SSIM, MAE, PCC, IQI etc.

III. PROPOSED METHODOLOGY

In proposed methodology we have used DWT technique on Host image and DCT technique is applied on secret image.The host image is RGB image so it has been separated into R, G, and B channel. The cover image is gone through two level of DWT decomposition and then embedding algorithm is used and at last, gray scale DCT operated secret image has been embedded in R, G, and B channel. The original image, Watermark image ,Watermarked image and its extracted image has been shown in figure 2 below respectively. In below figure (a) is Lena, (b) is Pepper,(c) is Greens, (d) is Trees, (e) is Fabric and (f) is cameraman image.

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Figure 2: (a)- (e) Cover Images; (f) Watermark image;(g)-(p) are DWT-DCT watermarked images and its extracted images respectively

IV. EXPERIMENTAL RESULTS

For testing the performance of this DWT-DCT proposed algorithm ,the experiments result is simulated with the software MATLAB (R2017a). In the following experiments, RGB image with size of "Lena.jpg" (512*512) is used as cover image to embed with watermark image "cameraman.jpg" (256*256).The PSNR obtained for Lena image is 97.8140 and MSE is 1.0757e-05 and for Pepper, PSNR and MSE are 116.5815 and 1.4287e-07. Then the watermarked image is experienced with different types of attacks such as Salt and Pepper noise, Speckle Noise, Gaussian Noise and Brightness with PSNR ,MSE and some other parameter results are shown in table1 to table 14. Figure 3 shows different types of attacks on watermarked image and its extracted image of cameraman.

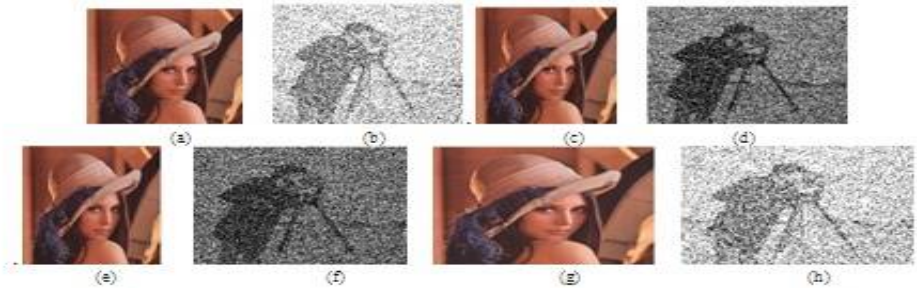

Figure 3: Attacks and Extracted Image (a)-(b) Salt and Pepper noise with density 0.001 and its Extracted image (c)-(d)Speckle noise with density 0.3 and its Extracted image(e)-(f) Gaussian noise with density 0.05 and its Extracted image (g)-(h) Brightness effect with 10 and its extracted image

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TABLE 1:PERFORMANCE PARAMETER OF DWT-DCT AFTER SALT AND PEPPER ATTACK WITH DENSITY OF 0.001

	Performance Parameter of Proposed Methodology								
Images	**PSNR**	**MSE**	**FSIM**	**SNR**	**IQI**	**SSIM**	**MAE**	**PCC**	**Robustness**
Lena	220.2052	6.2024e-18	0.9709	-4.6267e-04	0.9998	0.9414	6.9443	7.8145e+05	0.9981
Greens	220.5073	5.7857e-18	0.9441	-0.0846	0.9967	0.8963	20.6063	7.6187e+05	0.9864
Pepper	213.6583	2.8006e-17	0.9870	-0.0026	0.9933	0.9788	3.3747	7.8568e+05	0.9995
Trees	220.4693	5.8365e-18	0.9606	-0.0240	0.9951	0.9361	11.1779	7.8157e+05	0.9977
Fabric	220.1316	6.3085e-18	0.9383	-0.0064	0.9980	0.9121	17.5936	7.6598e+05	0.9928

TABLE 2:PERFORMANCE PARAMETER OF DWT-DCT AFTER SALT AND PEPPER ATTACK WITH DENSITY OF 0.01

	Performance Parameter of Proposed Methodology								
Images	**PSNR**	**MSE**	**FSIM**	**SNR**	**IQI**	**SSIM**	**MAE**	**PCC**	**Robustness**
Lena	203.6987	2.7747e-16	0.9709	-4.6096e-04	0.9998	0.9414	6.9444	7.8145e+05	0.9981
Greens	205.2711	1.9318e-16	0.9441	-0.0846	0.9928	0.8963	20.6065	7.6187e+05	0.9864
Pepper	200.1972	6.2139e-16	0.9870	-0.0026	0.9911	0.9788	3.3751	7.8568e+05	0.9995
Trees	204.1197	2.5183e-16	0.9606	-0.0240	0.9960	0.9361	11.1780	7.8157e+05	0.9977
Fabric	205.0221	2.0458e-16	0.9383	-0.0064	0.9980	0.9121	17.5936	7.6598e+05	0.9928

TABLE 3:PERFORMANCE PARAMETER OF DWT-DCT AFTER SALT AND PEPPER ATTACK WITH DENSITY OF 0.1

	Performance Parameter of Proposed Methodology								
Images	**PSNR**	**MSE**	**FSIM**	**SNR**	**IQI**	**SSIM**	**MAE**	**PCC**	**Robustness**
Lena	190.9244	5.2558e-15	0.9709	-4.6547e-04	0.9998	0.9414	6.9451	7.8145e+05	0.9981
Greens	190.9232	5.2572e-15	0.9441	-0.0846	0.9936	0.8963	20.6062	7.6187e+05	0.9864
Pepper	189.6073	7.1178e-15	0.9870	-0.0026	0.9907	0.9788	3.3778	7.8568e+05	0.9995
Trees	191.2680	4.8560e-15	0.9606	-0.0240	0.9950	0.9361	11.1784	7.8157e+05	0.9977
Fabric	190.7649	5.4524e-15	0.9383	-0.0064	0.9985	0.9121	17.5938	7.6598e+05	0.9928

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TABLE 4:PERFORMANCE PARAMETER OF DWT-DCT AFTER SALT AND PEPPER ATTACK WITH DENSITY OF 0.5

	Performance Parameter of Proposed Methodology								
Images	**PSNR**	**MSE**	**FSIM**	**SNR**	**IQI**	**SSIM**	**MAE**	**PCC**	**Robustness**
Lena	180.6667	5.5772e-14	0.9709	-4.6371e-04	0.9998	0.9413	6.9488	7.8145e+05	0.9981
Greens	180.8135	5.3918e-14	0.9441	-0.0846	0.9977	0.8963	20.6066	7.6187e+05	0.9864
Pepper	180.5060	5.7874e-14	0.9870	-0.0026	0.9949	0.9787	3.3848	7.8568e+05	0.9995
Trees	0.9977	5.5015e-14	0.9605	-0.0240	0.9943	0.9361	11.1799	7.8157e+05	0.9977
Fabric	180.6574	5.5890e-14	0.9383	-0.0064	0.9991	0.9121	17.5946	7.6598e+05	0.9928

TABLE 5:PERFORMANCE PARAMETER OF DWT-DCT AFTER SPECKLE NOISE DENSITY OF 0.3

	Performance Parameter of Proposed Methodology								
Images	**PSNR**	**MSE**	**FSIM**	**SNR**	**IQI**	**SSIM**	**MAE**	**PCC**	**Robustness**
Lena	180.5082	5.7845e-14	0.9709	-4.6792e-04	0.9998	0.9413	6.9491	7.8145e+05	0.9981
Greens	180.4933	5.8043e-14	0.9441	-0.0845	1.0235	0.8963	20.6071	7.6187e+05	0.9864
Pepper	180.3176	6.0439e-14	0.9869	-0.0026	0.9949	0.9787	3.3846	7.8568e+05	0.9995
Trees	180.6477	5.6016e-14	0.9605	-0.0240	0.9934	0.9360	11.1801	7.8157e+05	0.9977
Fabric	180.6038	5.6585e-14	0.9383	-0.0064	0.9987	0.9121	17.5953	7.6598e+05	0.9928

TABLE 6:PERFORMANCE PARAMETER OF DWT-DCT AFTER SPECKLE NOISE DENSITY OF 0.5

	Performance Parameter of Proposed Methodology								
Images	**PSNR**	**MSE**	**FSIM**	**SNR**	**IQI**	**SSIM**	**MAE**	**PCC**	**Robustness**
Lena	180.0872	6.3732e-14	0.9709	-4.6976e-04	0.9998	0.9412	6.9483	7.8145e+05	0.9981
Greens	180.2326	6.1634e-14	0.9441	-0.0845	1.0182	0.8963	20.6073	7.6187e+05	0.9864
Pepper	179.8521	6.7278e-14	0.9870	-0.0026	0.9921	0.9787	3.3838	7.8568e+05	0.9995
Trees	180.3421	6.0100e-14	0.9605	-0.0240	0.9968	0.9360	11.1803	7.8157e+05	0.9977
Fabric	180.0657	6.4049e-14	0.9383	-0.0064	0.9971	0.9121	17.5957	7.6598e+05	0.9928

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TABLE 7 :PERFORMANCE PARAMETER OF DWT-DCT AFTER SPECKLE NOISE DENSITY OF 0.01

	Performance Parameter of Proposed Methodology								
Images	**PSNR**	**MSE**	**FSIM**	**SNR**	**IQI**	**SSIM**	**MAE**	**PCC**	**Robustness**
Lena	180.2972	6.0724e-14	0.9709	-4.6904e-04	0.9998	0.9412	6.9481	7.8145e+05	0.9981
Greens	180.5129	5.7782e-14	0.9441	-0.0845	1.0231	0.8963	20.6072	7.6187e+05	0.9864
Pepper	180.1849	6.2315e-14	0.9870	-0.0026	0.9922	0.9787	3.3831	7.8568e+05	0.9995
Trees	180.6236	5.6327e-14	0.9605	-0.0240	0.9959	0.9360	11.1801	7.8157e+05	0.9977
Fabric	180.3897	5.9444e-14	0.9383	-0.0064	0.9971	0.9121	17.5956	7.6598e+05	0.9928

TABLE 8 :PERFORMANCE PARAMETER OF DWT-DCT AFTER GAUSSIAN NOISE DENSITY OF 0.05

	Performance Parameter of Proposed Methodology								
Images	**PSNR**	**MSE**	**FSIM**	**SNR**	**IQI**	**SSIM**	**MAE**	**PCC**	**Robustness**
Lena	180.9406	5.2363e-14	0.9709	-4.6751e-04	0.9998	0.9413	6.9482	7.8145e+05	0.9981
Greens	180.9175	5.2642e-14	0.9441	-0.0845	1.0212	0.8963	20.6071	7.6187e+05	0.9864
Pepper	180.6312	5.6229e-14	0.9870	-0.0026	0.9914	0.9787	3.3820	7.8568e+05	0.9995
Trees	180.9521	5.2224e-14	0.9606	-0.0240	0.9956	0.9360	11.1800	7.8157e+05	0.9977
Fabric	180.9519	5.2226e-14	0.9383	-0.0064	0.9971	0.9121	17.5957	7.6598e+05	0.9928

TABLE 9 :
PERFORMANCE PARAMETER OF DWT-DCT AFTER GAUSSIAN NOISE DENSITY OF 0.1

	Performance Parameter of Proposed Methodology								
Images	**PSNR**	**MSE**	**FSIM**	**SNR**	**IQI**	**SSIM**	**MAE**	**PCC**	**Robustness**
Lena	181.5206	4.5816e-14	0.9709	-4.6499e-04	0.9998	0.9413	6.9480	7.8145e+05	0.9981
Greens	181.7423	4.3536e-14	0.9441	-0.0845	1.0219	0.8963	20.6072	7.6187e+05	0.9864
Pepper	181.1881	4.9462e-14	0.9870	-0.0026	0.9924	0.9787	3.3816	7.8568e+05	0.9995
Trees	181.5432	4.5578e-14	0.9606	-0.0240	0.9947	0.9360	11.1799	7.8157e+05	0.9977
Fabric	181.5573	4.5431e-14	0.9383	-0.0064	0.9965	0.9121	17.5957	7.6598e+05	0.9928

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TABLE 10 :PERFORMANCE PARAMETER OF DWT-DCT AFTER GAUSSIAN NOISE DENSITY OF 0.5

	Performance Parameter of Proposed Methodology								
Images	**PSNR**	**MSE**	**FSIM**	**SNR**	**IQI**	**SSIM**	**MAE**	**PCC**	**Robustness**
Lena	184.6861	2.2104e-14	0.9709	-4.6276e-04	0.9998	0.9414	6.9468	7.8145e+05	0.9981
Greens	185.0381	2.0383e-14	0.9441	-0.0845	0.9887	0.8963	20.6074	7.6187e+05	0.9864
Pepper	183.7604	2.7355e-14	0.9869	-0.0026	0.9916	0.9788	3.3768	7.8567e+05	0.9995
Trees	184.6792	2.2139e-14	0.9605	-0.0240	0.9960	0.9360	11.1796	7.8157e+05	0.9977
Fabric	184.8109	2.1478e-14	0.9383	-0.0064	0.9995	0.9121	17.5956	7.6597e+05	0.9928

TABLE 11 :PERFORMANCE PARAMETER OF DWT-DCT AFTER BRIGHTNESS DENSITY OF 5

	Performance Parameter of Proposed Methodology								
Images	**PSNR**	**MSE**	**FSIM**	**SNR**	**IQI**	**SSIM**	**MAE**	**PCC**	**Robustness**
Lena	102.4608	3.6898e-06	0.9709	-0.0018	0.9933	0.9386	18.0187	7.8145e+05	0.9978
Greens	102.4776	3.6755e-06	0.9439	-0.3105	0.9686	0.8876	29.4817	7.6197e+05	0.9857
Pepper	102.8746	3.3545e-06	0.9868	-0.1222	0.9484	0.9608	15.4005	7.8563e+05	0.9989
Trees	103.1261	3.1657e-06	0.9598	-0.2138	0.9600	0.9240	20.5276	7.8155e+05	0.9974
Fabric	102.5148	3.6442e-06	0.9381	-0.0277	0.9905	0.9091	26.8843	7.6598e+05	0.9926

TABLE 12 :PERFORMANCE PARAMETER OF DWT-DCT AFTER BRIGHTNESS DENSITY OF 3

	Performance Parameter of Proposed Methodology								
Images	**PSNR**	**MSE**	**FSIM**	**SNR**	**IQI**	**SSIM**	**MAE**	**PCC**	**Robustness**
Lena	115.7695	1.7224e-07	0.9709	-0.0014	0.9973	0.9403	12.9709	7.8145e+05	0.9980
Greens	115.7820	1.7174e-07	0.9441	-0.2266	0.9782	0.8926	25.6317	7.6196e+05	0.9861
Pepper	116.1301	1.5851e-07	0.9869	-0.0776	0.9594	0.9691	10.0414	7.8566e+05	0.9993
Trees	116.3050	1.5226e-07	0.9604	-0.1455	0.9854	0.9307	16.3643	7.8157e+05	0.9976
Fabric	115.8091	1.7068e-07	0.9382	-0.0211	0.9901	0.9109	22.8142	7.6598e+05	0.9927

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TABLE 13 :PERFORMANCE PARAMETER OF DWT-DCT AFTER BRIGHTNESS DENSITY OF 7

	Performance Parameter of Proposed Methodology								
Images	**PSNR**	**MSE**	**FSIM**	**SNR**	**IQI**	**SSIM**	**MAE**	**PCC**	**Robustness**
Lena	93.6958	2.7765e-05	0.9708	-0.0021	0.9877	0.9362	23.3851	7.8145e+05	0.9976
Greens	93.7195	2.7614e-05	0.9438	-0.3835	0.9339	0.8813	33.6198	7.6196e+05	0.9851
Pepper	94.1354	2.5092e-05	0.9867	-0.1616	0.8933	0.9524	20.9379	7.8559e+05	0.9984
Trees	94.4556	2.3309e-05	0.9590	-0.2708	0.9199	0.9161	25.0361	7.8150e+05	0.9971
Fabric	93.7621	2.7345e-05	0.9380	-0.0324	0.9854	0.9067	31.2600	7.6597e+05	0.9923

TABLE 14 :PERFORMANCE PARAMETER OF DWT-DCT AFTER BRIGHTNESS DENSITY OF 10

	Performance Parameter of Proposed Methodology								
Images	**PSNR**	**MSE**	**FSIM**	**SNR**	**IQI**	**SSIM**	**MAE**	**PCC**	**Robustness**
Lena	84.4061	2.3576e-04	0.9707	-0.0023	0.9772	0.9314	31.7347	7.8145e+05	0.9972
Greens	84.4467	2.3357e-04	0.9433	-0.4693	0.9141	0.8703	40.2521	7.6196e+05	0.9838
Pepper	84.8653	2.1210e-04	0.9865	-0.2100	0.8588	0.9397	29.3940	7.8548e+05	0.9974
Trees	85.2764	1.9295e-04	0.9572	-0.3335	0.8913	0.9033	32.2063	7.8139e+05	0.9966
Fabric	84.4890	2.3130e-04	0.9377	-0.0371	0.9729	0.9021	38.2117	7.6595e+05	0.9918

The above Table no 1 to Table no 14 depicts the performance Parameter of proposed technique i.e. DWT-DCT technique. The accompanying Table 1 to Table 14 shows the different Parameters for a variety of pictures. Here, MSE is Mean Square Error; PSNR is Peak Signal to Noise Ratio; FSIM is feature similarity index ; PCC is Pearson correlation coefficient; IQI is Image Quality Index, MAE is Mean Absolute Error; SNR is Signal to Noise Ratio; SSIM is Measure of Structural Similarity Index.

V. CONCLUSION

The Image watermarking algorithm which is based on DWT and DCT is proposed in this paper. This watermarking algorithm takes advantage of the characteristics of the DCT technique and DWT to improve the security and robustness of the watermarks. Additionally, the experimental results have Verified the correctness of the conclusion and have shown the validity and feasibility in using DWT and DCT technique for performing digital image watermark embedding robustness and imperceptible. The robustness of proposed technique has also been verified by adding a range of density noises like salt and pepper, speckle, Gaussian & brightness on the watermarked image.

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