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A WATERMARKING RELATIONAL DATABASE BASED ON 5-LEVEL DWT USING GENETIC ALGORITHM & PSO

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ABSTRACT

A watermarking scheme for digital images based on Particle Swarm Optimization (PSO) in the Discrete Wavelet Transform (DWT) is proposed. The watermark is inserted into the DWT sub bands which have the most important coefficients. The robustness of proposed scheme is empowered by applying the PSO. PSO optimizes the imperceptibleness of the watermark and the quality of the watermarked image which results in identifying the optimal / nearly optimal embedding positions. A series of experiments were carried out using different host images with different watermarks under different attacks. It has been shown that the approach is robust against several watermarking attacks that may meet the watermarked image. Identification of owner is cryptographically made secure and used as an embedded watermark. An improved hash partitioning approach is used that is independent of primary key of the database to secure ordering of the tuples. Strength of PSO is explored to make the technique robust, secure and imperceptible. In this paper, we have prearranged for a brief overview about the proposed hybrid model optimization in which the embedding and extracting algorithms of watermarking in discrete wavelet transform are combined with GA-PSO based optimization techniques for watermarking. The key parameters to be concentrated for this proposed model are orthogonality, symmetry and compact support which will enable the model to achieve a better watermarked media and robustness in watermarking. The watermarking technique proposed in this work may be very effective against different low-frequency an attack that demolishes the low frequency component of the image. For the implementation of this proposed work we use the Image Processing Toolbox under Matlab software.

KEYWORDS: Watermarking, PSO, Genetic algorithm, DWT, PSNR, MSE and Image Processing.

INTRODUCTION

Before the invention of steganography and cryptography, it was challenging to transfer secure information and, thus, to achieve secure communication environment. Some of the techniques employed in early days are writing with an invisible ink, drawing a standard painting with some small modifications, combining two images to create a new image, shaving the head of the messenger in the form of a message, tattooing the message on the scalp and so on. Normally an application is developed by a person or a small group of people and used by many. 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. It is obvious that hackers are more in number compared to those who create. Hence, protecting an application should have the significant priority. Protection techniques have to be efficient, robust and unique to restrict malicious users. The development of technology has increased the scope of Steganography and at the same time decreased its efficiency since the medium is relatively insecure. This lead to the development of the new but related technology called "Watermarking". Some of the applications of Watermarking include ownership protection, proof for authentication, air traffic monitoring, medical applications etc. Watermarking for signal has greater importance because the music industry is one of the leading businesses in the world. Watermarking is the practice of hiding secret messages (hidden text) within every day, seemingly innocuous object (cover text) to produce a stego text. The recipient of a stego text can use his knowledge of the particular method of Watermarking employed to recover the hidden text from the stego text. 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. It contains two main branches: digital watermarking and steganography. The former is mainly used for copyright protection of electronic products. While steganography, as a new way of covert communication; the main purpose is to

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convey data secretly by concealing the very existence of communication. The carrier for steganography can be image, text, audio and video. Image is the most familiar carrier, but the limited size of image will inevitably restrict the capacity of embedding. In the case of requiring transmitting large number of secret messages, steganography in image will not satisfy the demand.

Human Visual System (HVS) has a very strong error correction. An image contains a lot of redundancies. Small changes are undetected. 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 requirement- 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. 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 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 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. 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). 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 and PSO is achieved.

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.

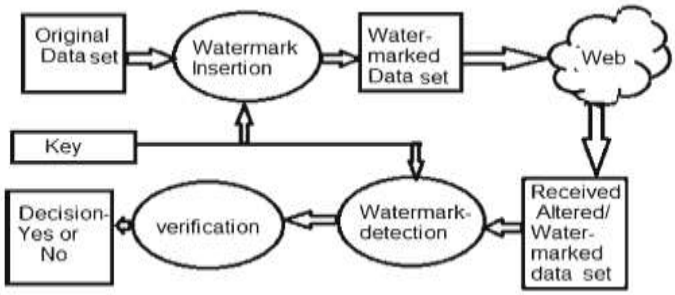

Figure1: Block diagram of digital watermarking scheme

There purposed 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

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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 PSO algorithm.

There are some parameters are give which used in this papers.

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:

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

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

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.

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:

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

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=20log10(PIXEL_VALUE/√M SE)

These all given parameters are important factor in watermarking techniques.

PSO
Particle swarm optimization (PSO) is a population based stochastic optimization technique developed by Dr. Eberhart and Dr. Kennedy in 1995, inspired by social behavior of bird flocking or fish schooling. PSO shares many similarities with evolutionary computation techniques such as Genetic Algorithms (GA). The system is initialized with a population of random solutions and searches for optima by updating generations. However, unlike GA, PSO has no evolution operators such as crossover and mutation. In PSO, the potential solutions, called particles, fly through the problem space by following the current optimum particles. Each particle keeps track of its coordinates in the problem space which are associated with the best solution (fitness) it has achieved so far. (The fitness value is also stored.) This value is called*pbest*. Another "best" value that is tracked by the particle swarm optimizer is the best value, obtained so far by any particle in the neighbors of the particle. This location is called *lbest*. when a particle takes all the population as its topological neighbors, the best value is a global best and is called *gbest*. The particle swarm optimization concept consists of, at each time step, changing the velocity of (accelerating) each particle

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toward its p*best* and *lbest* locations (local version of PSO). Acceleration is weighted by a random term, with separate random numbers being generated for acceleration toward *pbest* and *lbest* locations. In past several years, PSO has been successfully applied in many research and application areas. It is demonstrated that PSO gets better results in a faster, cheaper way compared with other methods. Another reason that PSO is attractive is that there are few parameters to adjust. One version, with slight variations, works well in a wide variety of applications. Particle swarm optimization has been used for approaches that can be used across a wide range of applications, as well as for specific applications focused on a specific requirement.

Improvements of our work: The main improvements in our work are Discreet Wavelet Transform (DWT). In the purposed work we present the Watermarking technique with DWT using PSO 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.

EVALUATION AND RESULTS

To verify the effectiveness (qualities and robustness) of the proposed watermarking technique, we conduct several experiments with this procedure. There are some steps of our proposed technique are 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 & PSO algorithm. When we apply the GA & PSO algorithm on the image then we got more accuracy than another technique.

Phase 3: Develop a code for the finding the watermarked data. Then we got 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 got the original image and message data by using the key.

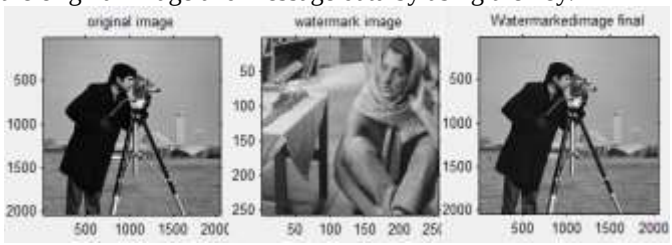

Fig.2. i) original image, ii) watermark image, iii) watermarked image

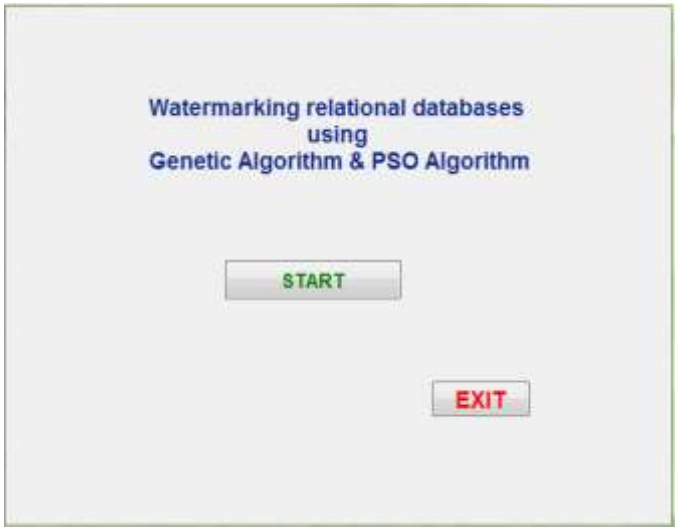

Fig.3 Main figure window

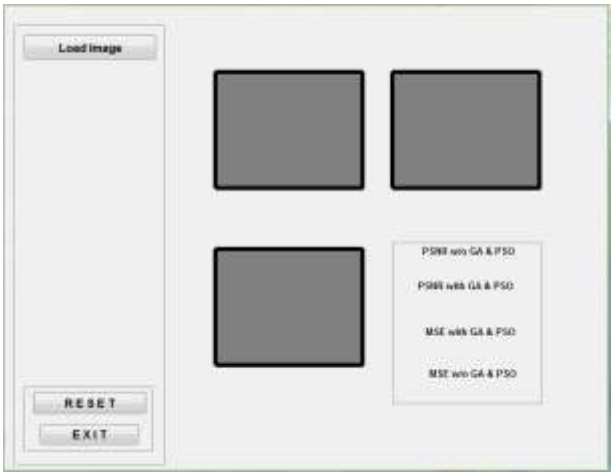

Fig.4 working panel window

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Fig.5. Running panel window

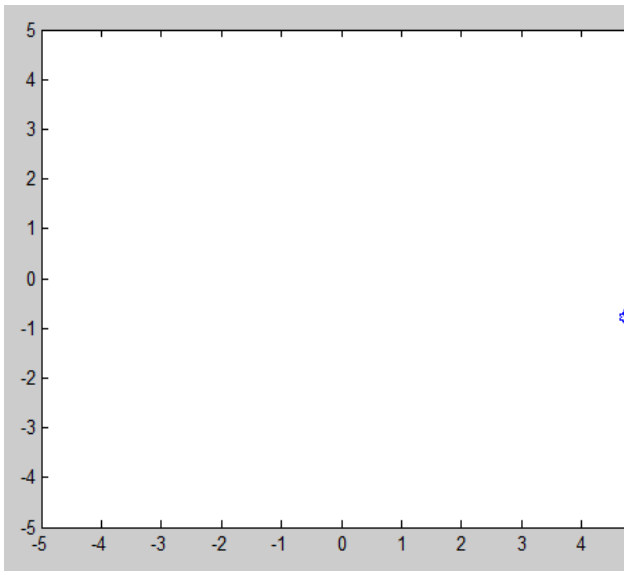

Fig.6. BFO optimization

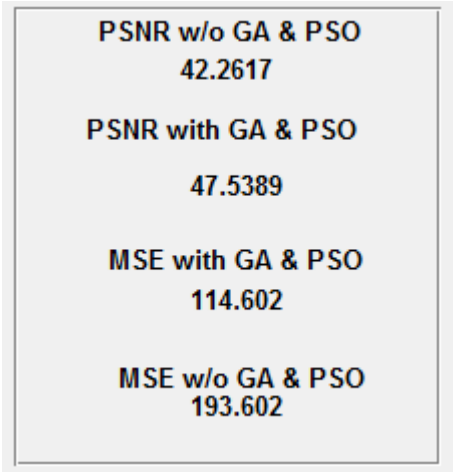

Fig.7. PSNR & MSE Table

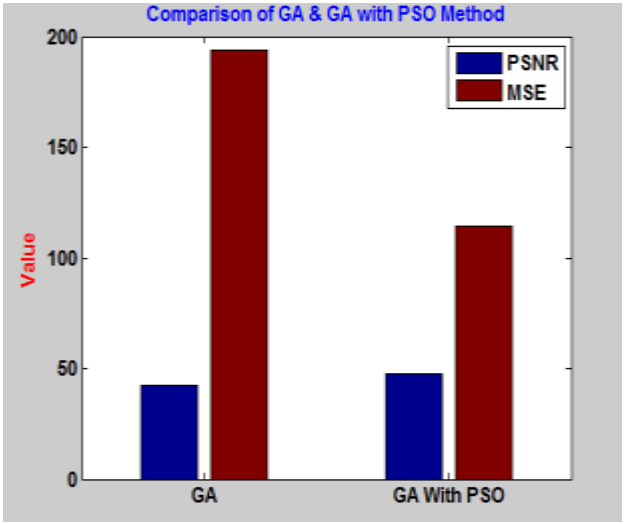

Fig.8. Comparison graph

CONCLUSION

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 using PSO. Bacterial Foraging Algorithm (BFA) is also use for the comparison purpose between watermarking through PSO & BFA technique. The particle swarm optimization concept consists of, at each time step, changing the velocity of (accelerating) each particle. Feasibility of BFA implementation is shown in the framed watermarking databases application. 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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