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A Review on Medical Image De-Noising using Bilateral Filter, Neuro-Fuzzy and GABOR

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ABSTRACT: Today's the medical image processing represent important role in the medical field. Bilateral filter is known for its effectiveness in edge-preserved image de-noising and GOBARwhere the linear filter used for disclosure the edge. This paper represents the design and development of an improved algorithm for medical image de-noising using Bilateral Filter, Neuro-fuzzy and GABOR and to remove the noise and enhance the medical image by using the proposed method which is simulated and compared with some existing method for performance analysis.

KEYWORDS: Bilateral Filter, Neuro-Fuzzy, GABOR, Medical Image De-Noising, Neural Network and Neuro-Fuzzy Inference Systems.

I. INTRODUCTION

Medical image approaches are the process of creating visual representations of the interior of a body for clinical analysis and medical intervention. An image of Medical explores to admit internal structures hidden aside the skin and bones just as to diagnose and treat disease. Medical imaging provide database of normal anatomy and physiology to make accessible for identifying abnormalities. Imaging removes the organs and tissues that can be performed for medical reasons such procedure are usually consider a part of pathology instead of medical imaging. Medical imaging is generally noted to label the set of techniques that not invisible produce the images for internal condition of the body. In this barred sense where medical imaging can be seen by the solution of mathematical inverse problems which measure the properties of living tissue is contained from effect of the observed signal.

The arrival of digital medical imaging technologies such as positron emission tomography, magnetic resonance imaging, computerized tomography and ultrasound Imaging has revolutionized modern medicine. Many patients no longer need to go through invasive and often dangerous procedures to diagnose a wide variety of illnesses with the widespread use of digital imaging in medicine therefore today quality of digital medical images becomes an important issue. Attain best possible diagnosis it is important that medical images be pointed clear also free of noise and artifacts while the technologies for acquiring digital medical images continue to improve the resulting in images of higher and higher resolution and quality and removing noise in these digital images remains one of the major challenges in the study of medical imaging because they could mask and blur important features in the images where many proposed de-noising techniques have their own problems. Image de-noising still remains a challenge for researchers because noise removal introduces artifacts and causes blurring of the images. Noise modeling in medical images is affecting the instruments which captured data transmission media, quantized image and discrete sources of radiation where there are different algorithms used which depend on the noise model. Ultimate images are assumed to have additive random noise which is modeled as a white Gaussian noise.

Medical images where these are magnetic resonance imaging (MRI) and ultrasound images have been widely exploited for more truthful pathological changes as well as diagnosis and they suffer from a number of shortcomings and these includes: acquisition noise from the equipment and ambient noise from the environment where the presence of background tissue of distinct organs and anatomical consequences equally to the body fat and for breathing motion.

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The noise reduction is important for various types of noise generated limit the effectiveness of medical image diagnosis.

(A) GABOR FILTER

In the image processing for Gabor filter the linear filter uses for detection edge where the frequency and orientation represents the Gabor filters which are same to those of human visual system and they keep found to be correct texture for the representation and discrimination.

$$g(x,y;\lambda,\theta,\psi,\sigma,\gamma) = \exp\left(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2}\right)\exp\left(i\left(2\pi\frac{x'}{\lambda}+\psi\right)\right)$$ Where

$$x' = x\cos\theta + y\sin\theta$$

And $$y' = -x\sin\theta + y\cos\theta$$

The equation having λ which represents the wavelength of the sinusoidal factor θ that show the orientation of normal to the parallel of Gabor function ψ which is the phase offset where σ is the sigma of the Gaussian envelope and γ is the spatial aspect ratio and ellipticity for backing of the Gabor function.

Lambda = 8
Theta = 0
Psi = [0 pi/2]
Gamma = 0.5
bw = 1
N = 8 (no. of sample for the filtering)
σ =λpi*sqrt(log(2)/2)*(2^bw+1)
(2^bw-1)
(This is defined for the Gaussian envelope)
sigma_x = sigma (for x gradient)
sigma_y = sigma/gamma (for y gradient)
sz=2 (size of envepole)
[xy]=meshgrid(-fix(sz/2):fix(sz/2),fix(sz/2):-1:fix(-sz/2)) (This is used to combing purpose of x gradient and y gradient. This is used as a limit.)

These two equations are used as a variable in the GABOR equation.]
x_theta=(x*cos (theta)) +(y*sin (theta))
y_theta= (-x*sin (theta)) +(y*cos (theta))

This is the final equation for the GABOR filtering
gb=exp((0.5).*((x_theta.^2)./(σ_x^2))+((y_theta.^2)/(σ_y^2))).*(cos(2.*pi)./(lambda.*x_theta)+(psi));

(B)The Adaptive Neuro Fuzzy Inference System (ANFIS)

It is a kind of neural network that is based on Takagi–Sugeno fuzzy inference system also integrates the both neural networks and fuzzy logic principles where it has potential to capture the benefits of both in a single framework. This correspond the inference system to a set of fuzzy IF–THEN rules that have learning capability to approximate nonlinear functions.Therefore the ANFIS considered to a universal estimator.

(i) Artificial Neural Networks

Artificial neural networks are composed of interconnecting artificial neurons where programming establishes that act the properties of biological neurons. Accordingly this is used to gain the considerate biological neural networks or also for clarifying the artificial intelligence problems without creating a model for real biological system.

The biological nervous system is highly complex: artificial neural network algorithms attempt to abstract this complexity or performance mimicking animal or human error patterns can then be used as one source of evidence

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towards supporting the hypothesis that the abstraction really captured something important from the point of view of information processing in the brain. Additionally the incentive for these abstractions reduces the amount of computation required which is to simulate artificial neural networks.

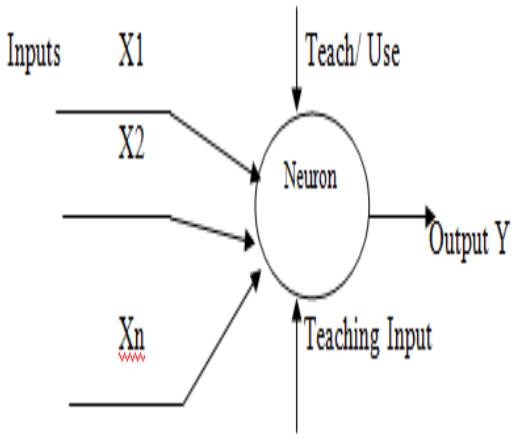

Figure: Simple Artificial Neural Network

(ii) Fuzzy logic as Control Method
FL incorporates simply for rule-based IF X AND Y THEN Z techniques for solving the control problem rather than pursuing to model and FL model empirically based which rely on operator experience except their technical perceptive of the system where example dealing with temperature control in terms as SP =500F, T <1000F or 210C<TEMP<220C, terms like IF where process is too cool AND where process is getting colder THEN where add heat to the process or IF where process is too hot AND where process is heating quickly THEN where cool the process quickly are being used all the terms imprecise and descriptive. Some numerical parameters are required by FL where operate as what is considered significant error and representative the rate of change of error however appropriate values for these numbers are usually not critical until responsive performance is required that case empirical tuning would be determine for them.

II. RELATED WORK

A lot of research has been done in the field of image de-noising still the area of image de-noising, especially for the medical images remains to be an active research.

Ms S. Hyder Ali et al. [10] where thisproposed unique thresh-holding neural networks with a new class of smooth non-linear thresh-holding functions which is being for activation function where dissimilar standard for soft thresh-holding functions the new non linear thresholding functions were infinitely differentiable. TNN can be further used to produce over effective learning algorithms for various applications.

Rajesh Kumar Rai et al. [12] conducted a study on various thresh-holding techniques which are Sure Shrink, Visu ShrinkandBayes Shrink which determine the best one for image de-noising where this wavelet de-noising try to remove the noise present in the signal while preserving the signal characteristics of its frequency content. It involves three steps which like as a linear forward wavelet transform, Step of nonlinear thresh-holding and a linear inverse wavelet transform. Wavelet thresholding is a signal estimation technique that exploits the capabilities of wavelet transform for signal de-noising. It removes noise by killing coefficients that are insignificant relative to

some threshold and turns out to be simple and effective which depends on the choice of a thresholding parameter and the choice of this threshold determines, to a great extent the efficiency of de-noising.

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S.Zhang et al. [5] presented a neural network based de-noising method resolve in the wavelet transform domain and this is the noisy image which is first wavelet transformed in four sub bands and after that trained layered neural network applied to every sub band to bring out the noise removed wavelet coefficients from their noisy ones. Study with other methods which performed in the wavelet domains that require no prior knowledge about noise and that need one signal decomposition to obtain results for good de-noising.

SME Sahraeian et al. [6**]** proposed a new method based on the wavelet transform. In this method an improved TNN were introduced by utilizing a new class of smooth non linear thresholding functions as the activation function. This approach introduced best threshold in the sense of minimum MSE mean square error. TNN obtained thresholds were employed using a cycle spinning based technique to reduce the image artifacts. This method outperforms other established wavelet de-noising techniques in terms of PSNR and visual quality.

Tanzila SABA et al. [11] presented a novel approach based on the Cellular neural networks (CNN) to denoise an image also in presence of high noise. Image De-noising was come up with a regression problem between the noise and signals which is solved by using CNN. The noises are detected with surrounding information and removed. The proposed algorithm exhibited promising results from qualitative and quantitative point of view. Experimental results of the proposed algorithm exhibit high performance in PSNR and visual effects in color image even in the presence of high ratio of the noise

Dr. T. Santhanam et al. [4]it delve into the possibility of using an Artificial Neural Network for image classification that followed by the suitable filter classification for particular type of noise which removed. In this method the Multilayer perception (MLP), Back propagation neural network(BPNN), Probabilistic Neural network(PNN) are used to classify the noise in an image as non Gaussian white noise, Gaussian noise and salt and pepper noise after this noise inputs are provided for MLP, BPNN, and PNN which identifies the suitable filters for the noise removal.

Yazeed A. Al-Sbou [3] presented neural network as a noise reduction efficient and robust tool where this research BPNN is used as learning algorithm and this approach includes using both mean and median statically functions for calculating the output pixels of the NN. It uses a part of degraded image pixels to generate the system training pattern. Output of the proposed approach provided a good image de-noising performance which exhibits promising results of the degraded noisy image in the name of PSNR, MSE and visual test.

III. PROPOSED METHODOLOGY

The methodology in this search is based on Hybrid research. First the knowledge about digital image processing and medical image processing will be gained. Then various types of noise in different medical images will be studied. Major issue in medical image de-noising is how to remove the noise from the image using the best method to enhance the image so that it becomes more accurate and useful for the diagnosis purposes. In this research, by analyzing the existing methods of image de-noising and understanding the limitations of an efficient technique for image de-noising is proposed to reduce the noise. Regarding this, work will be done using the Bilateral Filter, Neuro-Fuzzy and GABOR. Adaptive Neuro-Fuzzy Inference Systems (ANFIS), which are available in Fuzzy Logic Toolbox of MATLAB software, will be used. Proposed method is:

Following are the steps used to make an efficient image encryption and compression system.
STEP 1: Take an input original image.
STEP 2: Perform preprocess on it in order to convert it into unreadable format.
STEP3: then, proposed it with the method and after that post processed it.
STEP 4: Compare Obtained results.

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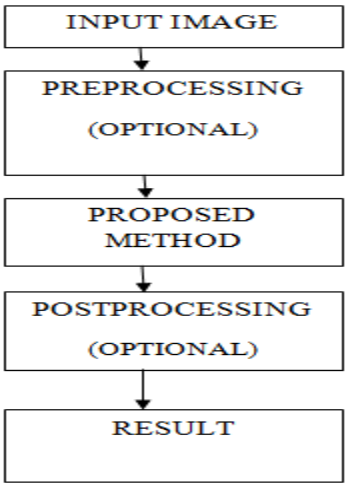

Figure: Flow Chart

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BIOGRAPHY

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