International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 10 | Oct -2020 ISSN: 2582-3930

A Novel Approach of Digital Image Watermarking by Using Fuzzy Logic

Kawalpreet Singh, Research Scholar
Department of Information Technology
Guru Nanak Dev Engineering College

Dr.Kulvinder Singh Mann, Professor
Department of Information and Technology
Guru Nanak Dev Engineering College

Abstract: In this paper, suggest a new digital watermarking method in the fuzzy inference system predicated on DCT domain and the human visual structure to evolve the embedding effect of various blocks. Initially, the initial area is split into another 8 ranges of partitions, but instead, as per distinct feature vector and luminance within every block, the fuzzy rule base decides distinct embedding abilities dynamically. The detection of watermarks takes on correlation technology. Experimental experiments demonstrated gives popular process of enhancing operators excellent imperceptibility and higher robustness of popular image processing fuzzy interference system.

Keywords:*Image processing, Digital Watermarking,*

Fuzzy logic,DWT,DCT,Robutness Medical Images

I.INTRODUCTION

In the medical profession the need for fast and accurate diagnosis is essential. These day, the communication of visual information is a normal habit and a convenient method of transmitting them over channels is needed[1]. The primary purpose is to ensure that medical images are preserved during transmitted, and also once this electronic information is archived[2]. In these situations , the watermarking is the best method of security. There's various scenarios for watermarking the text. Watermarking has recently been discovered for the safety of medical records. Although ,most of the watermarking work involved clinical data with a view to verifying image integrity or enhancing confidentiality[3]. watermarking offers a manner to share data. In essence, watermarking is described as the unseen embedding or inserting of a message into a host text , for example an image[5].

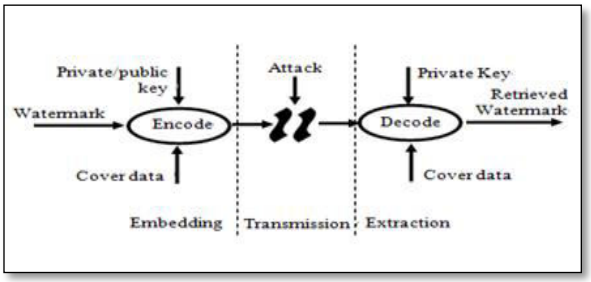

Figure1: Process of watermarking[4]

Spatial domain approaches [5] and domain transformationapproaches [4] are the two techniques for embedding watermarks. Because of low fidelity and reliability, spatial domain isn't ideal for embedding watermarks. Frequency domain watermark can be found in transformations such as DCT (Discrete Domain Transform), DWT (Discrete Wavelet Transform), respectively.

The Discrete Wavelet Transform (DWT) is accomplished by processing the signal at various scales by implementing a series of optical devices. Wavelet methods [6] include an

excellent compaction of space and frequency energy, and therefore DWT has developed an interest in many technologies for signal and image processing.

Whereas the watermark picture embedding factor coefficient DCT.

The objective function of a rectangular matrix A is a decomposition of the shape

$A=UDV^T$ (1)

Here A is a matrix of m*n, U, V are all ortho-normal matrices. D is a diagonal matrix consisting of singular A values.

$D = diag (\sigma1, \sigma2, \sigma3 ...)$ (2)

It is important to note that the luminance of an image layer is determined by every singular value, whereas the resulting pair of singular vectors defines the image layer geometry. Several techniques are possible within SVD-based watermarking. A common way is to use SVD for the entire cover image [7] .

- **FUZZY LOGIC**

The theory of fuzzy logic hits the proactive strategy in the sense that the variables being viewed are not binary but of variable linguistic parents of the human language as contrast ratio, much simpler, quite contoured, quite homogeneous respectively. In addition, these linguistic variables are handled using laws which relate to a certain system knowledge. The fuzzifier and defuzzifier are responsible for translating sensitive data into fuzzy numbers, and likewise. As in figure 2 FIS is composed of four feature blocks. They are

1. Fuzzifier: Converts the input crisp to fuzzy sets.

2. Knowledge Base: It primarily consists of the database and rule set. The Database determines the linguistic variables' membership functions. The control system is a collection of IFTHEN laws which can be provided by a human expert or can also be derived from the data's linguistic definition.

3. Inference Engine: It is a specific method of control that takes advantage of the fuzzy rules and the fuzzy sets described in the Knowledge Base to arrive at some result.

4. De-Fuzzifier: Moves the fuzzy packages to smooth outputs.

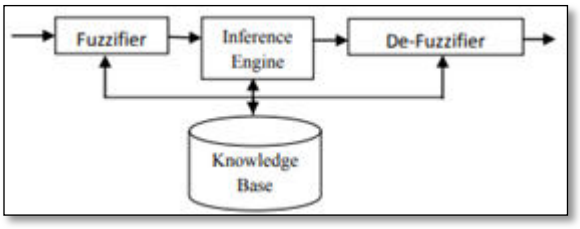

Figure 2. Scheme of a Fuzzy Inference System[8]

II.LITERATURE SURVEY

Anand et al.,[9]The software system for pattern detection provides several flexible uses to improve the identification of patterns of life by suggested (Hybrid Integration Methodology-HIM). The findings presented indicate very significant results and in MATLAB found a high precision identification. Every time the set of regulations executed displays the better effect and a safe performance. The aim of this paper is to apply the fuzzy framework to a broader collection of data that the template has defined.

Mishra et al.,[10]Embedding in the grayscale host images in the suggested hybrid technique is performed in the DWT-SVD framework. Second, specifications for entropy-based human visual system (HVS) are calculated block wise to classify the most suitable blocks in the spatial domain. For these develop action plans, first stage DWT is measured, and watermark embedding is performed via the measured Singular Value Decomposition (SVD) parameters. A well-established HVS model functioning in the DCT domain is applied in the second part of this simulation and contrasted

to the entropy-depend HVS strategy adopted in transform domain to insert the ECC encrypted binary watermark in frames. It is assumed that parameters of HVS – Luminance, Contrast and Edge Sensitivity are best placed to analyse image qualities and functions for watermarking purposes as opposed to entropy parameters.

Naseem et al.,[11]In this, proposed a novel block-based transform domain method utilising Fuzzy Rule Based System (FRBS) that chooses an image from image features that can incorporate and bring with highest imperceptibility and reliability our required capability.The FRBS suggested is implemented in two steps. The findings demonstrate that the system is reliable toward various attacks, in particular an attack on JPEG compression. The drawback of the suggested approach is that, at receiver end, the original image is required to extract the desired power implanted.

Alfonso et al.,[12]In this article propose a method for protecting exchanged information in medical centre , with specific regard to magnetic resonance imaging (MRI). Every other host network must validate the travelling data network as needed by block-chain approach exploit formal equivalence checking to conduct this validation, by designing automated magnetic resonance pictures by manipulating radiomic characteristics.

Saddek et al.,[13]This research describes the method for analyzing MRI images of a brain tumour. These images offer high precision data on the tumour 's size and spatial information. In relation to the type of the mass discovered, this research applies on other variables which influence the chances of tumour attack. In addition, all these considerations, such as the damaged tissue of the captured image, are called unknown given the structure of the problem to be studied. Using fuzzy logic is then perfectly appropriate. All parameters are fuzzy based. This compensates for inconsistencies and inaccuracies by switching from quantitative to linguistics to the picture of human thinking. This research provides a diagnostic support tool for brain tumours. Before settling on the diagnosis in case of risk, the doctor needs to weigh other factors that are unique to the patient being examined.

Swaraja et al.,[14]In this article, in conjunction with multiple watermarking, it is suggested that a region-based Firefly optimised method and hybridization of DWT and Schur be transformed to provide safety requirements like authenticity of medical image ownership as well as origin for medical image sharing in telemedicine apps. Imperceptibility, reliability and payload functionality are the key parameters for evaluating watermarking technique, with methods for MRI, Ultrasound plus gray-scale X-ray image. Simulations results make clear the effectiveness of the planned method in providing the critical safety advantages for telemedicine-related apps.

III.PROPOSED METHODOLOGY

- **PROBLEM DEFINITION**

As discussed earlier, the existing algorithms used to insert the watermark image and extract can only be implemented to the single image, and even the consistency of the emerged watermark is not up to standard. So , working on these implementations to use these architectures for the various kinds of pictures and also to receive the right quality performance of the extracted watermark.

- **OBJECTIVES**

1. To design the technique for fuzzy interface system via HSV model.
2. To create the watermark images from the developed methods.
3. To contrast the developed method with the existing one.

- **METHODOLOGY**

The technique used for this current research is achieved by suggesting two separate methods, and the MATLAB has been used for the assessment purposes. The proposed method approach is divided into the following groups.

- **First of all processing of host image then computing the HVS features of the image and the evolving the Fuzzy Inference System (FIS):**First , going to make the size blocks 8 x 8 pixels per day in the spatial domain of the particular volume 256 x 256 host image. Utilizing DCT method, the 1024 blocks acquired are then converted in the frequency domain. Three HVS qualities namely:- sensitivity to the luminance, sensitivity to the edge and sensitivity to the contrast are calculated over these frames:
- **The Luminance Sensitivity:** The DC coefficients of the host image DCT blocks are being used as sensitivity to the luminance as per the given equations:

  $L_i=X_{DC,\,i}/X_{DCM}(3)$

  For which L_i is the luminance sensitivity, XDC, I signify the ith block's DC coefficient and XDCM is the mean value of all the frames put together by DC coefficients.
- **The Edge Sensitivity:** Using threshold operation, edge sensitivity can be quantified as a natural corollary to block threshold calculation T after detecting the edge with in the image. The MATLAB image processing toolbox enforces a $grey^{thres}$ routine that uses histogram to calculate the block threshold-the Otsu methodology based.
- **The Contrast Sensitivity:**A key way to characterize an area is to measure its texture content or sensitivity to the contrast. For quantifying this function, the measured variance value of an image block is the basic metric. To this end a Matlab routine suggested by Gonzalez is used to measure the frame variance.
- **Next we will generate and embed the watermark:** The watermark embedded in the host image's low frequency DCT coefficient is a linear array (row vector) of normalized random numbers as per N (0 , 1) with mean 0 and variance 1. It is created use routine Matlab. The Methodology for embedding is given following.
- **Next we will extract watermark from the signed image and compute SIM(X, X^*) parameter:** As per the popular Cox method the watermark is removed from the marked image. Firstly, the DCT of both host and signed frames is calculated block wise in this process. The calculated correlations are then removed from one another, and the watermark is retrieved. Let's designate the initial and restored watermarks as X and X * accordingly.

$$\mathrm{SIM}(X, X*) = \sum_{i=1}^{n} (X.X*)/\sum_{i=1}^{n} \sqrt{\binom{X*}{.X*}} \quad (4)$$

The flow charts for proposed work are the following:

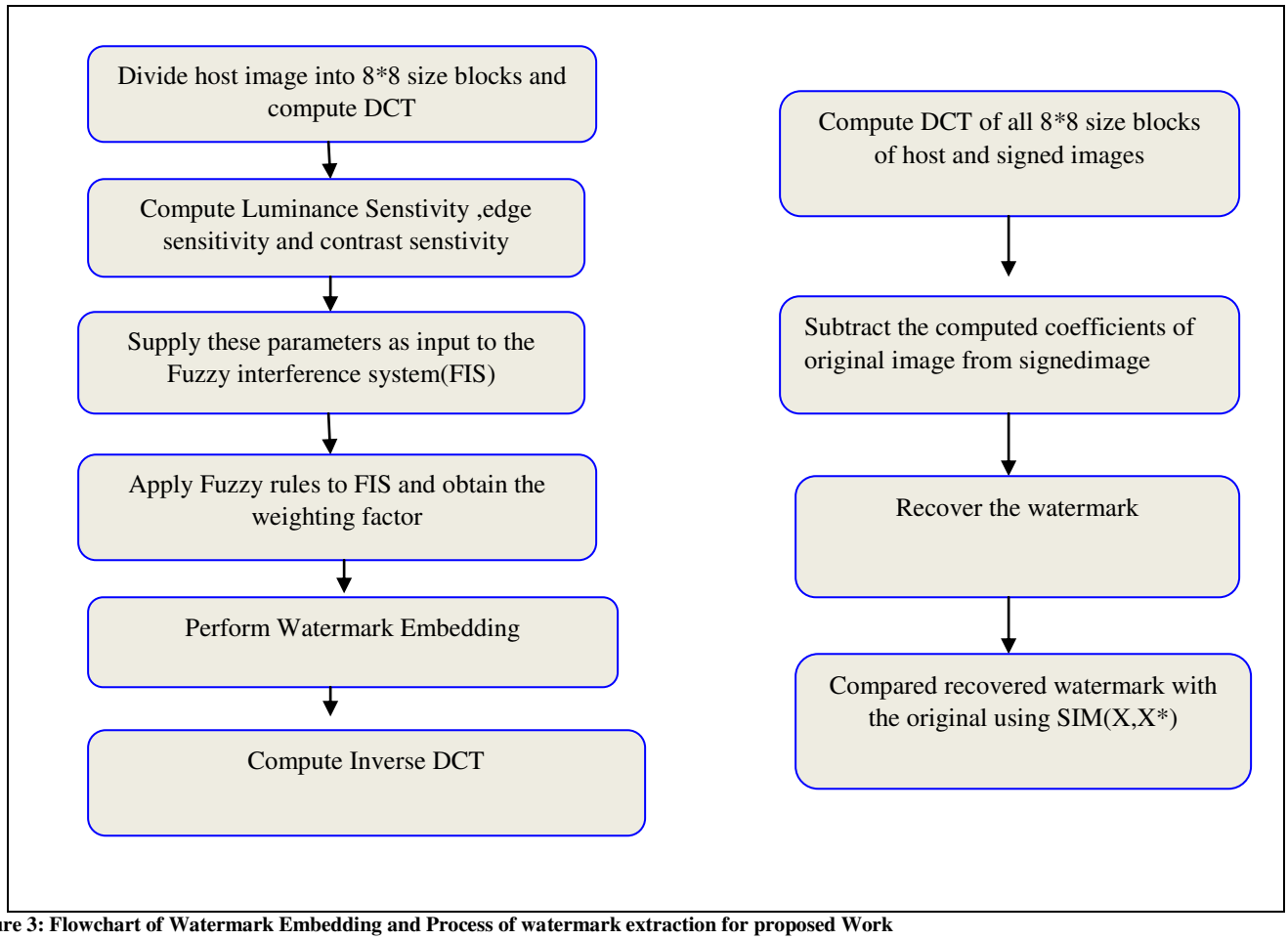

Figure 3: Flowchart of Watermark Embedding and Process of watermark extraction for proposed Work

IV.RESULTS

This section presents the performance results of the proposed algorithm using medical images of differentmodalities. The test images used for evaluation are 8-bit, gray scale medical images representing the common modalities, medical tested image,HSV Image assessing by using MATLAB.

The FIS watermarking algorithm was evaluated with medical images of various contrasts. To illustrate the robustness of the watermark scheme, the results for the applied image processing techniques are reported for the medical image. The results published are provided for a comparison.To obtain a measure of accuracy in extracting the watermark from the processed image, Watermark correlation ,Total computational time ,SSIM,PSNR was computed.

Figure 4 (a) Medical image

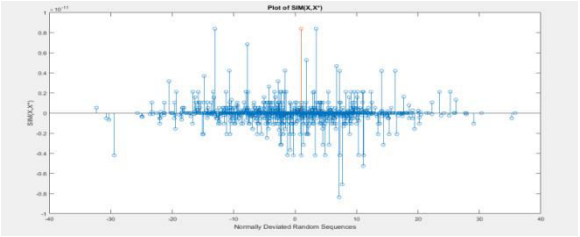

Figure 4 (c) Graphical representation of Normal deviated random sequences figure 5 (a) Medical image

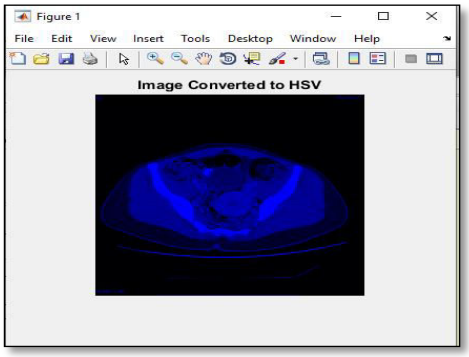

Figure 4 (b) Converted into HSV image

Figure 5(a)Medical image

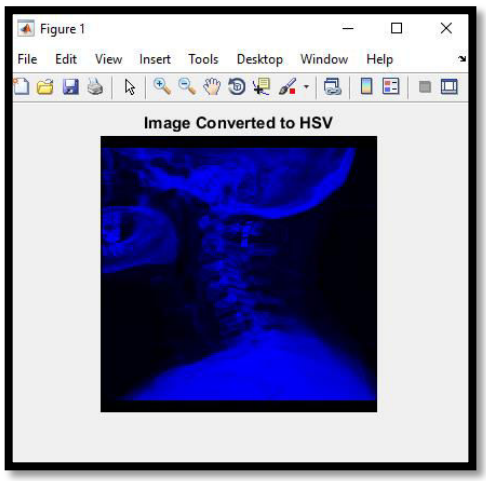

Figure 6 (b) Converted into HSV image

Figure 5 (b) Converted into HSV image

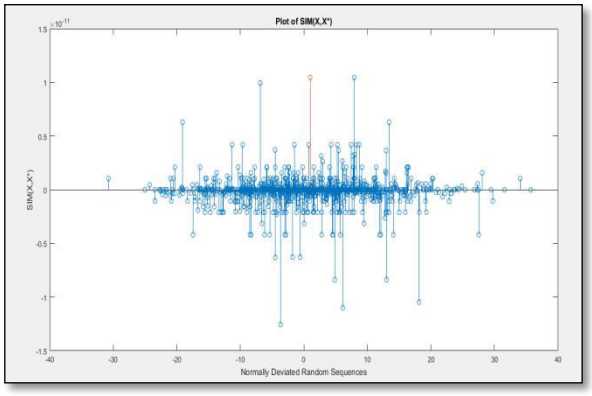

Figure 5(c) Graphical representation of Normal deviated random sequences

Figure 6 (a) Medical image

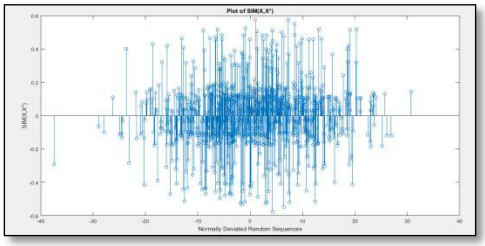

Figure 6(c) Graphical representation of

In nowadays Signal-to - Noise Ratio (SNR) and the Peak Signal-to - Noise Ratio (PSNR) are the most prominent distortion indicators in the field of ctures. Typically these are calculated in decibels, i.e. "dB":

$$MSE=\frac{1}{MN}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1}(f(x,y) - f'(x,y))^2 \quad (5)$$

Here M, N is the image size and includes M x N pixels, the host picture is f(x, y), and the embedded watermark is f'(x, y). This calculation offers an example of how many deterioration small values display less deterioration.

$$PSNR = 10\log_{10}(\frac{Xmax2}{MSE})=10\log_{10}(\frac{255}{MSE})^2 \quad (6)$$

X_{max} is the luminance max.

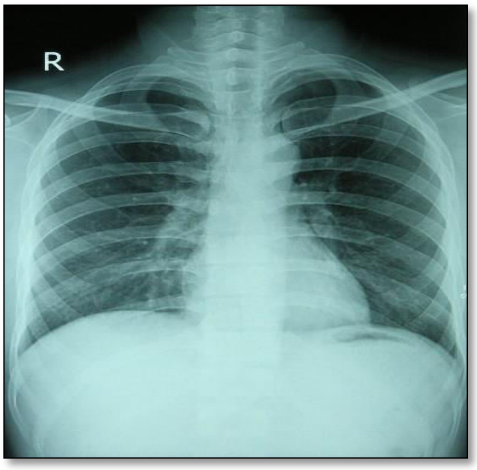

Figure 7 (a) Medical image

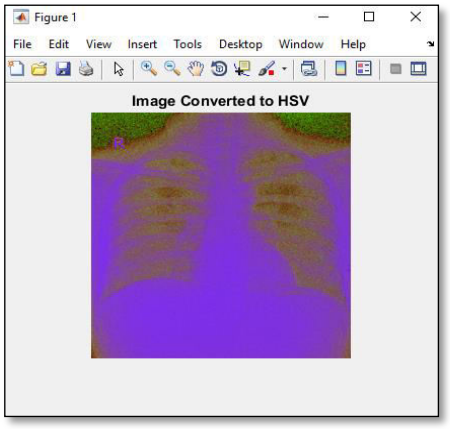

Figure 7 (b) Converted into HSV image

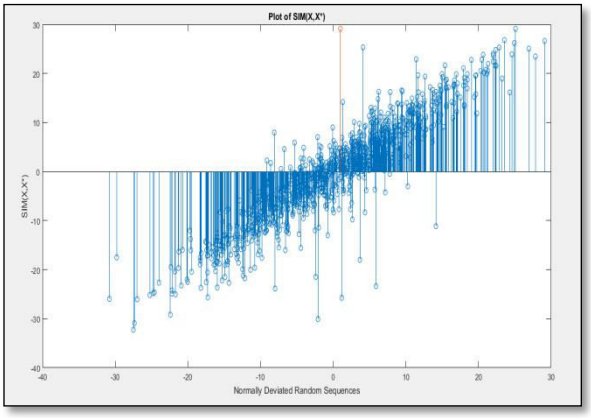

Figure 7(c) Graphical representation of Normal deviated random sequences

Table 1:Comparsion Between Different Tested Images

Tested Image	Watermark Corelation	SSIM	Total Computational Time	MSE	PSNR
Image 1	99.9586	0.3186	18.1406	0	∞
Image 2	99.9938	0.3211	12.4219	0	∞
Image 3	99.5160	0.3232	11.8906	0.0312	63.1950
Image 4	99.9879	0.3124	11.5781	0	∞
Image 5	99.9066	0.3148	11.1719	3.0518e-05	93.2853
Image 6	99.4222	0.3231	12.9219	0.0494	61.1928
Image 7	99.0831	0.3138	12.4219	0.0903	58.5761
Image 8	99.8412	0.3180	24.1250	0.0054	70.7689

As the analysis above demonstrates this very significant analysis and finds high detection rate when operating on the MATLAB. The rule set which was used for every execution exhibited the greatest result and consistent performance. Our study aimed to extend the fuzzy inference system to a broader collection of data for the identification of patterns accomplished.

V.CONCLUSION

In this paper , an method of watermarking method used in medical images was described which is reliable in certain attacks. The FIS is being used to modify the resilience of watermarking that can be integrated without significantly degrading the picture quality. After being changed by the Discrete Cosine Transform (DCT) the watermark is embed into the mid-band frequency range. As a consequence, the watermark is bulkier and much more imperceptible. The fuzzy logic, rather than the current iterative process, is able to provide the power level to be used directly. Our research has provided that FIS technique for the medical images. And by proposed technique obtained less distortion in the watermarked image and improved performance in the retrieved watermark.

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