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Enhancement in Watermarking Approach Using DCT-DWT-SVD Techniques by Applying Kalman Filter

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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. There are various algorithms for watermarking. The DCT-SVD based technique takes more processing time and has less capacity and imperceptibility. To increase the efficiency of SVD technique the DWT and SVD methods are combined and new method is generated which has less processing time and more robust to different type of security attacks. But the proposed hybrid algorithm is more robust to security attacks due to which the PSNR values have been increased. Then we will apply kalman filter to increase the PSNR value by removing noise.

Keywords- *SVD, DWT-DCT, Kalman filtering, Salt and Pepper and Robustness*

1. INTRODUCTION

DIGITAL watermarking is a process in which some information is embedded within a digital media so that the inserted data becomes part of the media. This technique serves a number of purposes such as broadcast monitoring, data authentication, data indexing and so forth. A digital watermarking system must successfully satisfy trade-offs between conflicting requirements of perceptual transparency, data capacity and robustness against attacks. These trade-offs are investigated from an information-theoretic perspective [1]. Watermarks have two categories of roles: In the first category, the watermark is considered as a transmission code and the decoder must recover the whole transmitted information correctly [2]. In the second category, the watermark serves as a verification code. In the latter system, the watermark detector must simply determine the presence of a specific pattern. Since the footprint of the verification watermarking, that is, the number of pixels per watermark code bit is typically higher, this case has higher robustness as compared to the subliminal channel (transmission code) case [3]. Digital watermarking is a technique which allows an individual to add hidden copyright notices or other verification messages to digital audio, video, or image signals and documents. Such hidden message is a group of bits describing information pertaining to the signal or to the author of the signal (name, place, etc.). The technique takes its name from watermarking of paper or money as a security measure [4]. Digital watermarking is not a form of steganography, in which data is hidden in the message without the end user's knowledge, although some watermarking techniques have the steganography feature of not being perceivable by the human eye.

Fig.1.1 a) Original Image b) Watermarked Image

1.1 TYPES OF WATERMARK

1.1.1 Visible watermarks: Visible watermarks are an extension of the concept of logos. Such watermarks are applicable to images only. These logos are inlaid into the image but they are transparent. Such watermarks cannot be removed by cropping the center part of the image. Further, such watermarks are protected against attacks such as statistical analysis [11].

1.1.2 Invisible watermark: Invisible watermark is hidden in the content. It can be detected by an authorized agency only. Such watermarks are used for content and/or author authentication and for detecting unauthorized copier [12].

*1.1.3 Public watermark:*Such a watermark can be read or retrieved by anyone using the specialized algorithm. In this sense, public watermarks are not secure. However, public watermarks are useful for carrying IPR information. They are good alternatives to labels [13].

1.1.4 Fragile watermark: Fragile watermarks are also known as tamper-proof watermarks. Such watermarks are destroyed by data manipulation [5].

1.1.5 Private Watermark: Private watermarks are also known as secure watermarks. To read or retrieve such a watermark, it is necessary to have the secret key [6].

1.1.6 Perceptual watermarks: A perceptual watermark exploits the aspects of human sensory system to provide invisible yet robust watermark. Such watermarks are also known as transparent watermarks that provide extremely high quality contents [12].

1.1.7 Bit-stream watermark: The term is sometimes used for watermarking of compressed data such as video [7].

2. REVIEW OF LITERATURE

In this paper they proposed [9] both Discrete Cosine Transform (DCT) and Singular Value Decomposition (SVD) have been used as mathematical tools for embedding data into an image. 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. They assume that the size of the visual watermark is one quarter of the size of the cover image. Modification in all frequencies enables a watermarking scheme that is robust to normal A/V processes or intentional attacks that destroy the watermark in either lower or higher frequencies. They 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. In this paper, they proposed [10] a two-stage method for demising images heavily contaminated by salt and pepper noise. In the first stage, they 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. In this paper presents [11] a robust watermarking technique for color and grayscale image. 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. In paper [12] to increase the reliability of the watermarking against the common geometric distortions, such as rotation and scaling, a post-processing technique is proposed. Understanding the type of distortion provides a mean to apply a reversal of the attack on the watermarked image, enabling the restoration to the synchronization of the embedding positions. 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. It survives about 60% of all Stirmark attacks. The simplicity of Hadamard transform offers a significant advantage in shorter processing time and ease of hardware implementation than the commonly used DCT and DWT techniques.

3. ALGORITHM FOR WATERMARKING

Singular Value Decomposition (SVD): SVD is robust and reliable orthogonal matrix decomposition method. Due to SVD conceptual and stability reasons, it becomes more and more popular in signal processing area. SVD is an attractive algebraic transform for image processing. SVD has prominent properties in imaging. The main SVD properties that may be utilized in image processing. Although some SVD properties are fully utilized in image processing, others still needs more investigation and contributed to. Several SVD properties are highly advantageous for images such as; its maximum energy packing, solving of least squares problem, computing pseudo- inverse of a matrix and multivariate analysis. A key property of SVD is its relation to the rank of a matrix and its ability to approximate matrices of a given rank. Digital images are often represented by low rank matrices and, therefore, able to be described by a sum of a relatively small set of eigenimages [5].

DWT: The discrete wavelet transform (DWT) is a linear transformation that operates on a data vector whose length is an integer power of two, transforming it into a numerically different vector of the same length. It is a tool that separates data into different frequency components, and then studies each component with resolution matched to its scale. DWT is computed with a cascade of filtering followed by a factor 2 sub sampling [8]. The Discrete Wavelet Transform (DWT) is used in a wide variety of signal processing applications. 2-D discrete wavelet transform (DWT) decomposes an image or a video frame into sub-images, 3 details and 1 approximation. The approximation sub-image resembles the original on 1/4 the scale of the original. The 2-D DWT is an application of the 1-D DWT in both the horizontal and the vertical directions. DWT separates the frequency band of an image into a lower resolution approximation sub-band (LL) as well as horizontal (HL), vertical (LH) and diagonal (HH) detail components.

Kalman Filtering: In radio communication systems, filtering is a desirable factor. As radio communication signals are often corrupted with noise, a good filtering algorithm is required to remove noise from electromagnetic signals while retaining the useful information. Kalman Filtering is an effective method to filter impurities in linear systems. The kalman filter basically consists of a set of mathematical equations that provides an efficient computational means to estimate the state of a process that minimizes the mean of the squared error. It operates recursively on streams of noisy input data to produce statistically optimal results [11]. The filter is very powerful in several aspects: it supports estimations of past, present, and even future states, and it can do so even when the precise nature of the modeled system is unknown.

4.PROPOSED METHODOLOGY

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 method is single value decomposition (SVD) technique. In SVD technique we simply change the high dimensional highly variable set of data points to lower dimensional state. In novel technique they had combined the SVD and DCT technique. The DCT-SVD based technique takes more processing time and has less capacity and imperceptibility. To increase the efficiency of SVD technique the DWT and SVD methods are combined and new method is generated which has less processing time and more robust to different type of security attacks. But the proposed hybrid algorithm is more robust to security attacks due to which the PSNR values have been increased. Due to increase in the PNSR value, the image, get very much distorted. There are many filtering technique like Gabor filtering, salt and pepper filtering which improves noise in the image. We also set hypothesis that kalman filtering will gives better results as compare to other filters.

5 EXPERIMENTAL RESULTS

The entire process has implemented in MATLAB

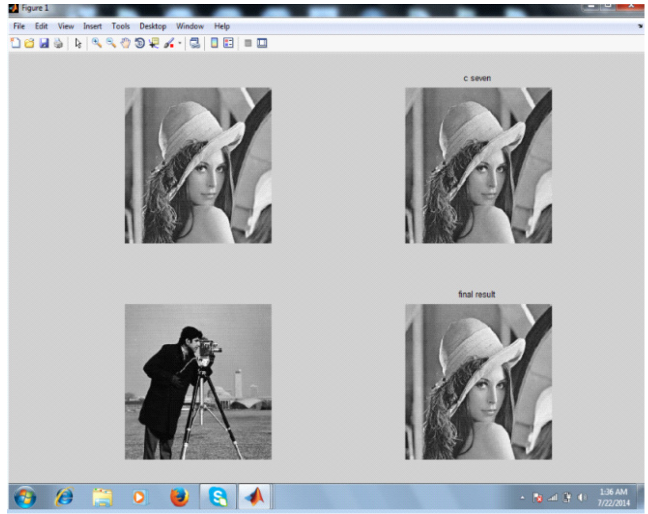

Fig 4.1

As illustrate in fig. 4.1, first image is input image i.e. original image. Second image is extracted after input value 7. Third image is watermarking image and fourth image is final result that is invisible watermarked image.

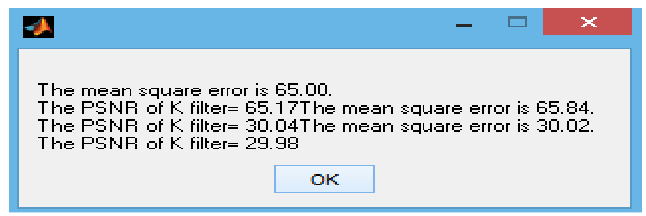

Fig. 4.2 Calculation of PSNR value of final image

As shown in figure 4.2, it shows calculation of PSNR of watermark image i.e. final image. If the watermark value id higher than PSNR value is also higher. PSNR value of final image is 29.98

As shown in above figure 4.3 salt and pepper image is extracted after applying salt and pepper attack.

Fig.4.4 After applied KALMAN FILTER

4.1 Robustness of Digital Watermarking

Image	Sharpened		contrast		Salt and Pepper	
	MSE	PSNR	MSE	PSNR	MSE	PSNR
Figure 1	43.22	31.83	69.12	29.77	42.91	31.83
Figure 2	54.23	30.82	137.96	26.77	54.39	30.81
Figure 3	46.29	31.53	103.71	28.01	46.14	31.49
Figure 4	65.03	30.05	244.29	24.29	64.73	30.02

Input Image	DWT-DCT-SVD by applying Kalman filter	
	MSE	PSNR
Figure 1	65.00	29.98
Figure 2	46.55	31.49
Figure 3	54.45	30.79
Figure 4	42.91	31.83

7. Conclusion

A digital watermarking system must successfully satisfy trade-offs between conflicting requirements of perceptual transparency, data capacity and robustness against attacks. There are some limitations in watermarking like noise, attacks etc. In this paper, we have many algorithms for watermarking techniques. After combing SVD-DCT-DWT, we have applied Kalman filter over it to decrease noise and increase its PSNR value.

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