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Performance Analysis on Fingerprint Watermarking with its Transform Techniques

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Abstract: *In this paper discuss about the watermarking of a fingerprinting based to prevent the forgery users and also discuss the concept of a watermarking. In this paper enhancement process of a fingerprint like, binary thinning process, minutiae process etc. Also, discuss the techniques of a watermarking i.e. spatial domain and the frequency domain and also further divided into techniques process like a least significant bit(LSB), discrete wavelet transform etc. and to calculate the result analysis of a DWT based for an embedding and extracting process. To find out the image quality i.e. PSNR is high and the MSE is a low.*

Keywords: *Least Significant Bit(LSB); Discrete Wavelet Transform(DWT); Peak-signal-to-noise ratio(PSNR); Mean Square Error(MSE)*

I. Introduction

Fingerprinting is a biometric terms depend on a guarantee system benefit of a personal identification techniques. It provides the security of an unauthorized users. This does not allow an individual, other than the owner, to manipulate, duplicate, or access media information without owner's permission. "Digital watermarking" is a technique to protect the copyright data such as document i.e. audio, video, image and so on of a forgery person[1].Fingerprints are an unique biometric data mainly used for personal identification and authentication purpose. But while transmitting over network to serve the request of intelligence agencies in order to use them for identification purposes they may be susceptible to accidental or purpose attacks. It is necessary to conserve loyalty and also the prohibit modifications[2]. Fingerprint recognition has rapidly become the widely used technology in biometrics and forensic application. In a crime scene, fingerprints play an important role in terms of identification of criminals. Latent prints are very important in forensic as they are evidence of interaction between an individual and the surface containing the fingerprint impression[4]. Most importantly, alteration from traditional fingerprint processing may contaminate the evidence and even rule out further evaluation from other perspective. The fingerprints obtained in crime scenes are known as latent fingerprints. Latent fingerprints are either visible or not visible to human naked eye[5]. Forensic investigators use various techniques to make invisible prints visible. However, these techniques rely on adhesives and chemicals to detect, visualize and preserve latent fingerprints on the surfaces[3]. Several administrative, legal, and news organizations depend on the digital images to take major judgments or used as a photographable proof for a particular event. This digital image shows some difficulties, as the threat of digital images has matched with the prevalent accessibility of image editing software. It is necessary to provide digital images with good contrast and digital is requisite in various major fields, for example, vision, remote sensing & biomedical image investigation. Delivering visually normal images or transforming an image to enhance display the visual information enclosed in the image is a constraint for approximately all vision & image processing strategies. The fingerprint identification is an automated procedure to identify the identity of a person, based on comparison of stored fingerprint images with the input fingerprint images. These are conspicuous bio-metrics, utilized to check on computer systems. The fingerprints are the impressions or patterns that are existing in fingers of human with any age and over the time this pattern never alters[7]. In recent years, the fingerprint identification technique has attracted the interest of so many researchers, due to its several benefits. One of the best benefit is that it is very well acknowledged by the legal community. This identification technique is very fast, reliable, least cost and easiest way to recognize an individual. Also, this identification technique has been broadly acknowledged for its accurateness in authentication as the probability of identical finger of two different persons is exceptional. Fingerprint never changes until any physical disorder like accidents occurs or those who works in mechanical or metal industries with burning or hot materials which can harm finger prints. Fingerprints are very beneficial[6].

II. Fingerprint Process

A. Fingerprint minutiae

Fingerprints are the patterns formed on the epidermis of the fingertip. The fingerprint is composed of ridges and valleys. It is one of the best biometric of a minutiae fingerprint. It is mainly used in a criminal record. It is an unique identification of a person because different person of the different fingerprint. Termination and bifurcation are the two feature point of a personal identification[10].

(a) Ridge ending (b) Bifurcation

Fig.1. Types of local ridge features

B. Fingerprint recognition process

The process is performing of two phases:

a. Training (Enrollment).

b. Testing(Recognition).

During the training phase each fingerprint is captured by biometrics sensor or reader to generate digital image[12]. Fingerprints are consisting of a combination of ridges & valleys named as patterns. These patterns utilize for authentication by the pattern identification methods. Pattern identification is a best characteristic of the input images as identifying patterns of comprises and the retained relations. The pattern identification methods are classified as Structural & Decision of theoretic. Descriptors Relationships are utilized to define a pattern as the structural method. Whereas, area, length & texture descriptors are utilized to define a pattern in the decision theoretic method. The most significant category of fingerprint identification system is to expose the better descriptors, which are presented in a better way. The fingerprint identification system based on pattern works through creating data of input data images are created[7]. When the input parameters are provided, if these are matched with a database of feature vector & based on the result, authentication is allowed or rejected to the individual [11].

III. Digital Watermarking

Watermarking is not a new technique. Watermarking is a technique of concealed the communication Digital watermarking is somewhat similar to physical object watermarking, the technique of watermarking is used in digital content not for physical objects. In watermarking a low energy signal is embedded into another signal. In digital watermarking, there are two signals, one is low energy signal and other is main signal. The low energy signals contain some security information and main signal referred to as watermark. The cover signal contains information such as an audio clip, video sequence, still image also text document in digital format.

A. Types of a watermark

The majority of the pictures in the web, utilizes watermark to give validness as a part of terms of including a primary picture which is overlaid on the essential picture, and gives a method for securing picture. The watermark may be of two sorts visible or invisible.

1) Visible watermarking

Invisible watermarking a semi transparent visible image is applied to the primary image. In this of watermark a signal is changed such that the watermarked signal is totally different from the actual signal, for ex, including a picture as a watermark to another picture. It comprises of logo or seal of the association that permits the saw of essential picture, yet at the same time marks it obviously as the property of the owning association. The watermark doesn't absolutely cloud the essential picture; however, it does distinguish the proprietor and keeps the picture from being utilized without that recognizable proof connected. It is imperative to overlay the watermark in a manner which makes it hard to remove, if the objective of showing property rights is to be accomplished.

2) Invisible watermarking

In invisible watermarking semi straightforward picture which can't be seen, yet can be identified algorithmically. Flags in invisible watermarking don't change, all things considered, i.e, yet in the yield sign reflects just minor varieties. Case in point, in invisible watermark added a few bits to a picture changing just its slightest huge bits. Diverse sorts of invisible watermarks contain distinctive application innovation, for example,

- A watermark which is destroyed when the picture is controlled digitally in any capacity may be valuable in demonstrating genuineness of a picture. In the event that the watermark is still in place, then the picture has not been 'doctored'. In the event that the watermark has been demolished, then the picture has been messed around with. Such an innovation may be essential, for instance, in conceding digital pictures as proof in court.
- An imperceptible watermark which is extremely impervious to decimate under any picture control may be helpful in confirming responsibility for pictures associated with misappropriation. Digital identification of the watermark would demonstrate the source of the picture. For media watermarking, the definition is conceptually straightforward the watermark is either visible (or audible) to a human, or not. The definition of visibility/audibility is a characteristic of humans whose perceptual characteristics are now fairly well defined. For data, it is the application that defines `visibility' (which can also be described as detectability, or on influencing, or biasing the interpretation of the marked data by the application.

3) Blind watermarking system

A watermarking technique is said to be blind, if to extract the watermark from watermarked data it does not need original image. The blind watermarking system is also known as oblivious. The blind watermarking system is more popular because it decreases the overhead of cost and memory for storing original data.

4) Non –blind watermarking system

It requires the original data to essence the watermark is known as non-blind watermarking system, it is also robust than the blind watermarking system.

5) Robust watermarking system

A watermarking system is said to be robust, if any, modification on the watermarked data results in no change in watermark value. That is extracting watermark information from the tampered watermarked data would be same as original watermark information. A robust watermarking system resists against a wide range of intentional and unintentional attacks such as, image enhancement, filtering, noise addition, JPEG compression and geometrical transformations, collusion and forgery attacks. Robust watermarking systems have been proposed to be implemented in a number of applications. Such as copyright protection, finger printing and access control. Copyright protection is one of the main applications of robust watermarking system. In copyright protection application the idea is to embed information about the copyright owner in the multimedia data to prevent parties from claiming to be the rightful owners of the data. The robust watermark embedded into the content is detectable despite common image processing manipulations. Fingerprinting is utilized to follow approved clients who abuse the permit understanding and disperse the copyrighted material unlawfully. Thus, the information embedded in the content is usually about the customer such as customer’s identification number.

6) Fragile watermarking system

In fragile watermarking system embedded watermark in host data can be easily destroyed. This property is useful to identify whether a multimedia data is modified/ manipulated or not? By embedding, then fragile watermark into multimedia data, the authenticity of multimedia data can be achieved. Any small manipulation of the watermarked data will lead to distortion in corresponding embedded fragile watermark. At the end side by comparing the extracted watermark with original watermark, it can be easily identified whether the multimedia data is manipulated or not. The different applications where fragile watermarking can be used are document authentication, evidence authentication, complete authentication etc.

B. Characteristics of a digital image watermarking

Digital watermarking procedures have the accompanying primary components for inserting meta information in media content.

1) Imperceptibilty

The watermark included is intangible both factually and perceptually and don't change the style of mixed media content that is watermarked. In the still pictures watermark doesn't make obvious relics, alter the bit rate of the feature or set up discernable frequencies in sound signs.

2) Robustness

On the premise of use, the digital watermarking method support diverse levels of strength against changes in watermarked picture. In the event that digital watermarking is utilized for possession distinguishing proof, then the watermark must be robust against any alterations. The watermark thought not devastated or corrupted as a consequence of geometric contortions or a malignant sign like simple to advanced transformations, digital to-simple transformation, resampling, trimming, turn, scaling and pressure of the substance. Whereas though it is utilized as a part of substance validation, the watermark ought to get demolished because of the delicacy and if the substance gets changed that can be effortlessly distinguished. In the design of any watermarking scheme, the ability to withstand host data distortions introduced through standard and legitimate data processing is defined as robustness . Standard data processing includes all host data manipulations and modifications that the data might undergo during its distribution chain. Examples of such processing in media domain are lossy compression, rotation, quantization, noise reduction, delay, and so on. Based on the degree of resistance, a watermark could be either fragile or robust. A fragile watermark fails to be detectable even after the slightest modification to the host data and therefore is useful for tamper prolong usages. In contrast, a robust watermark often considered resistant against both intentional and unintentional watermark damages as robustness. For brevity, we only consider resilience against any modifications that have relevance to the watermark extraction, but not to the application, as it is within noise levels, and treat resilience against any modifications beyond that as security. The robustness requirement can vary greatly due to different targeted applications. Consider a monitoring application where enormous quantities of data are streamed through a network[9].

3) Inseparability

After the digital substance is inserted with watermark, isolating the substance from the watermark to recover the first substance is unrealistic.

4) Security

As far as security it keeps unapproved access of clients from distinguishing and adjusting the embedded watermark in the spread sign. Watermark keys give certification that an unapproved client never ready to recognize/adjust the watermark. Regardless of the data type, we have identified a few challenges for watermark security herein. Firstly, the separation between watermark security and watermark robustness can be very well-defined. security is the watermark resistance against any intentional attempt by an adversary to impair watermark detection, as opposed to the normal data processing that a robust watermark should survive. This isolation assumes that the intention behind every operation is known and deterministic. In a real scenario, an innocent-looking operation might compromise the watermark usability, but one may not necessarily be able to say whether it is deliberate or not[9].

5) Capacity

Data capacity refers to the amount of information one can embed into any single piece of data. A watermark that encodes n bits, can embed 2n different messages and is referred to as multiple bit watermarking. In contrast, a zero bit watermark carries no hidden message, which means only the presence/absence of a watermark can be investigated. Also, capacity is sometimes given relative to the size of the host data. For instance, the capacity of a watermarked video can be measured by number of embedded bits per frame. Some other references, consider the number of correctly retrieved bits as the watermark capacity.

IV. Enhancement Techniques

The enhancements techniques have been broadly categorized as: spatial domain based and frequency domain based. The spatial domain based enhancement focuses on the pixels present in the image and operates on them. The benefit of improving an image using this approach is the simplicity of the method and easy implementation in real time. However, the problem is inadequate robustness. The frequency domain based methods operate on the frequency coefficients of the image through the applications of mathematical functions and signals. The transform coefficients are manipulated to enhance the image. These include methods like discrete cosine transform, discrete wavelet transform and Fourier transform. The benefit of this approach is easy computation functions and complex properties of domain can be implemented with less complexity. One of the oldest techniques employed for image enhancement is improvement of the contrast. In a fingerprint image acquired from a source, it is noticed that the grey and white level might not be uniform. This results in making the image darker at one end and lighter at other. Histogram equalization enhances the visible aspect and the modification of the grey levels results in stretching the image color equally throughout [8].

A. Spatial domain method

This technique are directly embedded to the pixel value of an image. Gray level image and the color image both the use of a spatial domain method. It is a less robust than the frequency domain method. It is also a low computational tool. It is also a lossless compression of an image. For lossy compression schemes like JPEG, some of the message bits get lost during the compression step.

1) Least significant bit

For hiding information inside the images, the LSB (Least Significant Byte) technique is typically used. To a PC a picture document is essentially a record that shows diverse hues and intensities of light on distinctive zones of a picture. It is a 8 bit digit is used into the original image to protect the unwanted users. Basic method of data hiding in an image is given as-:

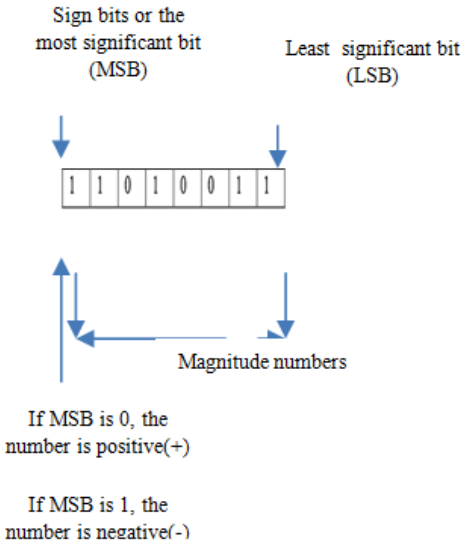

Fig.2. Least Significant Bit

B. Frequency domain method

Here we can implant watermark in DCT, DFT, FFT spaces and so forth. The primary quality offered by change area procedures is that they can exploit properties of exchange spaces to address the restrictions of pixel-based systems or to support extra components. A possible disadvantage of spatial procedures is that they are not exceptionally hearty against attacks. Notwithstanding this, adaptive watermarking strategies are some more troublesome in the spatial space. Both the robustness and quality of the watermark could be enhanced if the properties of the spread picture could also be misused. For example, it is by and large desirable over conceal watermarking data in loud districts and edges of the pictures, somewhat then in smoother areas. The advantage is twofold; Degradation in smoother locales of a picture is more noticeable to the HVS, and turns into a prime focus for lossy compression plans. Bring these perspectives, working in a frequency space or something to that affect turns out to be exceptionally appealing.

1) Discrete wavelet transform

In Wavelet theory is usually utilized in the signal processing. But, then the traditional wavelet transformation displayed some restrictions on the 2-D image processing. The image processing technique is a collectively partial differential equation & the wavelet theory can perform in a better way by holding the information of the image edge. This wavelet transform method can be utilized on the fingerprint patter to carry out the authentication. Wavelets are helping to cut down the input data images into various frequency components. Then every element is observed with a determination method of scale. The fingerprint images are divided by utilizing discrete wavelet transform in the wavelet based approach. Three stages of decomposition of fingerprint images are executed for the purpose of training. In the time of the decomposition procedure mean & standard deviation is utilized. To classify these fingerprint patterns, that are rotated from 0 to 360 degrees & also every step is increased by 10 degrees. After that, a set of values of wavelet statistic and co-occurrence feature are defined. It can be clearly stated that the directional resolving power of wavelets mines, texture information in LL, LH, HL & HH diagonal directions. Image preprocessing of finger printing or post processing are not required in wavelet based fingerprint recognition systems. Wavelet based pattern recognition technique are fast enough in contrast to minutiae based method. Another one benefit of the wavelet is that it performs at the least three levels of texture splits that make an automatic fingerprint identification system perfect. This is the

drawback of texture analysis systems because the images are observed at a single scale[4]. It split up into the two parts, first is high frequency and the another is low frequency. This process is continuing until the signal has been entirely decomposed or stopped before by the application at hand. For compression and watermarking applications, generally no more than four decomposition steps are computed.

Wavelet transform is both time-frequency domain combined analysis method. Its main feature is multi-resolution analysis. The DWT divides the input image into four Sub-images which are non-overlapping multi-resolution sub bands LL, LH, HL and HH. The LL sub-band represents the coarse-scale (approximation) DWT coefficients and the three LH, HL and HH sub-band represent the fine-scale (detail) coefficients of DWT. Because of excellent spatio frequency localization properties of DWT, the DWT is useful to identify the region in host image where a watermark can be embedded effectively[10].

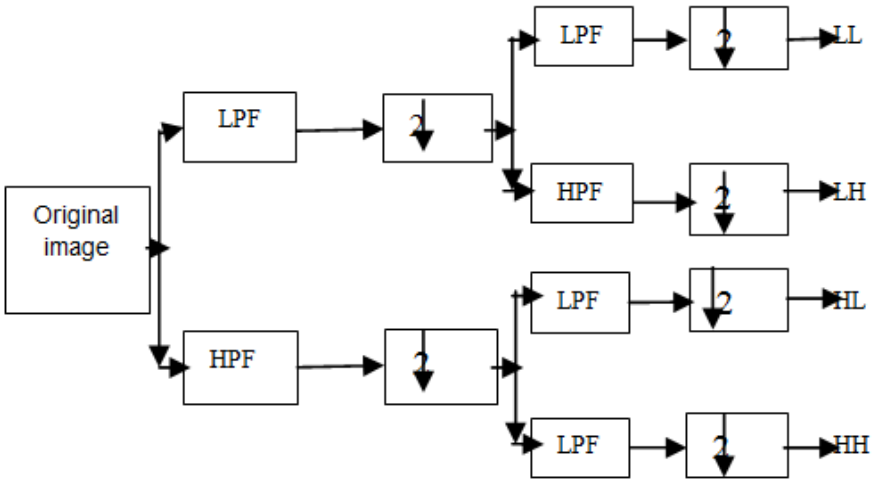

Fig.3. Discrete Wavelet Transform

C. Parameters

The parameters PSNR, MSE, Accuracy, FMR and FRR are as follows**.**

1) Calculate Mean Square Error (MSE) value of watermarked and cover image.

Where x is cover image, x^ is watermarked image, N is the size of cover image.

2) Calculate Peak Signal Noise Ratio (PSNR) value of watermarked and cover image.

Where m is the maximum value of the cover image.

3) False Matching Rate

It is the probability that the system will decide to allow access to an (FMR) imposter

The imposter attempts are implemented through matching all input image with every template images. False match was recorded for the every imposter attempt when matching score was greater than the established threshold.

V. Literature Survey

[8] This paper use the major challenges of the Automatic Finger print Recognition System. This paper use the filter technique to remove the blur and the noise of a salt and pepper and also a Gaussian noise. This paper is calculate to the PSNR and a MSE value for a result analysis. This paper work to the various type of the enhancement technique. The experimental result shows that the feature of an image enhancement and to check the quality of the image like ridge and valley. Also, in this paper is used to the latent image and it is extracted fingerprint from FVC2004.

[6] This paper use the fingerprint identification for an person unique in a recent years. It is the concept of a biometric system. This paper improve the technology of a fingerprint is used to the various type of the fingerprint image. It is the biometric technique used to prevent the copyright data. There are the different approach used as a pattern recognition, wavelet etc .Wave atom is one of the best new geometric multi scale multidirectional transform that is suitable for the representation of the fingerprint structures. Fingerprint recognition is used as a minutiae based method. It is also provides the accuracy and the robustness of this fingerprint concept. With compare to other existing method, Wave Atom Transform and Modified Cuckoo Search (MCS) algorithm, provides the better results of a PSNR value.

[12]This paper use the various types of applications for a fingerprint recognition which is used for different purposes. Fingerprint Recognition system is divided into the four stage- The acquisition stage to capture the fingerprint image and the second stage is Pre-processing to the enhancement, binarization, thinning

of the fingerprint image and the third stage is Feature Extraction to extract the feature of ridge ending and the ridge bifurcation from the thinning image and the fourth stage is matching to the two minutiae points one is an identification and the another is verification. In this paper, FVC2000 and FVC2002 are the two fingerprint database, the FVC2002 database perform better results compare the FVC2000 database. Euclidean distance algorithm is used the minutiae point to find the similarity score of the fingerprints images. The future work is used to the concept of a neural network and fuzzy logic in order to enhance the performance of fingerprint recognition system.

VI. Result Analysis

Comparative Result of the DWT Image Based

Serial no.	**Images**			
	Original image	***Waterma rk image***	***Embed image***	***Extracted image***
1				
2				
3				
4				

Comparative Result of the Embed And Extract Image

SERIAL NO.	**Embed image**		**Extracted image**	
	PSNR	***MSE***	***PSNR***	***MSE***
1	7.6488	1.1174	7.6322	1.1217
2	7.1422	1.2556	7.1235	1.2611
3	7.6427	1.1189	7.6248	1.1236
4	7.1797	1.2448	7.1797	1.2498

VII. conclusion

In future work, different enhancement techniques is used for the concept of a fingerprint based watermarking and also the increase the comparative result of the DWT based or the different techniques like a DWT and a FFT is used to compare the better result than this paper DWT techniques is used. And also the color image in a future processes for an enhancement the image.

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