[Satbir Kaur *et al.*, 5(7): July, 2016]
IC™ Value: 3.00
ISSN: 2277-9655
Impact Factor: 4.116

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

# A REVIEW PAPER ON MEDICAL IMAGE WATERMARKING FOR COPYRIGHT PROTECTION BASED ON VISUAL CRYPTOGRAPHY USING GENETIC ALGORITHM

**Ms. Satbir Kaur, Mr. Kantveer**
Asst. Prof. Global Institute of Management & Emerging Technologies, Amritsar(Punjab), India

**DOI**: 10.5281/zenodo.56919

## ABSTRACT

A method for creating digital image copyright protection is proposed in this paper. The proposed method in this paper is based on visual cryptography using Genetic Algorithm. The proposed method is working on selection of random pixels from the original digital image instead of specific selection of pixels. In today's scenario protection of digital data is utmost necessary in every part of life. More robust methods are being developed to protect the proprietary rights of the multimedia. In this paper, an invisible watermarking technique is proposed, to embed multiple binary watermarks into digital medical images based on the concept of Visual Cryptography (VC). The proposed scheme embeds the watermarks without modifying the original host image. Multiple watermarks can be embedded as shares in the same image. In addition, the size of the watermarks is not restricted to being smaller than that of the original host image. Experimental results prove that, the output of proposed watermarking technique gives good similarity ratio, peak signal to noise ration and correlation coefficient. To improve the visual quality of the extracted watermark we use Genetic Algorithm. This relationship keeps the marked image coherent against diverse attacks even if the most significant bits of randomly selected pixels have been changed by attacker as we will see later in this paper. Experimental results show the proposed method can recover the watermark pattern from the marked image even if major changes are made to the original digital image. The Medical Image Watermarking is implemented using Image Processing Toolbox within Matlab Software. This work has been tested and found suitable for its purpose.

**KEYWORDS**: Copyright, Digital medical image, digital watermarking, Multimedia, visual cryptography, Complex Wavelet Transform and Genetic Algorithm.

## INTRODUCTION

Technological advancements in both hardware and software are making communication easy and cost effective, which in turn, is producing large volume of digital information being transmitted through the Internet and communication networks. This advancement, in recent years, has created awareness on the risk of piracy and on the importance of protection of content being shared. Several researches have been focused on providing solutions to copyright protection and authentication. These techniques mainly fall into three categories, namely, Steganography, Cryptography and Watermarking. Out of these, watermarking techniques have gained more popularity for proving integrity and authenticity of the owner.

Digital watermarking is defined as an algorithm that can be used to hide secret signal into digital audio, video, image or documents in a manner that does reduce the overall quality of the original signal. The secret signal, identified as the watermark, can be copyright notices or authentication information or secret text. The origin al sign al is called as „ cover signal‟ or „host sign al‟. The process of inserting the secret signal is called embedding and the image after embedding is called "watermarked image". Extraction or detection is a process retrieves the stored watermark. Thus the two main components of digital watermarking systems are (i) Embedding and (ii) Extraction. Digital watermark is used in many applications including copyright protection, fingerprinting, copy protection, broadcast monitoring and data authentication. The watermarking techniques are grouped as text-based watermarking, image watermarking, video watermarking, audio watermarking and 3D watermarking. Due to advancement in information and communication technologies, digital media (such as image, video, audio or text) can be easily distribute, duplicate and modify. However, there are some areas where the data cannot be arbitrary exploited; especially where critical judgments are made based on the information available in the data. The use of medical images for diagnosis in hospitals is an example of such area. Medical images demand strict security to ensure only the occurrence of legitimate changes. Exchange of medical images between hospitals located in different geographical locations is a common practice now days. But unfortunately, this exchange of medical images through insecure open networks like Internet provides conditions of changes to occur in medical images and consequently creates a threat of undesirable outcome in case, if important information contained in the image is lost or corrupted. Large image databases are to be handled in hospitals need to be protected against malicious attempts. For this purpose, authentication of the medical images can be performed through digital image watermarking.

Digital image watermarking techniques have been developed to protect intellectual property of image in digital form. It is realized by embedding the copyright information, called also "the watermark pattern", into the original image. The watermark pattern in the cover image can be either visible or invisible. However the visible watermarking techniques destroy the image quality and are easily attacked through direct image processing, which increase studies on invisible watermarking. By using the invisible watermarking scheme, the owner can prove his copyrights by extracting the watermark pattern from the watermarked image. There is a lot of medical image watermarking techniques described in the literature, that we can classify in three schools thought:

• ROI (Region of Interest) and RONI (Region of Non- Interest) watermarking: in the ROI watermarking techniques, the watermark is embedded in ROI in such a way that perceptual quality of image is not compromised. In RONI watermarking techniques, watermark information is embedded in RONI in order to keep the ROI distortion free. This way diagnosis value of medical image is not compromised. In medical images RONI generally contains the black background which encircles the ROI.
• Reversible Watermarking: The second approach corresponds to reversible watermarking. Once the embedded content is read, the watermark can be removed from the image allowing retrieval of the original image.
• Classic watermarking: The third approach consists in using classical watermarking methods while minimizing the distortion. In that case, the watermark replaces some image details such as the least significant bit of the image or details lost after lossy image compression. Medical image watermarking techniques can also be grouped into two main categories. In the first one, the watermark is embedded in the spatial domain by directly modifying the pixel intensity of the original image, and in the second one, the watermark is embedded in the transform domain, such as Complex Cosine Transform (DCT), Complex Fourier Transform (DFT) and Complex Wavelet Transform (DWT) etc. In general, the DWT produces watermark images with the best visual quality due to the absence of blocking artifacts. However, it has two draw backs:
• Lack of shift invariance, which means that small shifts in the input signal can cause major variations in the distribution of energy between DWT coefficients at different scales.
• Poor directional selectivity for diagonal features, because the wavelet filters are separable and real. To overcome these problems, Kingsbury introduced the design and implementation of 2-D multi-scale transform, called Complex Dual Tree Wavelet Transform (DT-CWT), that represent edges more efficiently than does the DWT.

In the few last years, we find out the apparition of a new rang of watermarking techniques using the concept of Visual Cryptography (VC). The act of decryption is to simply stack shares and view the secret image that appears on the stacked shares. The decoding of the secret image by the Human Visual System (HVS) is the interesting feature that has attracted the researchers in adapting this concept for several applications including watermarking. In accordance with cryptography, the security of a crypto-system does not reside in the algorithm, but resides in the secret key; that is, the security will maintain well even if the algorithm has been published. In the watermarking schemes using VC, the watermark pattern can be either physically embedded into the cover image or not. The first category schemes which are similar to traditional methods are called watermark embedding schemes. The second category are called watermark concealing schemes, they are particularly useful in protecting highly sensitive images, since the original image is not altered. This last feature has attracted us to use this concept for medical images watermarking, due to the high sensitivity of medical image. In this way our medical images may remain intact and protected from illegitimate changes in the same time.

ISSN: 2277-9655
Impact Factor: 4.116

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 Complex wavelet transform are combined with GA 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.

**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. Based on artificial intelligent method, the coefficients at widespread sub-bands HL and LH are chosen for watermark embedding, in order to attain a balance between robustness and fidelity. The watermarking pixels are, at the same time, embedded into the HL and LH sub-band based on the some steps. In the embedding process we used the GA and BFO for the checking of the fitness of the stego message. A genetic algorithm (GA) is a method for solving both constrained and unconstrained optimization problems based on a natural selection process that mimics biological evolution. The algorithm repeatedly modifies a population of individual solutions. At each step, the genetic algorithm randomly selects individuals from the current population and uses them as parents to produce the children for the next generation. Over successive generations, the population "evolves" toward an optimal solution. You can apply the genetic algorithm to solve problems that are not well suited for standard optimization algorithms, including problems in which the objective function is discontinuous, non differentiable, stochastic, or highly nonlinear. When we use GA in the purposed work then we got the more accuracy than other techniques.

**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. In this work GA for generating the chromosomes .GA optimization techniques are applied in embedding and extraction process. So we can take the watermarked media parameters like intensity, etc., for computing PSNR and BER of the watermarked media. These values are based on the original media size and intensity. The optimization process of GA is described as follows.

**Genetic Algorithm**

Genetic Algorithm (GA) An evolutionary algorithm which generates each individual from some encoded form known as a "chromosome" or "genome". Chromosomes are combined or mutated to breed new individuals. "Crossover", the kind of recombination of chromosomes found in sexual reproduction in nature, is often also used in GAs. Here, an offspring's chromosome is created by joining segments chosen alternately from each of two parent's chromosomes which are of fixed length. GA is useful for multidimensional optimization problems in which the chromosome can encode the values for the different variables being optimized.

**Generation of Chromosome**

The function of the randomly generated set of chromosomes (set of genes) is the generation of chromosomes. Presently, population size plays an important role in presenting the solution to the problem at hand. The beginning population set up is done by producing a population set P that comprises of set of chromosome vectors having half size of the HL or LH sub-band. Subsequently, we have placed the one's value with the size of the watermarked (hiding) media in that vector in a random manner. And, the remaining cases are filled down by zero value. Then, the beginning set of chromosomes is brought forth at random with minimum number.

**Fitness Computation**

Finding the optimized solution to the chromosomes is the better way. Till finding the locations defined in the chromosomes for each chromosome in the population set, the watermarking embedding process is iterated. Here embedding and extraction process is carried out using these procedures which were. Then the fitness of GA is calculated by us, which is utilized for calculating PSNR along with the measure of BER value. Below cited the formula is for discovering the fitness value of PSO. Fitness computation formula is depicted below,

$$\text{Fitness}=\text{PSNR}+\text{BER}$$

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

**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:

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

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

**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:

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

**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 = 20log10 (PIXEL_VALUE/√MSE)**

These all given parameters are important factor in watermarking techniques.

## EVALUATION AND RESULTS

To To verify the effectiveness (qualities and robustness) of the proposed Medical Image Watermarking we conduct several experiments with this procedure on several images. The methodology of our proposed work is given below:
Phase1: Firstly we develop a particular GUI for this implementation. After that we develop a code for the loading the original mage and message image or message in the Matlab database.
Phase2:Develop a code for the Complex Wavelet Transform and Inverse Complex Wavelet Transform with partitioning technique. After that we apply CWT on the selected image and develop code for Visual Cryptography with GA. When we apply the GA on the image then we got more accuracy than another technique.
Phase3: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.
Phase4: 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 ICWT. After the extraction process we got the original image and message data by using the key.

## CONCLUSION & FUTURE WORK

In this paper we propose "Medical Image Watermarking for Copyright Protection Based on Visual Cryptography using Genetic Algorithm". In this paper, the image is decomposed into their color components R, G and B. One of these matrices are divided into odd and even banks of 8X8 each, such that pixel values present in the odd positions will go to the odd bank and similarly even bank. The embedding position of the data to be watermarked into the image is found out using Genetic Algorithm. Using GA a key of 64-bit is generated by repeated application of the GA operators repeatedly for a certain number of generations or until the fitness requirement of the key is met. The main criteria behind the generation of this key are that the change introduced by embedding the watermark into it should bring about the least. The set bits in the key indicate the positions of the image where the watermark is embedded. In this work time criticality and robustness of the watermarking system are considered. To compliment the secure watermarking scheme, the recovery process is also made robust to ensure that watermarks can be extracted back accurately even from a distorted or altered medical watermarked image.

## REFERENCES

[1] P. Surekha and S. Sumathi, "Implementation of Genetic Algorithm for a DWT Based Image Watermarking Scheme", Ictact Journal on Soft Computing: Special Issue on Fuzzy In Industrial and Process Automation, Vol. 02, No. 01, pp. 244-252, July 2011.
[2] SawsanMorkosGharghory "Hybrid Of Particle Swarm Optimization With Evolutionary Operators To Fragile Image Watermarking Based on DCT", International Journal of Computer Science & Information Technology (IJCSIT), Vol 3, No 3, June 2011,DOI : 10.5121/ijcsit.2011.3310 141
[3] Mona M. Soliman, Aboul Ella Hassanien, Neveen i. Ghali and hoda M. Onsi, "The way of Improving PSO Performance: Medical Imaging Watermarking Case Study", RSCTC 2012, LNAI 7413, pp. 237-242 2012
[4] Ziquian Wang, Xia Sun, and Dexian Zhang, " A novel Watermarking Scheme Based on PSO Algorithm" , LSMS 2007, LNCS 4688, pp. 307-314, 2007.
[5] S.M. Ramesh,AShnamugam "An Efficient Robust Watermarking Algorithm in Filter Techniques for Embedding Digital Signature into Medical Images Using Discrete Wavelet Transform", European Journal of Scientific Research, ISSN 1450-216X Vol. 60 No. 1 (2011), pp. 33-44.
[6] A Chaudhry, A Jaffar, B Sikandar, J Y Kim "Genetic Swarm Based Robust Image Watermarking" Proceedings of the 7th International Conference on Ubiquitous Information Management and Communication, ICUIMC 2013, ISBN: 978-1-4503-1958-4 doi>10.1145/2448556.2448562
[7] Mona M. Soliman, Aboul Ella Hassanien, Neveen i. Ghali and hoda M. Onsi, " An Adaptive Watermarking Approach for Medical Imaging Using Swarm Intelligent", International Journal of Smart Home, Vol. 6, no. 1 January, 2012.
[8] Mohsen Rohani* and AlirezaNasiriAvanaki , " A Watermarking Method Based on Optimizing SSIM Index by using PSO in DCT Domain",14th International CSI conference (CSICC2009), July 1-2, 2009, Tehran, Iran,"
[9] P. Surekha and S. Sumathi, "Application of GA and PSO to the Analysis of Digital Image Watermarking Process", International Journal of Computer Science & Emerging Technologies (E-ISSN: 2044-6004) Volume 1, Issue 4, December 2010.

[10] Dr.M.MohamedSathik and S.S.Sujatha"An Improved Invisible Watermarking Technique for Image Authentication" International Journal of Advanced Science and Technology,Vol. 24, November, 2010, p-p 61-73
[11] Saraju P. Mohanty Bharat K. Bhargava"Invisible Watermarking Based on Creation and Robust Insertion-Extraction of Image Adaptive Watermarks" ACM Journal Name, Vol. V, No. N, February 2008, p-p 1-24
[12] Shekhawat, R.S.; Rao, V.S.; Srivastava, V.K. "A robust watermarking technique based on biorthogonal wavelet transform", IEEE Students Conference on Engineering and Systems (SCES), 2012, p-p 1 - 6
[13] PrayothKusmawat, KittiAttakitmongcol,andArthitSrikaew,"An Optimal Robust Digital Image Watermarking Based on Genetic Algorithms in Multi Wavelet Domain", WSEAS Transactions on Signal Processing, ISSN: 1790-5052, issue 1, Volume 5, 2009
[14] Schneier B (2008) Applied cryptography, protocols, algorithms and source code in Matlab.
[15] Shehab M, Bertino E, Ghafoor A (2008) Watermarking relational databases using optimization-based techniques. IEEE Trans Knowl Data Eng 20(1):116–129
[16] Silberschatz A, Korth HF, Sudarshan S (2005) Database system concepts. McGraw-Hill Int. Edition
[17] Sion R, Atallah M, Prabhakar S (2004) Rights protection for relational data. IEEE Trans Knowl Data Eng 16(12):1509–1525
[18] Stalling W (2006) Cryptography and network security- principles and practices. PHI
[19] Sun J, Cao Z, Hu Z (2008) Multiple watermarking relational databases using image. Proc IEEE IntConfMultiMediaInfTechnol 373–376
[20] Tripathy M, Mishra S (2006) Bacteria foraging: a new tool for simultaneous robust design of UPFC controllers. International Joint Conference on Neural Networks (IJCNN).Vancouver, BC, 2274–2280.
[21] Tripathy M, Mishra S, Lai LL, Zhang QP (2006) Transmission loss reduction based on FACTS and bacteria foraging algorithm. Lect Notes ComputSci 4193:222–231
[22] Verma OP, Hanmandlu M, Kumar P, Chhabra S, Jindal A (2011) A novel bacterial foraging technique for edge detection. Pattern RecognitLett 32(8):1187–1196.
[23] Zhang Z-H, Jin X-M, Wan J-M (2004) Watermarking relational database using image.Proc IEEE Third International Conference on Machine Learning and Cybernetics, vol 3. 1739–1740.
[24] Zhang Y, Niu X, Zhao D (2005) A method of protecting relational databases copyright with cloud watermark. World AcadSciEngTechnol 3:170–174.