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An Improved Watermarking of Digital Images using DWT & SVD Approach

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Abstract: The process of embedding information into another object/signal can termed as watermarking. The basic idea of watermarking is embed a stealthy image into the image needed to be secured. The stealthy picture is gotten from the first picture and ought to convey adequate data to guarantee copyright check. Digital watermarking is one of the best solutions to prevent illegal copying, modifying and redistributing the multimedia data. Encryption of the multimedia products prevents an intruder from accessing the contents without a proper decryption key. Digital Watermarking is the process of embedding data called a watermark into the digital media such that watermark can be detected or extracted later to make an assertion about the object. The Proposed research aims to develop an improved Watermarking approach which is based on DWT and SVD along with encryption of color images with higher imperceptibility/quality, large capacity/payload and better in robustness/resistance to attacks. We have tested the proposed system on various images from standard dataset as well as from real world images. Performance of the same had been analyzed by calculating normalized correlation (NC), peak signal to noise ratio(PSNR) men square error (MSE) for various attacks. Moreover the performance of had been compared with Tapas et al Algorithm, DSAWM Algorithm.

Keywords: Digital Watermarking, Image Security, DWT, SVD, Watermark Attacks.

I. INTRODUCTION

It is procedure of adding data into another object/signal can termed as watermarking. The basic idea of watermarking is embed a stealthy image into the image needed to be secured. The stealthy picture is gotten from the first picture and ought to convey adequate data to guarantee copyright confirmation. Cryptography has been the corner stone of technologies used to protect intellectual property rights. However, cryptography protects only the work during transmission or distribution. This provides no protection after the work is decrypted. All work must eventually be decrypted if consumers are to enjoy the photograph, music, or movie. Watermarking is a technology that complements cryptography by embedding imperceptible signals in a work. The signals remain in the work after decryption and even after conversion to analog world, and their use has been proposed for the variety of digital rights management purposes. Thus watermark is a secondary image which overlaid within the primary image and provides way to protect the image.

Advanced watermarking is one of the best answers for avert illicit replicating, adjusting and redistributing the sight and sound information. Encryption of the sight and sound items keeps an interloper from getting to the substance without a legitimate unscrambling key. Digital Watermarking is the way toward implanting information called a watermark into the advanced media with the end goal that watermark can be identified or extricated later to make a declaration about the question.

A watermarking algorithm embeds watermark in different kind of data to protect digital data by embedding watermark that is encrypted by DES algorithm.

A watermark is a form of image or text that is impressed onto the paper that provides evidence of its authenticity. A recognizing mark urged paper amid make; unmistakable when paper is held up to the light (e.g. $ Bill). A complete digital watermarking system is composed of two basic modules:

a. **Watermark embedding module**:-embedding module is in charge of adding the watermark sign to the first information. The watermark can be any type of information, for example, numeric, content, picture, and so forth. Key is utilized to fortify security to anticipate unapproved parties reestablish and adjust the watermark.

b. **Watermark detection and extraction module**: - is utilized to figure out if the information contains determined watermark or the watermark can be removed. The module info might be picture, key, watermark or unique picture, the yield is a watermark or some sort of tenable worth which shows the likelihood of the information having a given watermark.

II. LITERATURE SURVEY

Ahmad et al. (2014) [1] proposed a strong picture watermarking strategy for the copyright insurance .The proposed technique depends on the 3-level discrete wavelet change. Encoded mystery picture utilizing winding filtering is covered up by alpha mixing strategy in LL sub groups. The scheme is found robust to various image processing attacks such as JPEG type compression,

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rotation, blurring, median filtering and Gaussian noise. The proposed algorithm is invisible and the quality of the watermarked image and the recovered image are improved. This system can implant the imperceptible watermark into remarkable elements of a picture. Comes about demonstrate that the nature of the watermarked picture and the recuperated watermark depend just on the scaling components k and q. The discrete wavelet transform watermarking is resilient to frequency attacks and least robust to Gaussian noise.

Akter and Ullah (2014) [2] proposed a new embedding algorithm (NEA) of digital watermarking. The proposed procedure is executed using digital image as data. The performance is compared between NEA and well established Cox's modified embedding algorithm. The watermarking technique is based on discrete wavelet transforms and discrete cosine transforms. The acknowledgment of the new calculation is scaled by the two necessities of computerized watermarking. One is indistinctness of the watermarked picture, measured as pinnacle flag to clamor proportion (PSNR) in dB, another is vigor of the check picture, measured by relationship of unique stamp picture and recuperating mark picture. From all recreation comes about this paper acknowledges the execution of new installing calculation (NEA) and one might say that the NEA will be a substitute of changed Cox's calculation with better execution.

Chen et al. (2014) [3] presented an authentication and recovery scheme to protect images. The image blocks are firstly DCT transformed and then encoded with the different patterns. An optimal way to find the best pattern for each blocks which results in better image quality. Both the recovery and the check data are embedded for data protection. The exploratory results exhibit that the technique can recognize and restrict locales have been altered. Moreover, picture quality for both watermarked and recouped pictures are all around safeguarded. The blocks of image are DCT transformed and then encoded with different patterns. An optimal selection method is adopted to find the best pattern for each block. Such selection results in a better image quality. For data protection both the recovery and check data are embedded.

Craig and Kapgate (2014) [5] presented the role of watermarking for developing the protection schemes. Wolfgang and Delp Algorithm (Technique) is used in watermark Embedding. The algorithm presented the scheme of watermarking by encrypting the watermark image using symmetric encryption such as DES. According to this method, the watermark symbol to be encrypted first using DES and then embedded it into RGB vectors of an original image using SVD transformation sampling. In the calculation, watermark data was installed into corner to corner components of S, U, or V lattices. The calculation scrambles the double watermark picture utilizing DES which is implanted into the RGB channels decayed by video. The watermark implanting has no impact to the first video; there is no contrast between the watermark picture removed from the watermarked picture and the first watermark video.

III. PROPOSED METHODOLOGY

The Proposed research aims to develop an improved Watermarking approach which is based on DWT and SVD along with encryption. of colour images with higher imperceptibility/quality, large capacity/payload and better in robustness/resistance to attacks. Pictures and in addition instant messages can be stow away inside the pictures utilizing successive and arbitrary techniques. It will fuse cryptography to accomplish high security and irregular pixel inserting to achieve high insusceptibility to assaults. It would be profoundly insusceptible to any ecological unsettling influences like commotion because of hybrid filtering.

A. DISCRETE WAVELET TRANSFORM (DWT)

Discrete Wavelet transform (DWT) is a mathematical tool for for progressively decaying a picture. It is valuable for preparing of non-stationary signs. The change depends on little waves, called wavelets, of shifting recurrence and constrained span. Wavelet change gives both recurrence and spatial depiction of a picture. Not at all like customary Fourier change, fleeting data is held in this change procedure. Wavelets are made by interpretations and enlargements of a settled capacity called mother wavelet.

DWT is the multiresolution depiction of a picture the unraveling can be prepared successively from a low determination to the higher determination. The DWT parts the sign into high and low recurrence parts. The high recurrence part contains data about the edge segments, while the low recurrence part is part again into high and low recurrence parts. The high recurrence segments are normally utilized for watermarking since the human eye is less touchy to changes in edges. In two dimensional applications, for every level of deterioration, we first play out the DWT in the vertical bearing, trailed by the DWT in the flat course. After the main level of decay, there are 4 sub-groups: LL1, LH1, HL1, and HH1. For each progressive level of deterioration, the LL subband of the past level is utilized as the information. To perform second level disintegration, the DWT is connected to LL1 band which deteriorates the LL1 band into the four sub-groups LL2, LH2, HL2, and HH2. To perform third level deterioration, the DWT is connected to LL2 band which break down this band into the four sub-groups – LL3, LH3, HL3, HH3. This outcomes in 10 sub-groups per part. LH1, HL1, and HH1 contain the most astounding recurrence groups present in the picture tile, while LL3 contains the least recurrence band.

Singular Value decomposition (SVD)

SVD is a successful numerical examination apparatus used to break down grids. In SVD change, a grid can be decayed into three frameworks that are of the same size as

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the first network. From the perspective purpose of direct variable based math, a picture is a variety of nonnegative scalar sections that can be viewed as a network. Without loss of sweeping statement, if A will be a square picture, meant as , where R speaks to the genuine number area, then SVD of An is characterized as $A = USV^T$ where U and V are orthogonal matrices, and S is a diagonal matrix, as

$$S = \begin{bmatrix} s_1 & & \\ & \ddots & \\ & & s_n \end{bmatrix}$$

Here diagonal elements i.e. s's are singular values and satisfy s1≥ s2≥….sr ≥ sr+1≥=……= =0 SVD is an optimal matrix decomposition technique in a least square sense that it packs the maximum signal energy into as few coefficients as possible.

The proposed system comprises of two components:
1. Embedding Module
2. Extracting Module.

The proposed system will work as shown below:

Step 1: Input the Cover and watermark image.
Step 2: Perform the three level DWT of cover image.
Step3: Perform the encryption using encryption key of watermark image using encryption algorithm
Step 4: Perform one level DWT of the encrypted image
Step 5: Now embedded lower frequency sub band of watermark in lower frequency sub band of cover image.
Step 6: Extract the watermark from the step 5.
Step 7: Decrypt the watermark using decryption algorithm along with decryption key.
Step 8: Evaluate the performance of the proposed system on the basis of the performance parameters.
Step 9: Compare the performance parameters of the proposed system with the existing system.
Step 10: Perform the above algorithm to different set of images.

IV. RESULTS AND DISCUSSION

We have tested the proposed system on various images from standard dataset as well as from real world images. Performance of the same had been analyzed by calculating normalized correlation (NC), peak signal to noise ratio (PSNR) men square error (MSE) for various attacks. Moreover the performance of had been compared with Tapas et al Algorithm, DSAWM Algorithm.

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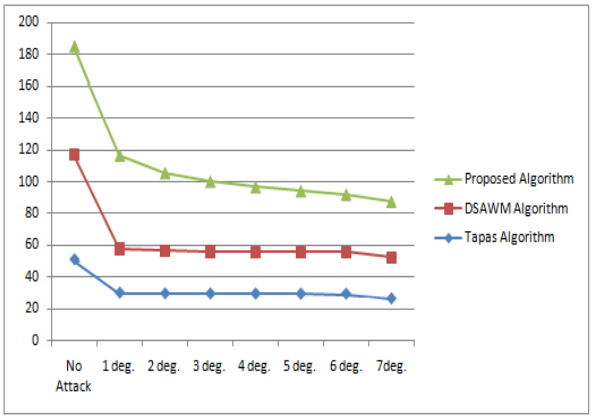
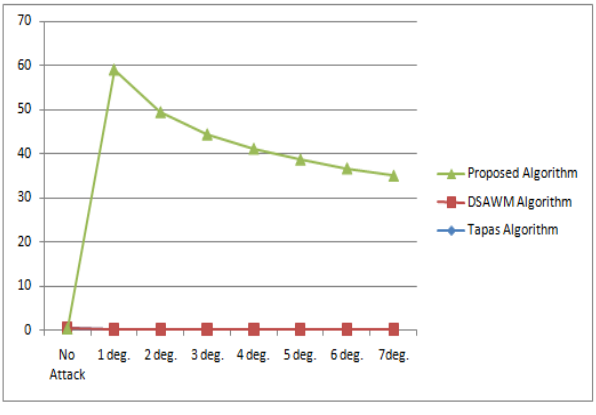
Results and their corresponding comparison is shown as below:

Sr. NO.	Rotation attack	Tapas *et al* Algorithm			DSAWM Algorithm			Algorithm		
		PSNR	MSE	NC	PSNR	MSE	NC	PSNR	MSE	NC
1.	No attack	51.3458	0.476	0.999	65.382	0.0188	1.000	68.4146	0.0052125	1.000
2.	1 	30.114	0.063329	0.735	27.587	0.113322	0.973	58.9411	0.0052124	0.9984
3.	2 	29.660	0.070315	0.609	26.671	0.139938	0.922	49.2776	0.0010448	0.9991
4.	3 	29.529	0.072461	0.529	26.389	0.149311	0.865	44.2414	0.0014979	0.9993
5.	4 	29.485	0.073207	0.475	26.229	0.154922	0.811	40.9725	0.0018992	0.9990
6.	5 	29.442	0.073925	0.435	26.123	0.158747	0.766	38.5205	0.0028657	0.9984
7.	6 	29.424	0.074246	0.401	26.046	0.161595	0.725	36.5101	0.0026183	0.9976
8.	7 	29.4270	0.074194	0.374	25.995	0.163513	0.685	34.8589	0.0029466	0.9965

Result Comparison of PNSR



Result comparison of MSE



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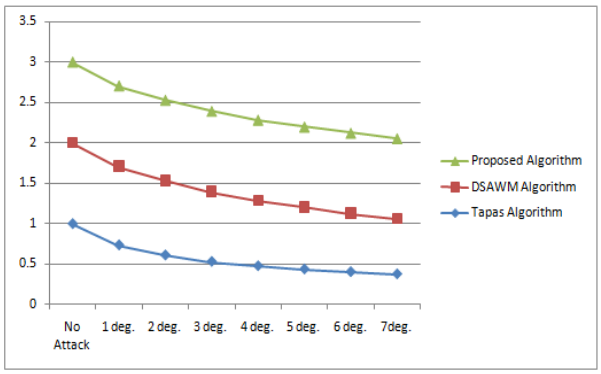
Result comparison of NC



V. CONCLUSION AND FUTURE SCOPE

A. Conclusion

Digital watermarking prevents illegal copying, modifying and redistributing the multimedia data by attackers. Though a new algorithm has required to be implemented to overcome the difficulties and to assure copyright. In this research work a new approach for watermarking of digital images is to be implemented. The new approach will tested on various images. Here we have tested this system on 50 different images. In the proposed system a new technique is developed to watermark the images after encryption process. In addition to DES algorithm we use DWT and SVD to apply the watermark. Proposed system is also tested on various types of attacks on the watermarked images to check the robustness of the system.

B. Future Scope

The upcoming era needs higher security enhancements in watermarking in which the various high security encoding techniques can be used as well as the techniques which significantly recover the watermark from watermarked image after combination of various attacks. Proposed system can also be extended to apply the watermark on video files.

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