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Digital Image Watermarking Using Discrete Fractional Fourier Transform for gray scale Image

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Abstract-- *This paper surveys in recent advances in watermarking techniques in digital images. Digital watermarking is to include subliminal information about multimedia information to provide a security service or simply a labeling application. It's possible to recover the embedded message, if the information is some non-destructive attacks, it's malicious or not. It's commercial application range from copyright protection to digital right management. . In my major work describe a watermark embedding technique for images using discrete fractional Fourier transform. In this method it's totally based on power and Location. After embedding and extracting when we get watermarked image than my work is if any noise attack will apply on that image than that message will distory at that t-time.*

Keywords-Watermarking, Advance Techniques, DFRFT, proposed work

I. INTRODUCTION

Watermarking is the process of embedding secret information (i.e. watermark) into digital multimedia data such as texts, audio, images, and video by taking into account the limitations of human perception system such as Human Auditory System(HAS) and Human Visual System(HVS). These techniques can be used on any type of digital data including still images, movies, and music [1]. The term digital watermarking first appeared in 1993, when Tirkel presented two watermarking techniques to hide watermark data in images [2]. Methods are based on change of least significant bits (LSBs) of the pixel values of an image.

A digital watermarking is a signal permanently embedded into digital multimedia data i.e., host signal (audio, video, images and text) that can be detected or extracted. That means of computing operations in order to make assertions about the multimedia data [3-5]. Hereby, watermarking is the multimedia data is still accessible but permanently marked.

Watermarks and attacks on watermarks are sides of the same coin. The goal of both is to preserve the value of the digital multimedia data. However, the goal of a watermark is to be robust enough to resist attacks but not at the expense of altering the value of the multimedia data being protected [3]. On the other hand, the goal of the attack is to remove the watermark without destroying the value of the protected data.

This paper is organized as follows: Section II describes The types of watermarking techniques, Section III describe Recent Advances Watermarking Techniques in Digital Images. Different spatial-domain and transform domain watermarking techniques are reviewed. Section IV describe the proposed work for the paper, Section VI challenges of Watermarking, Section VII describe the conclusion of the paper.

II. TYPES OF WATERMARKING

Each of the different types of watermarking techniques mentioned below has different applications.

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1) **Robust and Fragile Watermarking:** Robust watermarking is a technique in which modification to the watermarked signal will not affect the watermark. As opposed to this, fragile watermarking is a technique in which watermark gets destroyed when watermarked signal is modified or tampered with.

2) **Visible and Transparent Watermarking:** Visible watermarks are ones which are embedded in visual content in such a way that they are visible when the content is viewed. Transparent watermarks are imperceptible and they cannot be detected by just viewing the digital content.

3) **Public and Private Watermarking:** In public watermarking, users of the content are authorized to detect the watermark while in private watermarking the users are not authorized to detect the watermark.

4) **Asymmetric and Symmetric Watermarking:** Asymmetric watermarking is a technique where different keys are used for embedding and detecting the watermark. In symmetric watermarking, the same keys are used for embedding and detecting the watermarks.

5) **Blind and Non-blind Watermarking:** Watermarking in which original host signals is not required for watermark detection/extraction is known as blind watermarking. If original host signal is required in watermark detection/extraction then this watermarking is said non-blind (informed) type.

III. RECENT ADVANCES IN WATERMARKING TECHNIQUES IN DIGITAL IMAGES

Recently use of watermarking techniques can be grouped into three different classes. The first include the time-domain/spatial-domain watermarking techniques. In these techniques, the watermark signal is embedded by directly modified the sample values/pixel values of the original audio signal/image. The second class of watermarking includes the transform domain watermarking techniques in which watermark data is embedded in the transform-domain signal coefficients. The transform domain watermarking techniques have been found to have the greater robustness against common signal processing operation. The third class of watermarking is compressed domain watermarking in which watermark signal is embedded in compressed format of original host signal using some standard compression algorithms such as JPEG & JPEG2000 for images and MPEG-1 layer-3 (MP3) for audio signals. Compressed-domain watermarking is more popular for video data because most of the video material is available only in compressed format and the computational cost of completely decoding and the re-encoding the video for adding the watermark in some other domain can be really prohibitive. A part from this, considerations similar to those drawn for still images are also, in general, valid for video.

1) SPATIAL-DOMAIN WATERMARKING TECHNIQUES

In Spatial domain ,where copyright information is added by changing pixel values of host images.LSB(Least Significant Bit)is one of example of this technique. But such algorithms have low payload, they can be easily discovered and quality of image after embedding the copyright information and extracted watermark is not acceptable as pixel strengths are directly changed in these algorithms[6]

2) FREQUENCY-DOMAIN WATERMARKING TECHNIQUES

In this domain the Watermark is embedding into frequency coefficient of host image.This domain watermarking provide extra information hiding capacity and high robustness against vatious attacks.Frequency domain watermarking is more robust then Spatial domain Watermarking due to embedding of the watermark into altered frequency coefficients of the transformed image[6].

A.Discrete Fourier Transform(DFT)

This type of Transforms a continuous fuction into frequency components. It has robustness against geomatric attacks like rotation, scaling, cropping, translation etc[7].

B.Discrete Cosine Transform(DCT)

DCT like fourier transform, it represents data in terms of frequency space rather than an amplitude space. DCT based watermarking techniques are robust compared to spatial domain techniques[7].

C.Discrete Wavelet Transform(DWT)

The transforms are based on small waves, called waavelet, of varying frequency and limited duration.The wavelet transform decomposes the image into three spatial directions, i.e. horizonal, vertical and diagonal[7].

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IV. PROPOSED WORK

Several techniques to hide information are presented, terminology and possible related attacks, with specific attention on Steganographic and copyright schemes. In my major work describes a watermark embedding technique for images using discrete fractional Fourier transform. The idea is that a 2D discrete fractional Fourier transform of the image is computed, the robust watermark and fragile watermark embed in in the fractional Fourier transform (FRFT) domain of the image, and the watermark position and the transform order are used as the encryption keys. My proposed results indicate the embedded watermark is perceptually invisible and robust also compare with the discrete Fourier transform based method along with various image processing operations.

Discrete Fractional Fourier transform has several different definitions, and the various definitions forms are interrelated, different definitions have different interpretation. The basic definition of fractional Fourier transform is given by the angle from the linear integral transform, it reflects the most basic features of fractional Fourier transform. The p-order fractional Fourier transform of the function fit) defined in the u domain is a linear integral operator.

$$X_p(u) = F^p\{f(t)\} = \int_{-\infty}^{\infty} K_p(t,u) f(t) dt \qquad (2)$$

The kernel function of Fractional Fourier transform is,

$$K_p(t,u) = \begin{cases} \sqrt{\dfrac{1-j\cot\alpha}{2\pi}} \exp\left(j\dfrac{t^2+u^2}{2}\cot\alpha - tu\csc\alpha\right), & \alpha \neq n\pi \\ \delta(t-u), & \alpha = 2n\pi \\ \delta(t+u), & \alpha = (2n\pm 1)\pi \end{cases} \qquad (3)$$

$$= \sum_{n=0}^{\infty} e^{-jn\alpha} H_n(t) H_n(u)$$

Where , the inverse transformation of Fractional Fourier transform at order p is,

$$f(t) = F^{-p}[F^p(f(t))] \qquad (4)$$

Let.f(t) for a signal with sampling period T, then the p-order

$$f_p = \sum_{k=-\frac{N}{2}}^{\frac{N}{2}-1} f\left(k\frac{T}{N}\right) \sum_{n=-\infty}^{\infty} K_p\left(x, \left(n+\frac{k}{N}\right)T\right) \qquad (5)$$

When sampling the signal at the sampling frequency fs Is, the sampling time is, that is the sampling duration is Td the number of samples is n=Tdfs, the sampling signal is the uniform discrete by the interval of 1/fs in the time domain , and its and its corresponding discrete Fourier transform is the uniform discrete by the interval of 1/Td in the frequency domain [-fs/2,fs/2]The analysis range of discrete fractional Fourier transform at angle a is,

$$\left(-\sqrt{\frac{T_d^2}{4}\cos^2\alpha + \frac{f_s^2}{4}\sin^2\alpha}, \sqrt{\frac{T_d^2}{4}\cos^2\alpha + \frac{f_s^2}{4}\sin^2\alpha} \right) \quad (6)$$

The discrete resolution is,

$$\Delta = 2u_N / N = \sqrt{\frac{\cos^2\alpha}{f_s^2} + \frac{\sin^2\alpha}{T_d^2}} \quad (7)$$

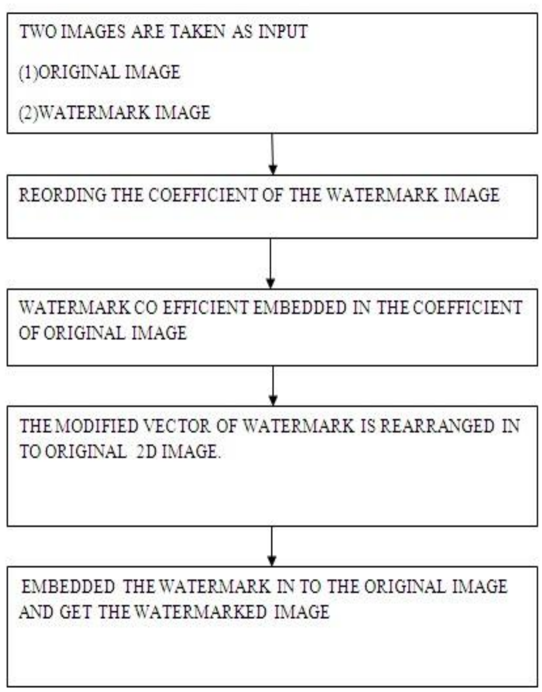
We use two-dimensional fractional discrete transform algorithm in dealing with digital images.

$$F_{\alpha,\beta}(u,v) = \sum_{m=0}^{M-1}\sum_{n=0}^{N-1} f(m,n)K_{\alpha,\beta}(m,n,u,v) \quad (8)$$

Its inverse is,

$$f(m,n) = \sum_{u=0}^{M-1}\sum_{v=0}^{N-1} F_{\alpha,\beta}(u,v)K_{-\alpha,-\beta}(m,n,u,v) \quad (9)$$

ALGORITHM :(Embedding)



ALGORITHM :(Extracting)

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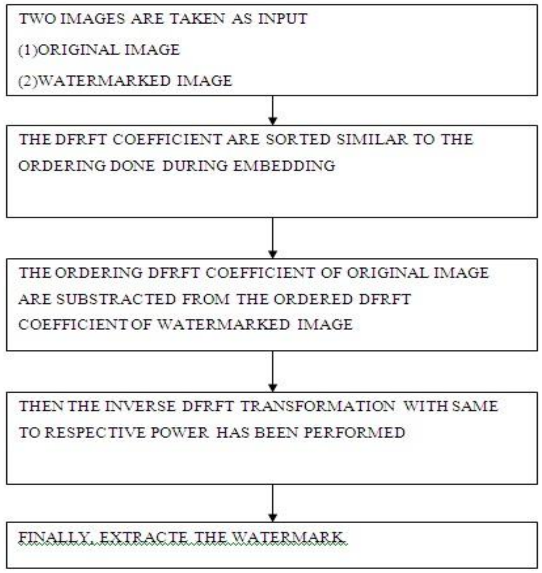

V. OUTPUT

(a) Original image

(b) Watermark image

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(C) Output image using invisible Watermarking

VI. CHALLENGES IN WATERMARKING

There are four criteria that can be used to measure the performance of an information hiding system. They are invisibility, robustness or security, payload ratio and computational cost. From the observation of the current watermarking systems, it can be seen that some of these criteria are less satisfied than others. The first criterion is invisibility. A watermarking system is of no use if it distorts the cover image to the point of being useless or even highly distracting. Ideally the watermarked imaged should look indistinguishable from the original even on the highest quality equipment.

The second criterion which is often overlooked when assessing system performance is robustness. Robust watermarking systems are expected to withstand different kind of attacks. Image compression, introduction of noise, low pass filtering, and image rescaling, cropping, rotation are some but a few of types of attacks that often are not addressed in most literatures. Both pixel domain and transform domain watermarking techniques share the same level of exposure to these attacks. There are a few tools that can be used to measure a system robustness level, e.g., Stirmark. Many of the proposed watermarking techniques aim at hiding data with large size. These techniques manage to hide image as large as, or even larger than, the cover image [8].

Show in below figure tradeoffs between robustness, invisibility and capacity, a good watermarking system should balance these three variables.

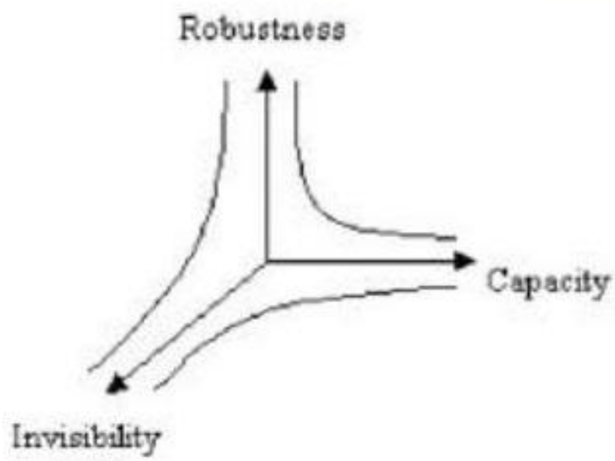

Fig. Tradeoffs between robustness, invisibility and capacity [9]

VII. CONCLUSION

Digital Image Watermarking can protect image, video, audio from unauthorized person, noise, copyright etc. DCT and DWT domain watermarking is comparatively much better than the spatial domain encoding since DCT domain watermarking can survive against the attacks such as Noising, compression, sharpening, , and filtering and also use JPEG compression method and DWT is used embedded zero-tree wavelet (EZW) image compression scheme and high frequency sub bands as LH,HL,HH etc. after this transform.

By using varying DFRFT powers in digital image watermarking in DFRFT domain watermark can be embedded. The DFRFT powers and watermark location can be used as secret keys for such type of watermarking techniques. It is not possible to extract watermark in DFRFT domain digital image watermarking without the knowledge of the above given secret key. In this technique all the watermarked images satisfy the imperceptibility criterion that is the difference between the watermarked image and the original image is not perceivable. Simulation result show that the extracted watermark image is very close to the original watermark image.

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