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PROTECTION OF DATA USING DIGITAL WATERMARKING TECHNIQUE

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ABSTRACT
With the rapid growth of internet the various digital methods has been proposed to protect the multimedia information from the non-authorized accesses use and change. Among all the proposed methods the watermarking technique is the most common technique for protecting the multimedia data for unauthorized access. A novel method is proposed which deals with secure extraction of data by utilizing transform based image watermarking techniques. The image is embedded with a watermark using a combination of Discrete Cosine Transform (DCT), Discrete Fourier Transform (DFT) and Discrete Wavelet Transform (DWT) in this scheme. The conventional transforms are applied in an optimized mode in these schemes in different spatial regions of the image to embed a watermark. The scheme is subjected to Signal processing attacks and Geometric attack to test against the robustness of the image. The watermarking of image is made secure by testing against unauthorized detection techniques employed by attackers. This is realized by a correlation based detector applied to the scheme. Experimental results show that the watermarked image is robust and secure against Signal Processing attacks, Geometric attacks and unauthorized Detection attacks. The water marking methods have been categorized as spatial domain method and frequency domain method. In spatial domain method we modify the lower order bits of cover image to embed the water mark. The main advantage of this technique is of low complexity and less computational values. But this technique is very robust to certain types of security attacks. The second method is frequency domain transform method. These methods are based upon the using of some invertible transformations like discrete cosine transform i.e. DTC. Discrete Fourier transforms (DFT) and Discrete Wavelet Transform (DWT) to host image. To embed the water mark in the image simply changes the coefficient value of these transforms according to the watermark and the inverse transform is applied to the original image. These methods are too complicated and require more computational power. These methods are also provides more reverts to the security attacks. The another method is GLCM technique.

1. Introduction
Digital watermarking refers to the procedure where all the data is installed into digital media with the goal that it can't be used or replicated by anybody. This operation serves various aims, for example, information verification, information ordering among others [1]. A digital watermarking framework should be able to create a balance between the clashing requirements of sensors, action clarity, information ability. It should also be robust to different attacks. Therefore, a knowledge driven approach is adopted to investigate these adjustments [2]. Watermark processing takes place in two steps. The first step thinks of the watermark as a transmission code and uses a decipher to properly retrieve the entire transferred data. The next step uses watermark as a code to verify.

1.2 Purpose of digital watermarking:
The ability of an imperceptible watermark is to separate the origin, designer, producer, proprietor and provider or approved buyer of a record or photograph. The basic goal of this method is to preserve the essence of the picture forever, free from nay alteration so that no non-approved subscriber can replicate or alter the material. If an illegal use occurs, this watermark helps the proprietor by guaranteeing

copyright on it. This strategy also works with different aims, for example, it enables tracking to prevent the use of a picture for illicit purpose [3]. This process should carry out, for example, transmission check, information validation, information ordering etc. Thus, digital watermarking makes it feasible for each user to uniquely stamp each picture.

1.2.1 Visible watermarks:

Visible watermark is considered to be the enhancement of the idea of a logo. These watermarks are merely relevant to the pictures. These logos are implanted inside a picture with great clarity. It is impossible to delete these watermarks from a picture by editing the center of the picture. Such watermarks tend to be secure against few assaults [4].

1.2.2 Invisible watermark: These watermarks hide in the content and no illicit person can identify them. The main application of such watermarks involves validation of content creator and illegal repetition [4].

1.2.3 Public watermark: These watermarks can be recovered and read using a dedicated algorithm only. Consequently, such watermarks are unsecure and contain only IPR information. They are good choices for labels [5].

1.2.4 Fragile watermark: Watermarks in this category are not prone to ant type of tampering. Data treatment extinguishes such watermarks.

1.2.5 Private Watermark: A secret key is essentially required for reading or recovering these watermarks. These watermarks are additionally called protected watermarks [6].

1.2.6 Perceptual watermarks: These watermarks give the imperceptible however vigorous watermark based on the sense modalities of people. They are otherwise called the translucent watermarks because of the excellent content quality.

1.2.7 Bit-stream watermark: These watermarks aim to provide compressed data, for example, videos [7].

1.3. Algorithms for Watermarking:

1.3.1 Singular Value Decomposition (SVD):

Singular value decomposition (SVD) in linear algebra not only makes a major important contribution but also a source of knowledge for most arithmetic. It includes several real-time as well as imaginary values and has the specific characteristics to be used for a physical (m, n) matrix. Consider matrix A, with m and n (where m and n denote rows and columns respectively). Variable ‘r’ be rank and $r \leq n \leq m$, can then be factored into three elements such as:

$$A = USV^T$$

SVD obtains nearly best matrix disintegration in case of least square because it mixes the entire signal energy into some coefficient [8]. SVM is able to bifurcate the framework into a group of elements that don’t depend on each other in a linear manner. Each system has its own energy contribution in SVD. Every framework distributes energy independently in SVD. It is usually adopted as a mathematical tool for diagonalizing a matrix while performing mathematical study. Owing to the wide-ranging benefits, this approach is in great demand as an algebraic transformation tool to process photographs for example maximal energy filling, which is used for manipulating photographs centers into two distinct subspaces of data and noise [9]. These subspaces are useful for several purposes like denoising and watermarking. These are the main characteristics of SVD. SVD can also deal with LSQ issue. SVD refers to an approach to disintegrate orthogonal matrix. It is quite practicable and vigorous. This approach has gained substantial popularity in signal processing for theoretical and steadiness. This approach is exceptional in its numerical conversion to process photographs and possess outstanding imaging traits [10]. Image processing use few traits of SVD because others require additional assessment. Multiple characteristics of SVD are of utmost importance which includes maximal energy filling, least squares issue tackling, pseudo-inverse of a computed matrix and multi-variant scrutiny.

One of the main traits of SVD is the association with matrix rank for approximation conditions. Low-ranked properties may signify digital photographs as they can be defined using minor group of eigen photos.

DWT in Image Processing: Discrete Wavelet Transform (DWT) refers to a form of linear transformation. This approach applies all process on a data vector which mathematically converts it into various vectors of similar dimension [11]. This mechanism bifurcates data into individual frequency elements and examines each element for getting resolution corresponding to its measure. Cascaded filters assist in calculating DWT which performs sub sampling from two viewpoints. the use of DWT approach is quite popular for several implementations. A 2D DWT disintegrates a photograph or video sequence into several sub-photographs, 3 particulars and 1 calculation. The uniqueness of a photograph corresponds to the calculation of the sub-image to a scale 1/4 of the natural. 2D DWT is an improvement over 1D DWT both horizontally and vertically. DWT decomposes the frequency bands into sub-bands (LL) along with several detailed units in a photograph. The obtained sub-bands include horizontal (HL) [12], vertical (LH) and diagonal (HH). Decomposing wavelets assists the embedding of watermarks in a low-frequency band so as to improve the toughness against assaults.

Watermarks implanted in the high frequency sub-band improves the visibility of watermarks because HVS tends to be less responsive to high frequency. Watermarks' embedding in lower frequency band helps to create a framework that provides good defence to miscellaneous assaults [13]. This methodology is appropriate to process variable signals. Wavelets corresponds to small waveform changes in which the frequency diverges for a limited duration. Both frequency and spatial details are accessible through wavelet transforms in an image. Contrary to traditional Fourier transform, this translation retains temporal info. Mother Wavelet helps making a wavelet through transformation and dispersion of a certain function. DWT can bifurcate the signal into high and low frequency signals. High frequency signals contain info of edge elements [14]. However, low frequency signals are bifurcated another time into high and low frequency components. Watermarking is performed using high frequency constituents because human eyes are less sensitive to the variations in edge. For decomposing at each step in a 2D implementation, the DWT is first applied perpendicularly and then horizontally. The primary step of disintegration is followed by 4 sub-bands: LL1, LH1, HL1 and HH1. The LL sub-bands of the preceding step are inputted into each step of disintegration. DWT is enforced on the LL1 band for the disintegration in next step [15]. This step denigrates the LL1 band into four subunits. The disintegration at 3^{rd} step involves applying to the LL2 band which denigrates the band into four sub-bands: LL3, LH3, HL3, HH3. This operation leads to the formation of 10 sub-bands for each constituent. In a photograph, LH1, HL1 and HH1 denote frequency bands of maximum frequency while the frequency band with minimal frequency lies in LL3. DWT has a broad spectrum of applications including compressing of sound recordings and videos, and making sound recordings' noise-free [16]. Wavelets' energy is time-based and they are widely investigated for temporal analysis, as signals in real world vary according to time.

2. Literature Review

Martin, et.al (2000) explained about Image Processing Algorithms are the basis for Image Computer Analysis and Machine Vision [17]. Employing a theoretical foundation – Image Algebra and powerful development tools – Visual C++, Visual Fortran, Visual Basic, and Visual Java high-level and efficient Computer Vision Techniques have been developed. This paper analyzes different Image Processing Algorithms by classifying them in logical groups. In addition, specific methods are presented illustrating the application of such techniques to the real-world images. In most cases more than one method is used. This allows a basis for comparison of different methods as advantageous features as well as negative characteristics of each technique is delineated.

Navnidhi Chaturvedi, et.al (2012) described about the authenticity & copyright protection are two major problems in handling digital multimedia [18]. The Image watermarking is the most popular method for copyright protection by discrete Wavelet Transform (DWT) which performs 2 Level Decomposition of original (cover) image and watermark image is embedded in Lowest Level (LL) sub band of cover image. Inverse Discrete Wavelet Transform (IDWT) is used to recover original image from watermarked image. And Discrete Cosine Transform (DCT) which convert image into Blocks of M bits and then reconstruct using IDCT. In this paper we have compared watermarking using DWT & DWT-DCT methods performance analysis on basis of PSNR, Similarity factor of watermark and recovered watermark.

Ali Al-Haj, et.al (2007) described about the proliferation of digitized media due to the rapid growth of networked multimedia systems, has created an urgent need for copyright enforcement technologies that can protect copyright ownership of multimedia objects [19]. Digital image watermarking is one such technology that has been developed to protect digital images from illegal manipulations. In particular, digital image watermarking algorithms which are based on the discrete wavelet transform have been widely recognized to be more prevalent than others. This is due to the wavelets' excellent spatial localization, frequency spread, and multi-resolution characteristics, which are similar to the theoretical models of the human visual system. In this paper, they describe an imperceptible and a robust combined DWT-DCT digital image watermarking algorithm. The algorithm watermarks a given digital image using a combination of the Discrete Wavelet Transform (DWT) and the Discrete Cosine Transform (DCT). Performance evaluation results show that combining the two transforms improved the performance of the watermarking algorithms that are based solely on the DWT transform.

Surya Pratap Singh, et.al (2012) presents a robust watermarking technique for color and grayscale image [20]. The proposed method involves many techniques to conform a secure and robust watermarking. In the proposed technique the watermark is embedded in 3rd level of DWT (Discrete Wavelet Transform) and before embedding the watermark image is passed through chaotic encryption process for its security, other important thing is that in the proposed method watermark is embedded in the form of DCT (Discrete Cosine Transform) with special coefficient shifting algorithm to minimize the impact on main image. The performance of the proposed watermarking is robust to a variety of image processing techniques, such as JPEG compression, enhancement, resizing, and geometric operations.

A Mansouri et.al, (2009) a new robust method of non-blind image watermarking is proposed [21]. The suggested method is performed by modification on singular value decomposition (SVD) of images in Complex Wavelet Transform (CWT) domain while CWT provides higher capacity than the real wavelet domain. Modification of the appropriate sub-bands leads to a watermarking scheme which favorably preserves the quality. The additional advantage of the proposed technique is its robustness against the most of common attacks. Analysis and experimental results show much improved performance of the proposed method in comparison with the pure SVD-based as well as hybrid methods. A new non-blind SVD-based watermarking method in CWT domain was introduced. Modifying SVs of the host image in CWT domain provides high robustness against the common attacks. Since the proposed algorithm takes the advantages of the Wavelet Transform and SVD methods simultaneously, the extracted watermarks are more robust against all mentioned attacks. The additional privilege of suggested algorithm is its compatibility with human visual system characteristics to embed the watermark by selecting the best sub-bands in CWT domain. In this way, high capacity of CWT domain is applied to embed the watermark information along with preserving the quality of the watermarked image.

Anthony T.S. Ho et.al, (2011) propose a robust image-in-image watermarking algorithm based on the fast Hadamard transform (FHT) for the copyright protection of digital images [22]. In the proposed approach, a number of pseudorandom selected 8×8 sub-blocks of original image and a watermark image are decomposed into Hadamard coefficients. To increase the invisibility of the watermark, a visual model based on original image characteristics, such as edges and textures are incorporated to determine the watermarking strength factor. All the AC Hadamard coefficients of watermark image is scaled by the watermarking strength factor and inserted into several middle and high frequency AC components of the Hadamard coefficients from the sub-blocks of original image. To further increase the reliability of the watermarking against the common geometric distortions, such as rotation and scaling, a post-processing technique is proposed. The performance of the proposed algorithm is evaluated using Stirmark. The experiment uses container image of size 512×512×8bits and the watermark image of size 64×64×8bits.

Alexander Sverdlov et.al, (2003) proposed both Discrete Cosine Transform (DCT) and Singular Value Decomposition (SVD) have been used as mathematical tools for embedding data into an image [23]. In the DCT-domain, the DCT coefficients are modified by the elements of a pseudo-random sequence of real values. In the SVD domain, a common approach is to modify the singular values bythe singular values of a visual watermark. In this paper, we present a new robust hybrid watermarking schemes based on DCT and SVD. After applying the DCT to the cover image, we map the DCT coefficients in a zig-zag order into four quadrants, and apply the SVD to each quadrant. These four quadrants represent frequency bands from the lowest to the highest. The singular values in each quadrant are then modified by the singular values of the DCT-transformed visual watermark. We show that embedding data in lowest frequencies is resistant to one set of attacks while embedding data in highest frequencies is resistant to another set of attacks. The only exception is the rotation attack for which the data embedded in middle frequencies survive better.

Fang Li, (2009) proposed a two-stage method for demising images heavily contaminated by salt and pepper noise [24]. In the first stage, we use adaptive median filter to detect the noisy pixels. All the pixels are marked as noisy or noise-free pixels. In the second stage, we take the noisy pixels as inpainting regions and noise-free pixels as true information. The inpainting task is done by the normalized mean curvature flow. The method is generalized to color image. Experimental results show that the proposed algorithm has advantages over nonlinear filtering or regularizing methods in terms of edge preservation and noise removal and is competitive with other two-stage methods in the literature.

T. Vimala, (2012) a Modified Decision Based Unsymmetrical Trimmed Median Filter (MDBUTMF) followed [25] by Fuzzy Noise Reduction Method (FNRM) is proposed for the restoration of color images that are highly corrupted by salt and pepper noise. The proposed filter (MDBUTMF) replaces the noisy pixel by trimmed median value when some of the elements with values 0‟s and 255‟s is present in the selected window. The throughput of MDBUTMF is a partial noise removed image. It is further processed by FNRM. The FNRM has two sub-filters. The first sub-filter computes fuzzy distances between the color components of the central pixel and its neighborhood. The target of the second sub-filter is to correct the corrupted pixels. The throughput of FNRM is a fully noise removed image. Simulation results show the feasibility of the proposed method. The proposed method is tested against different color images.

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