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A NOVEL IMAGE ENHANCEMENT METHOD USING GENETIC ALGORITHM AND NEURAL NETWORK

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Abstract: *The processing of images to carry out specific features of an image is image enhancement. It is to develop an image so that the result is more appropriate than the original in definite application. During image acquisition, images are frequently degraded with noise due to imperfections in the imaging system. Images may lose important information that is required to enhance the quality of a given image. It is becoming quite difficult to extract right information from noisy images. Resolution and contrast are decisive attributes of a digital image. Now the question arises how to enhance the quality of a digital image so that it looks more pleading? The previous work which has been taken into the consideration and thus the simple DWT-HAAR method of resolution enhancement of the image is used. In this research work we develop a unique method for the image enhancement which would be a combination of wavelet transformation followed by the Neural Network. Wavelet transformation would be a result of two combinations namely Daubechies and Symlet. Now once the Daubechies and Symlet is combined, Neural Network has to be trained and on the basis of the training provided to the neural network the result would be evaluated that how much erosion has to be done in the image to enhance it. The evaluation parameters would be as PSNR, MSE and SNR. The results shows that neural network works better as compared to genetic algorithm when compared by given parameters results. The whole stimulation will take place in MATLAB 7.10 environment.*

Keywords: *Image enhancement, Discreet Wavelet Transform, Neural network, Genetic algorithm, Noise.*

1 INTRODUCTION

Image enhancement is among the smoothest and most promising areas of digital image processing. Basically, the concept afterwards enhancement processes is to bring out detail that is concealed, or simply to focus on certain features of interest in an image [1]. A well-known example of enhancement is when we increase the contrast of an image because it looks better [2]. It must be keep in mind that enhancement is a very subjective area of image processing [3] [4]. Image enhancement is a process that reduces noise, removing artefacts and preserve details in an image. Its purpose is to amplify certain image features for analysis, diagnosis and display [5-8]. This technique can be performed by either suppressing the noise or the image contrast.

The digital images corrupted by various types of noises is a considerable problem in DIP [9]. Images are often degraded with various types of noises during image acquisition process and during transmission process over communication channel [10-12]. Noise elimination and enhancement process are important activities in dip. For the period of picture acquisition, pictures are recurrently despoiled by noise because of inadequacies in the imaging framework [13] [14]. Pictures may possibly lose significant data which is probably essential to augment the quality of a particular picture [15]. Currently available nonlinear filters cannot simultaneously handle all problems related to enhancement process. In terms of error, if the image is simply noised then it means that noise level in the image is not up to a higher level, it is becoming easy to apply a filter and de noising the given image and in terms of highly noised images simple filters do not work with much efficiently [16]. Hence the main focus is on the DWT transformation as a filter after the basic implementation of the basic filter so that restoration process becomes easy and the peak signal to noise ratio gets quite effective after its restoration process [17].

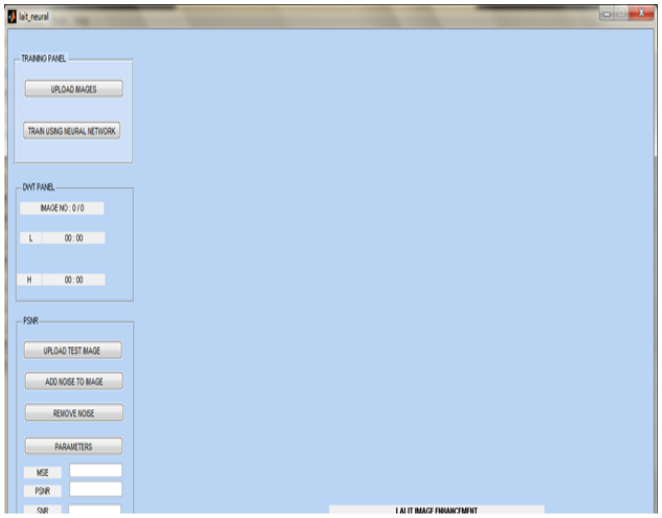
The previous work which has been taken into the consideration is the simple DWT-HAAR method of resolution enhancement of the image [1] [3] [7] [8]. There are a lot of different wavelet transmission family members such as SYMLET, Daubechies etc. In the proposed work, we have used Daubechies to check the performance issue based on the PSNR and MSE of the resulting image.

2 PROPOSED WORK

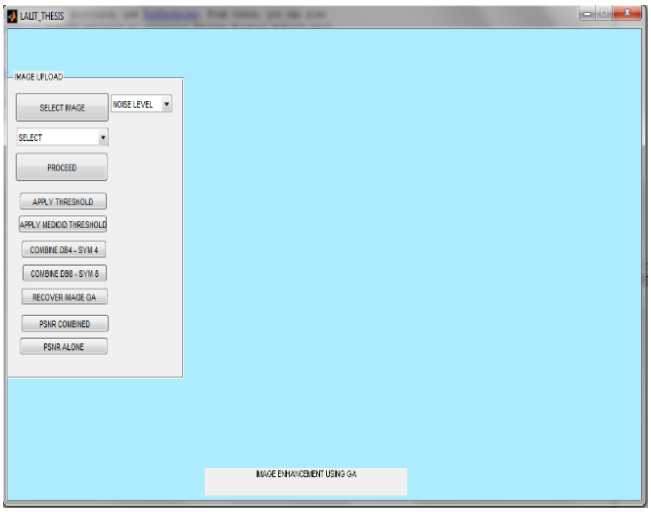
This section is partitioned in two parts:

2.1 Simulation Work model

The following steps present the different stages that need to be accomplished in order to enhance the quality of the digital images.



a) Neural Network GUI



b) Genetic Algorithm

Figure 1: Main GUI system of Neural Network and Genetic Algorithm

Step 1: In this step we upload the main test image.

Figure 2: Main Test Image

Step 2: Select noise level in the given image.
Gaussian Noise is added in the original image. It represents statistical noise having normal distribution. It arises during the image acquisition process for example sensor noise due to poor illumination, bad weather conditions and so on.

Figure 3: Image with Noise

Step 3: Select DWT family to convert it into wave form.
On noisy image, two wavelet families are applied i.e. Symlet and Daubechies. Daubechies wavelet has a high frequency coefficient spectrum than the HAAR wavelet. Daubechies wavelet is (used in solving problems such as fractal problems, signal discontinuities etc. Symlet wavelets are enhanced versions of Daubechies wavelets. The operation for Daubechies and Symlet DWT is more effective than other wavelets of the wavelet family. It has been applied to images of multi resolution representation.

Step 4: Calculate threshold value with average threshold rule.

Thresholding value is calculated with the help of average thresholding rule.

Average Thresholding rule =

$$\frac{\text{Sum of all the pixels in the image}}{\text{No. of pixels in the image}}$$

Step 5: Implement image hybridization techniques for combining different DWT families.

Step 6: Implement neural network as well as genetic algorithm to get back enhanced image.

Figure 4: Filtered Image

Step 7: Calculate performance metrics such as PSNR, SNR and MSE of Neural Network and Genetic Algorithm. Then, compare the results to show which is better.

The PSNR and MSE values are calculated using equation (1) and (2). The Peak Signal-to-Noise Ratio (PSNR) is defined as [7,8]:

$$PSNR = 10.log_{10}\left(\frac{MAX_I^2}{MSE}\right) \qquad \text{eq.(1)}$$

The mean-squared error (MSE) between two images I1(m,n) and I2(m,n) is

$$MSE = \frac{1}{m\,n}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2 \qquad \text{eq.(2)}$$

Where M and N are the number of rows and columns in the input images respectively.

In addition to this decryption time has also been calculated**.**

2.2 FLOWCHART

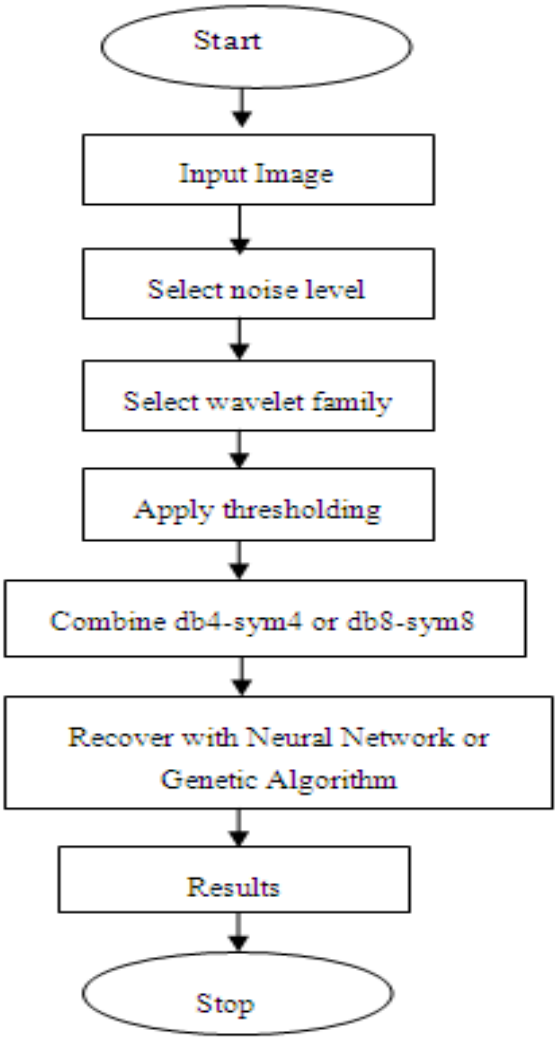


Figure 5: Flowchart of proposed work.

3 RESULTS

We have utilized two types of algorithms for image enhancement:

1) Neural Network Algorithm

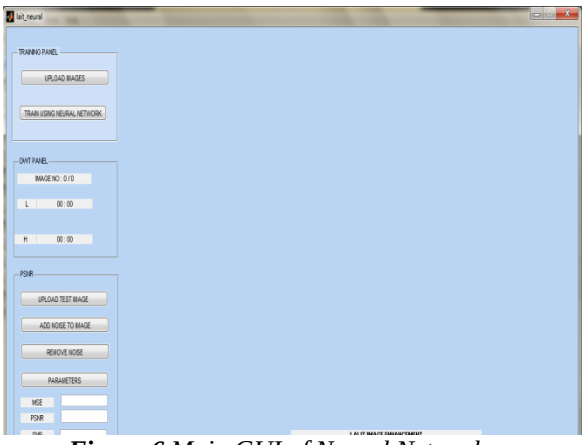


Figure 6 *Main GUI of Neural Network*

Above figures shows the uplodation of images. There are various buttons that has been shown in the above snapshot that are upload images,train using neural network, Upload test image, DWT panel. In DWT we found upper values and lower values.

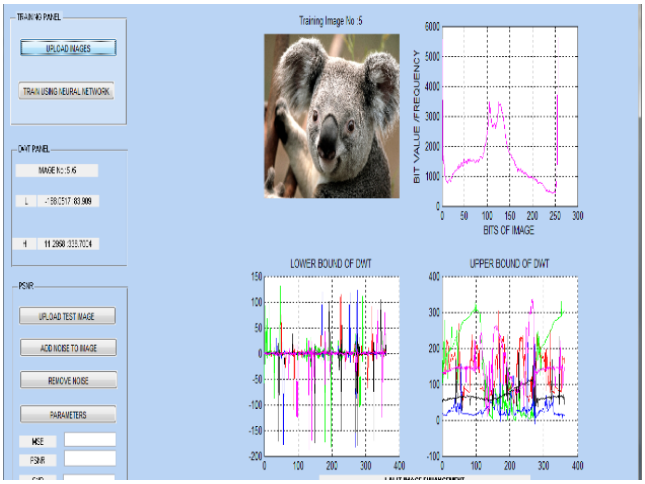


Figure 7 *Upload image for training*

Above figures shows the uplodation of images. There are various buttons that has been shown in the above snapshot that are upload images, Upload test image, DWT panel. In DWT we found upper values and lower values. Next panel is for testing firstly upload the image for testing, merge image to image and find the parameters like(PSNR, SNR AND MSE).

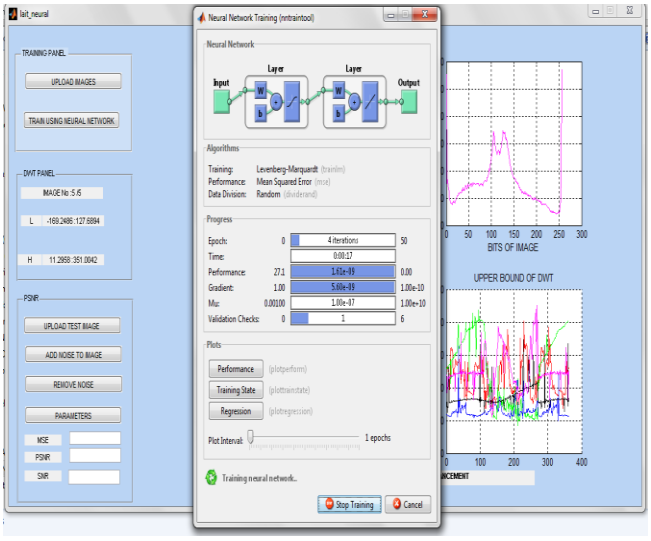


Figure 8 *Training using neural network*

In above figure we are performing training action using neural network. Above we have shown NN training flowchart then algorithms, progress and plots.

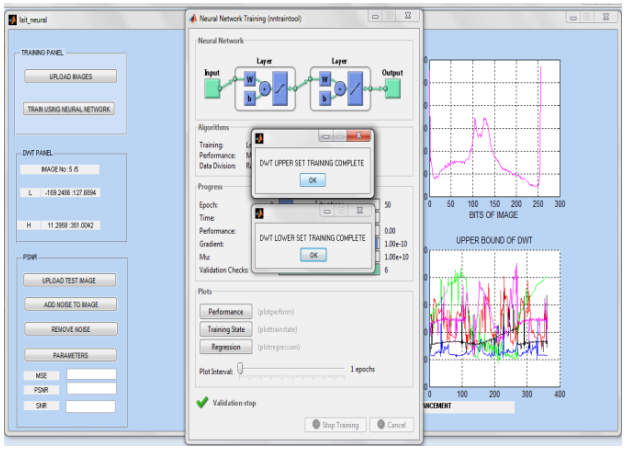


Figure 9 *Training complete*

In above figure it shows that the training of upper DWT set and lower DWT set, have been completed.

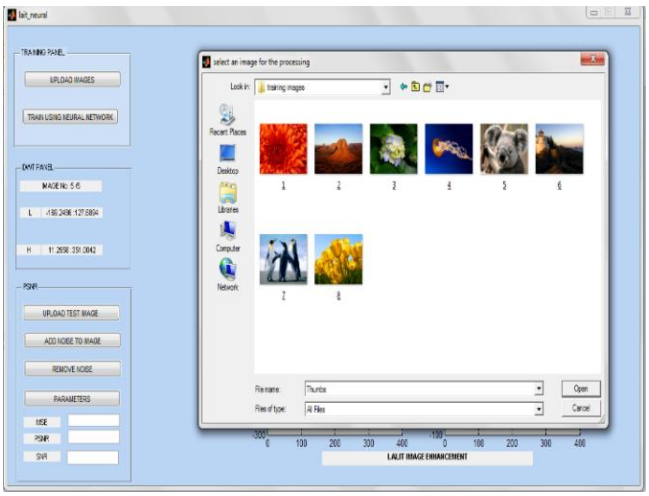


Figure 10 *Uploading test image for processing*

In above figure we add/ upload any random image for enhancement from database.

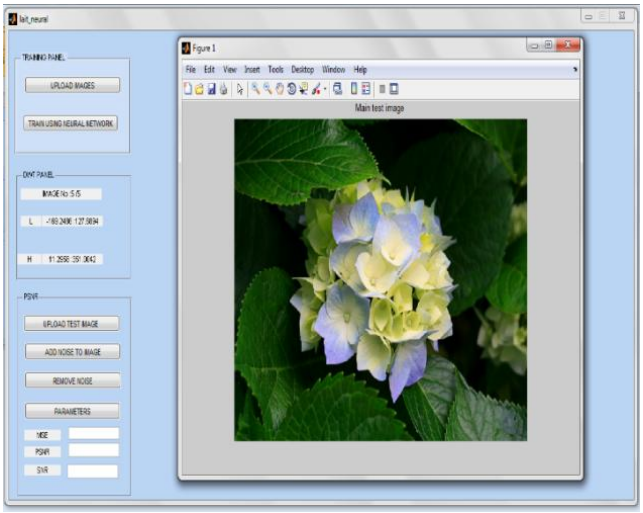


Figure 11 *Main Test Image*

Above figure shows that main test image we have taken.

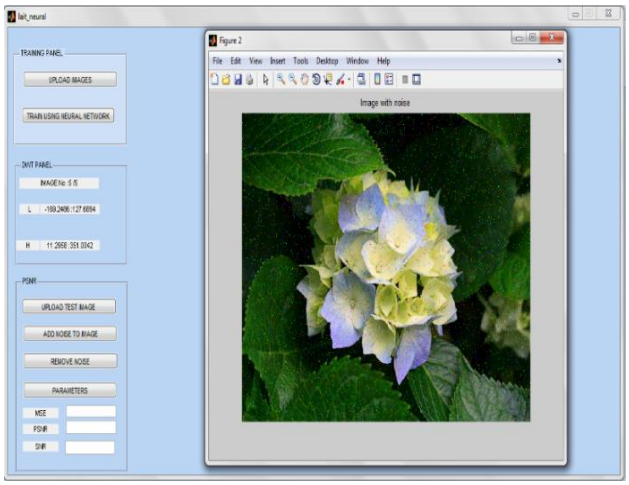


Figure 12 *Image with noise*

In above figure we add noise to the uploaded test image. Gaussian Noise is added in the original image. It represents statistical noise having normal distribution.

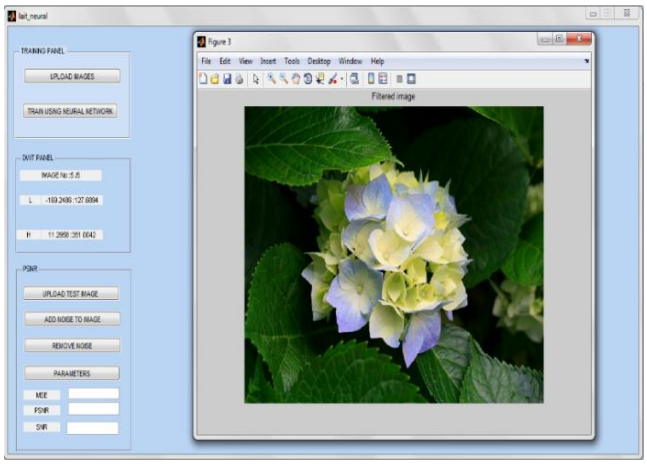


Figure 13 *Filtered Image*

In above figure it shows the image which is filtered by removing noise from it.

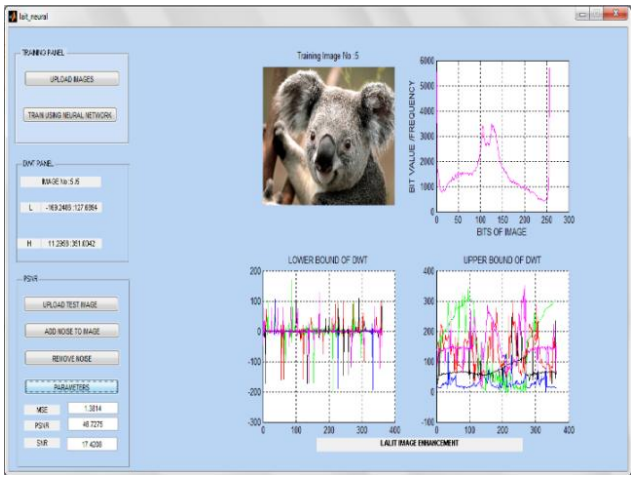


Figure 14 *Results of Neural Network*

This figure shows the result of using Neural Network for image enhancement. These results are given through various parameters that are given as MSE- Mean Square Error, PSNR- Peak to Signal Noise Ratio, and SNR- Signal Noise Ratio.

PARAMETERS	Mean Square Error (MSE)	Peak to Signal Noise Ratio (PSNR)	Signal Noise Ratio (SNR)
RESULTS	1.3814	46.7275	17.4208

Table 1 *Results Parameter Table of Image Enhancement Using Neural Network*

In above table we have shown value of various parameters used.

2) GENETIC ALGORITHM

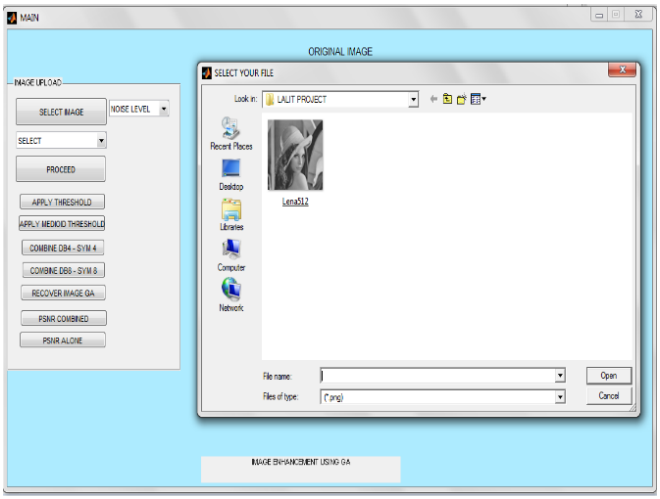


Figure 15 *Uploading Image for enhancement*

MAIN GUI represents the uploading of images. There are various buttons that has been shown in the above snapshot that are Select Image, choose DWT family and noise level, apply threshold, apply mediod threshold, combine db4 with sym4, combine db8 with sym8, recover image using Genetic Algorithm, PSNR combined and PSNR alone value.

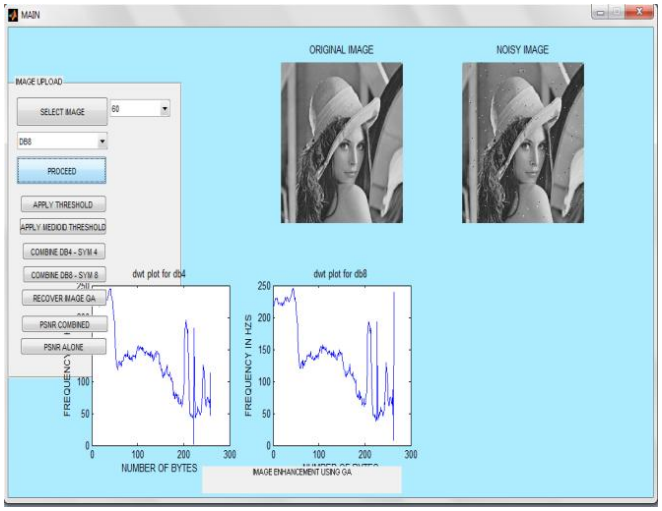


Figure 16 *Noise level and DWT that is db4 and db8 is added.*

In above figure we add noise level as well as DWT wavelet family member in original image and then proceed. On selecting noise level 60 and db8 we plot dwt graph.

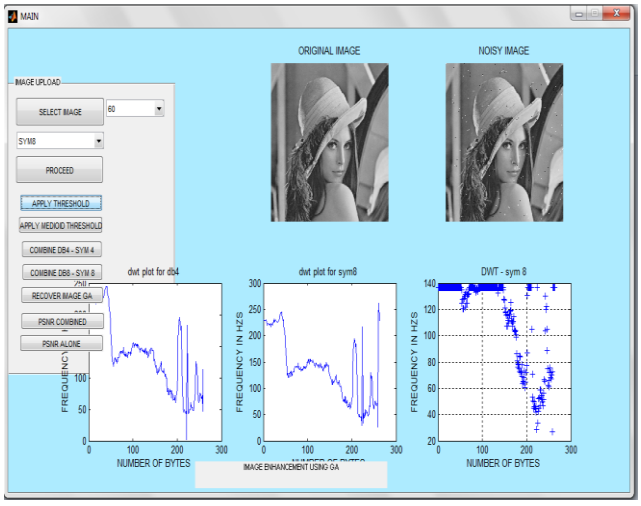


Figure 17 *Noise level and DWT that is sym4 and sym8 is added*

Above figure shows that we have added gaussian noise level i.e. 60 and also addded DWT sym4 and sym8.

Gaussian Noise is added in the original image. On noisy image, two wavelet families are applied i.e. Symlet and Daubechies Daubechies wavelet is (used in solving problems such as fractal problems, signal discontinuities etc. Symlet wavelets are enhanced versions of Daubechies wavelets.

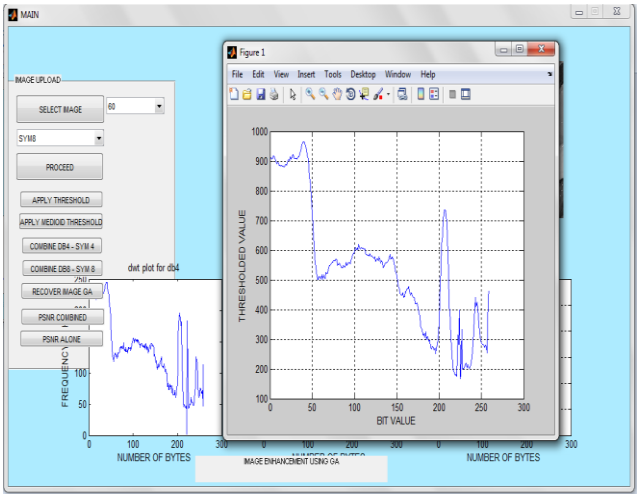


Figure 18 *Applying sym8 and thresholding*

In this figure, we apply sym8 and thresholding with Gaussian noise of about 60%

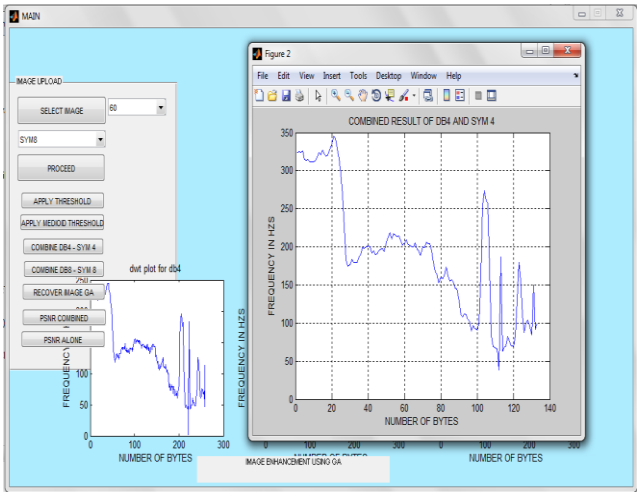


Figure 19 *Combined output of db4 and sym4*

In above figure, we combined output of db4 and sym4.

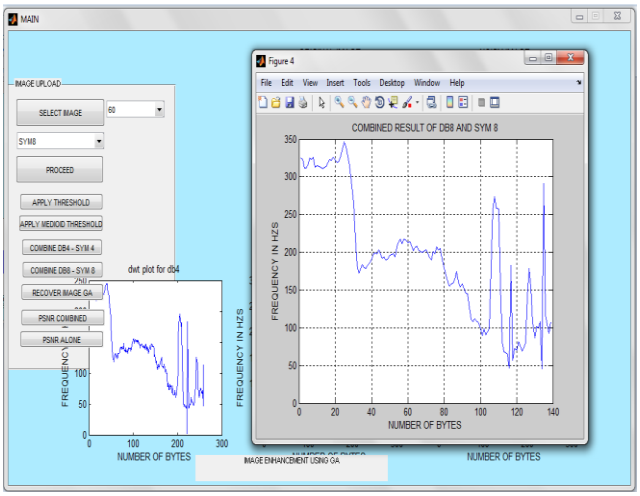


Figure 20 *Combined output of db8 and sym8*

In this we have shown, combined output of db8 and sym8.

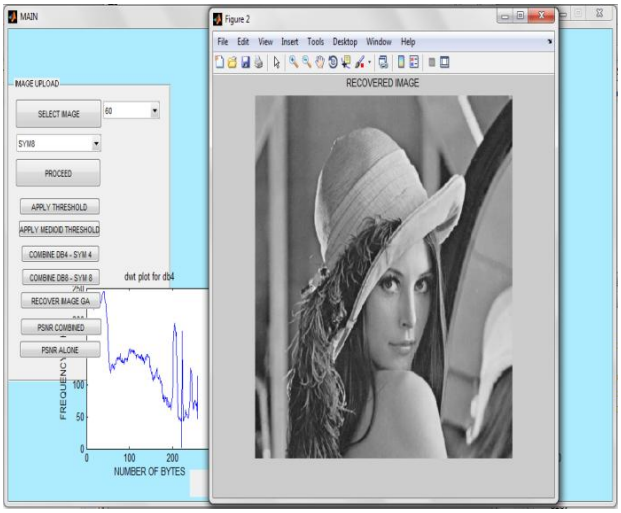


Figure 21 *Recover image using genetic algorithm*

In this figure, we have shown the recovered image by implementing Genetic Algorithm.

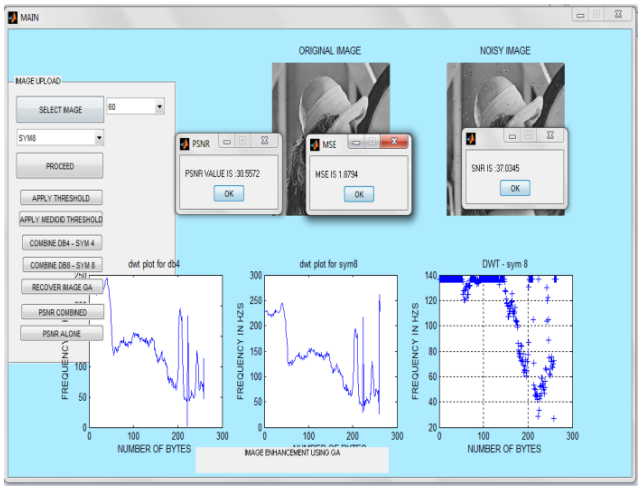


Figure 22 *Results of Genetic algorithm*

This figure shows the result of using Neural Network for image enhancement. These results are given through various parameters that are given as MSE- Mean Square Error, PSNR- Peak to Signal Noise Ratio, and SNR- Signal Noise Ratio.

PARAMETERS	Mean Square Error (MSE)	Peak to Signal Noise Ratio (PSNR)	Signal Noise Ratio (SNR)
RESULTS	1.8794	30.5572	37.0345

Table 2 *Results Parameter Table of Image Enhancement Using Genetic Algorithm*

In above table we have shown value of various parameters used.

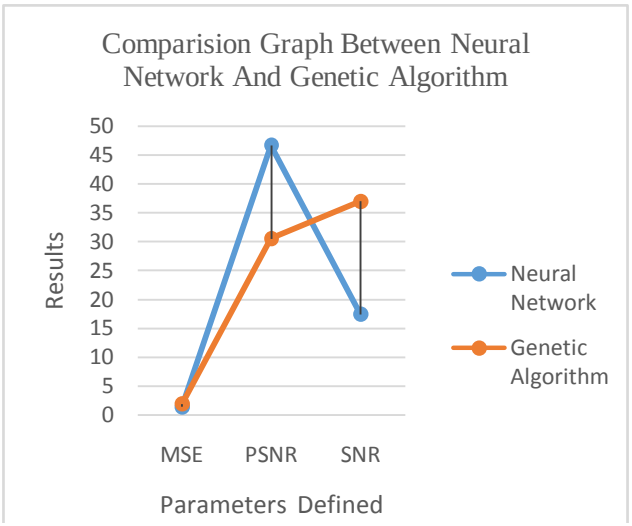


Figure 23: *Comparison graph between parameters defined (MSE, PSNR, and SNR) and results of Neural Network and Genetic Algorithm*

In above chart we have shown comparison on the basis of results obtained of various parameters such as MSE, PSNR and SNR in Neural network as compared to genetic algorithm. In this we get that neural network gives much better performance as compared to GA in terms of MSE, PSNR and SNR parameters.

4 CONCLUSION

For image enhancement, DWT for sampling is applied with Back Propagation Neural network for training the data which is used for conjunction and for evaluating the loss function for optimization. The DWT is an implementation of the wavelet transform using a discrete set of the wavelets scales for numerical analysis and functional analysis. Then, BPNN is compared with Genetic Algorithm for image enhancement by carrying out various wavelet transforms like Daubechies and Symlets. Genetic algorithms (GA's) are search algorithms that work basically for the optimal solutions via the process of natural selection. In Neural network, PSNR is used for bringing less error ratio. The results shows that neural network is far better than genetic algorithm in terms of PSNR, MSE and SNR.

In future, neural network can be used with Bacterial forging optimization Algorithm. The Bacterial Foraging Optimization Algorithm is motivated by the group foraging behavior of bacteria such as E.Coli and M.Xanthus. Explicitly, the BFOA is stimulated by the chemo taxis performance of bacteria that will recognize chemical gradients in the environment and move toward or away from specific signals. The BFO with NN can be used for the optimization results.

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