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Watermarking Relational Databases using Genetic Algorithm & Bacterial Foraging Algorithm

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Abstract

The vast usage of digital multimedia content in public communication system has raised an increasingly important issue for content owners and service providers. Digital watermarking provides techniques to hide watermarks into digital content to achieve copyright protection and prevent its illegal copy or reproduction. This paper proposes a novel method for watermarking relational databases based on hybrid model optimization in which the embedding and extracting algorithms of watermarking in discrete wavelet transform (DWT) are combined with Genetic Algorithm (GA)-Bacterial Foraging Algorithm (BFO) based optimization techniques for watermarking. We use the 5-level DWT for the spatial transform; because of this we get the more accurate watermark. Identification of owner is cryptographically made secure and used as an embedded watermark. Strength of BFA is explored to make the technique robust, secure and imperceptible.

Keywords— Watermarking, Bacterial Foraging Algorithm, Genetic algorithm, DWT, PSNR, MSE and Image Processing

I. INTRODUCTION

Before the invention of steganography and cryptography, it was challenging to transfer secure information and thus, to achieve secure communication environment. Hackers are the people who tend to change the original application by modifying it or use the same application to make profits without giving credit to the owner. Hence, protection techniques are required to be efficient, robust and unique to restrict malicious users. This lead to the development of the new technology called "Watermarking". To achieve protection watermark is permanently embedded in the digital data to identify its origin. The goal of Watermarking is to allow parties to

converse covertly in such a way that an attacker cannot tell whether or not there is hidden meaning to their conversation.

Based on the method used for watermark embedding and extraction, invisible watermarking techniques are of three types– Spatial Domain, Frequency Domain and Mixed Domain. Invisible Watermarking is an optimization problem. There is a wide tradeoff between the two requirements- invisibility and robustness. Moreover various techniques show different level of robustness to different types of attacks. Therefore this research study aims for Performance optimization of invisible watermarking based on creation and robust extraction.

Surekha et al. [1] have proposed a new optimization method for digital images in the Discrete Wavelet Transform (DWT) domain. The tradeoff between the transparency and robustness is considered as an optimization problem and is solved by applying Genetic Algorithm. Particle swarm optimization (PSO) is a new promising evolutionary algorithm for the optimization and search problem. One problem of PSO is its tendency to trap into local optima due to its mechanism in information sharing. This paper proposes a novel hybrid PSO, namely (HPSO) technique by merging both a mutation operator and natural selection to solve the problem of premature convergence [2]HPSO is proposed to improve the performance of fragile watermarking based DCT which results in enhancing both the quality of the watermarked image and the extracted watermark.

Mona M. Suliman[2] et al have incorporated PSO with GA in hybrid technique called GPSO. This paper proposes the use of GPSO in designing an adaptive medical watermarking algorithm.

S. M. Ramesh[5] et al. have presented an efficient image watermarking technique to defend the copyright protection of digital signatures. The major steps include the watermark embedding and watermark extraction. This work is implemented to watermark the original input medical image. The grayscale digital signature image as a watermark and it is embedded in the HL and LH sub-bands of the wavelet transformed image.

Chaudhary et al. [6] have presented a new method for adaptive watermark strength optimization in Discrete Cosine Transform (DCT) domain. The DCT sub-band is selected using Genetic Algorithm (GA) and watermark strength is intelligently selected through Particle Swarm Optimization (PSO)[8, 9]. In past years, singular value decomposition SVD-based watermarking technique and its variations has been proposed. The proposed work is based on further improvement of the research work based on DCT, DWT, and optimization based on PSO, GA. Significantly better results have been yielded with the single level DWT, and an optimization of Robustness and imperceptibility based on the hybrid technique of GA[10] and PSO is achieved.

II. PROPOSED TECHNIQUE

This section illustrates the overall technique of our proposed algorithm. The proposed watermarking system consists of two subsystems:

1. Watermark Encoder and
2. Watermark Decoder.

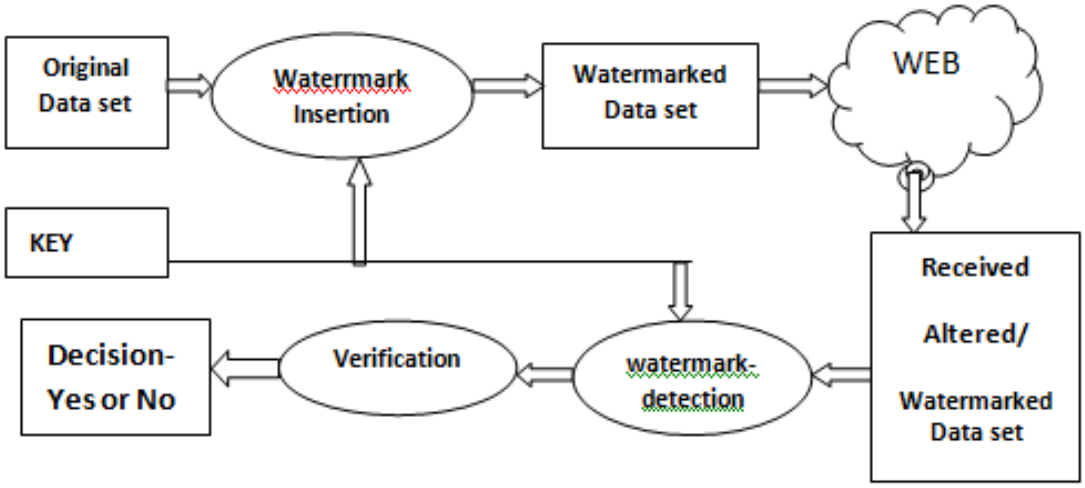

Fig1: Digital watermarking scheme

There proposed techniques are given below:

Embedding Process

In Embedding process, we have the inputs: original image and one watermark image, and output is watermarked image. By using Haar wavelet transform, the original image is decomposed into four sub-bands like HH, LL, HL and LH for embedding watermark image. Choose the HL and LH sub-bands for embedding the watermark image from the four sub-bands. Most techniques are utilizing these aforementioned two parts only for this purpose. So, here also we are using these parts because producing high PSNR and robustness for hiding information in different media and approximation coefficients are thought to be reasonably firm and less sensitive to slight changes of the image pixel, they are the perfect embedding area.

Extraction Process

Here the inputs are watermarked image I, size of the watermarking image Is, and an output is extracted watermarking image Io. Due to wavelet transform the obtained watermarked image is decomposed into different sub bands such as HH, HL, LH and LL for extracting the watermark image. In order to achieve both quality of watermarked media and robustness of the watermarked media, we use the Genetic algorithm (GA) and BFO algorithm.

There are some parameters which used in this paper.

A. MSE:

Mean Squared Error is essentially a signal fidelity measure. The goal of a signal fidelity measure is to compare two signals by providing a quantitative score that describes the degree of similarity/fidelity or, conversely, the level of error/distortion between them. Usually, it is assumed that one of the signals is a pristine original, while the other is distorted or contaminated by errors. The MSE between the signals is given by the following formula:

$$MSE = (1/N)\Sigma i|x\ (i)- e\ (i)|^2$$

Here x and e are the encrypted watermarked audio signals respectively and N is the number of samples in the audio signal.

B. BER:

Bit error rate refers to the amount of watermark data that may be reliably embedded within a host signal per unit of time or space, such as bits per second or bits per pixel. A higher bit rate may be desirable in some applications in order to embed more copyright information. In this study, reliability was measured as the bit error rate (BER) of extracted watermark data. The BER (in percent) is given by the expression:

$$Q(x) = \frac{1}{\sqrt{2\pi}} \int_x^{\infty} \exp\left(\frac{-u^2}{2}\right) du$$

Where x is a function of the block size.

C. PERCEPTUAL QUALITY:

Perceptual quality refers to the imperceptibility of embedded watermark data within the host signal. In most applications, it is important that the watermark is undetectable to a listener or viewer. This ensures that the quality of the host signal is not perceivably distorted, and does not indicate the presence or location of a watermark. In this study, the signal-to-noise ratio (SNR) of the watermarked signal versus the host signal was used as a quality measure:

$$SNR = 10 \cdot \log_{10} \left\{ \frac{\sum_{n=0}^{N-1} x^2(n)}{\sum_{n=]}^{N-1} \left[\tilde{x}(n) - x(n)\right]^2} \right\}$$

D. PSNR

Embedding this extra data must not degrade human perception about the object. Namely, the watermark should be “invisible” in a watermarked image or “inaudible” in watermarked digital music. Evaluation of imperceptibility is usually based on an objective measure of quality, called peak signal to noise ratio (PSNR), or a subjective test with specified procedures. The PSNR values can be obtained using following formula-

$$PSNR=20\log10\ (pixel\_value/\sqrt{mse})$$

These all given parameters are important factor in watermarking techniques.

Improvements of our work: The main improvements in our work are Discreet Wavelet Transform (DWT). In the proposed work the Watermarking technique with 5-level DWT using BFO algorithm and GA is presented. The DWT allows good localization both in time and spatial frequency domain. When we use 5-level DWT then PSNR is increased and MSE decreases as compared to 3-level DWT.

III. EVALUATION AND RESULTS

To verify the effectiveness (qualities and robustness) of the proposed watermarking technique, we conduct several experiments with this procedure. Here are some steps of the proposed technique given below:

Phase 1:

Firstly we develop a particular GUI for this implementation. After that we develop a code for the loading the Cover Image and message image or message in the Matlab database.

Phase 2:

Develop a code for the Discrete Wavelet Transform and Inverse Discrete Wavelet Transform with partitioning technique. After that we apply DWT on the selected image and develop code for GA & BFO algorithm. When we apply the GA & BFO algorithm on the image then we get more accuracy than another technique.

Phase 3:

Develop a code for the finding the watermarked data. Then we get the image with message data this is called Embedding technique. For the embedding process we apply the key for the security purpose.

Phase 4:

After that we develop code for the extraction process. Within the extraction process we develop coed for the message extraction from the watermarked file using IDWT. After the extraction process we get the original image and message data by using the key.

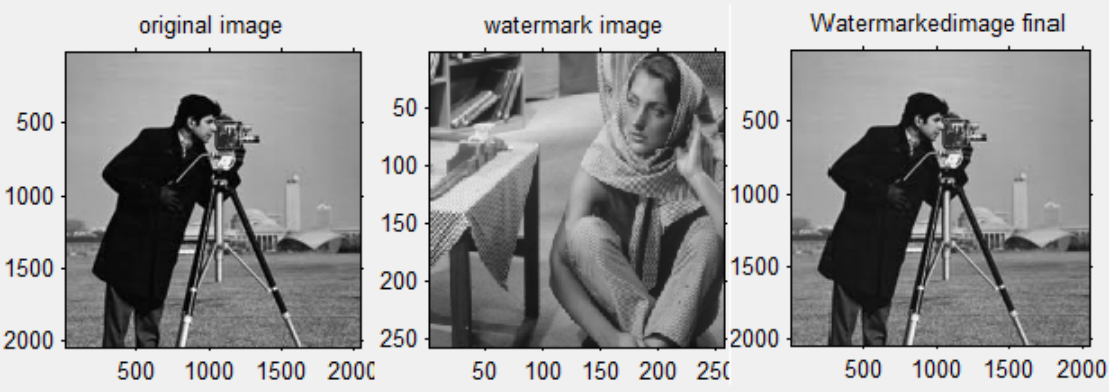

Fig 2. i) original image, ii)watermark image, iii)watermarked image

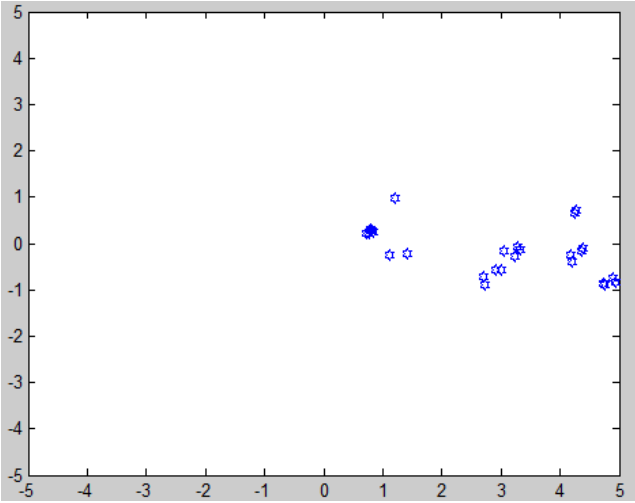

Fig 3. BFO optimization

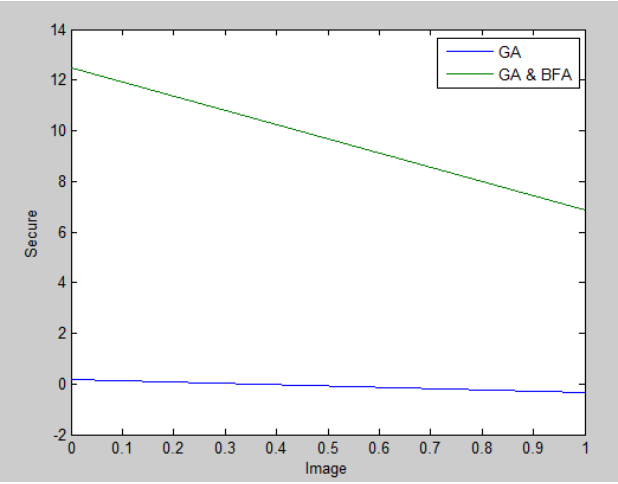

Fig 4. Comparison of GA and BFA with 5- level DWT

IV. CONCLUSION & FUTER SCOPE

In this paper, We proposed a method for watermarking relational databases for identification and proof of ownership based on the secure embedding of blind and multi-bit watermarks based on 5-level DWT using Bacterial Foraging Algorithm (BFA). When we use 5-level DWT then PSNR is increased and MSE decreases as compared to 3-level DWT. Watermarking technique is applied with DWT using BFO algorithm and GA. The DWT allows good localization both in time and spatial frequency domain. Transformation of the whole image introduces inherent scaling better identification of which data is relevant to human perception higher compression ratio. For future scope use it with 5-level DWT and ACO algorithm.

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