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Analysis of Image Compression in medical images Using Hybridization of DWT and Neural Network

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Abstract: *Image compression plays a critical role in telemetric applications and especially in telemedicine. It is desired that either single images or sequences of images be transmitted over computer networks at large distances so as that they could be used in a multitude of purposes. It is necessary that medical images be transmitted so as that reliable, improved and fast medical diagnosis performed by many centers could be facilitated. To this end, image compression is an important research issue. The difficulty, however, in several applications lies on the fact that, while high compression rates are desired. So, in this paper the image compression system is being developed using DWT and NN in MATLAB environment. To validate the results three parameter has been chosen i.e. PSNR, Compression ratio and MSE value. The evaluation results show that proposed technique leads to high compression ratio.*

Keywords: *Image Compression, DWT, DCT, Neural Network.*

1. INTRODUCTION

Compression ways area unit being speedily developed to compress massive information files like pictures, wherever information compression in transmission applications has recently become additional important .With the increasing growth of technology and therefore the entrance into the digital age, a colossal quantity of image information should be handled to be hold on in an exceedingly correct means exploitation economical ways typically achieve compressing pictures, whereas holding high image quality and marginal reduction in image size [1]. In medical image compression applications, diagnosis is effective only when compression techniques preserve all the relevant and important image information needed.

Image compression exploitation wave Transforms could be a powerful technique that's most popular by scientists to induce the compressed pictures at higher compression ratios [2]. It's a well-liked rework used for a few of the compression standards in lossy compression ways. Not like the separate cosine transform, the wave transform isn't Fourier-based and thus wavelets do a stronger job of handling discontinuities in information. With wave transform primarily based compression, the standard of compressed pictures is typically high, and therefore the alternative of a perfect compression quantitative relation is tough to create because it varies looking on the content of the image. Therefore, it's of nice advantage to possess a system that may confirm AN optimum compression quantitative relation upon presenting it with a picture. Compression exploitation wave transform and a neural network was recommended recently [3]. Moreover, completely different compression techniques were combined with neural network classifier for numerous applications [4]. Neural network is trained to determine the non-linear relationship between the image intensity and its compression quantitative relations in hunt for an optimum ratio. The wave rework and additional significantly discrete wave transform (DWT) could be a comparatively recent and computationally economical technique for analyzing and extracting data from image signals [5]. separate wave rework (DWT) includes a

sensible illustration at frequency and time scaling with that DWT was recently utilized by some international organizations as compression normal like JPEG2000. MPEG4.

A wavelet function Ψ(t) has two main properties,

$$\int_{-\infty}^{0} \Psi(t)\, dt = 0; \qquad (1)$$

That is, the function is oscillatory or has wavy appearance.

$$\int_{-\infty}^{0} |\Psi(t)|^2\, dt = 0; \qquad (2)$$

That is, the most of the energy in Ψ(t) is confined to a finite duration.

2. IMAGE COMPRESSION AND RECONSTRUCTION

Fig. below shows the essential steps in a picture compression system. The compression system consists of 2 distinct structural blocks: associate degree encoder and a decoder. Image f(x,y) is fed into the encoder, that creates a collection of symbols from the computer file and uses them to represent the image. Image f^ (x,y) denotes associate degree approximation of the input image that results from press and after pressing the input image [6].

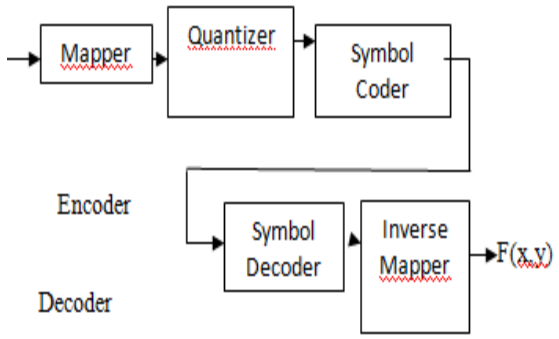

Figure.2 Basic step in an image compression system.

The compression that's achieved will be quantified by the compression quantitative relation given by the subsequent formula:

$$CR = m1/m2 \qquad (3)$$

where m1 and m2 denote the quantity of data carrying units (bits) within the original image and therefore the compressed image severally. A compression quantitative relation like ten (or ten:1) indicates that the first image has 10 data carrying units (e.g. bits) for each one unit within the compressed knowledge set.

Several quality measure variables like, PSNR (peak signal/noise ratio ratio), MSE (mean sq. error) etc. will be measured to seek out however well a picture is reproduced with relevancy the reference image. These variables area unit} signal fidelity metrics and don't measure however viewers understand impairments. Numerical values of those variables for any image tell us concerning the standard of that image [7-8].

The measure of peak signal-to-noise ratio (PSNR) is defined as the following formula:

1. **PSNR:** The Peak Signal-to-Noise Ratio (PSNR) is defined as:

$$PSNR = 10.\log_{10} (MAX^2 / MSE) \qquad (3)$$

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

$$MSE = \frac{1}{mn} \sum \sum [(I,j) - K(I,j)]^2 \qquad (4)$$

3. **Compression rate**

3. DESIGN AND IMPLEMENTATION

Following block diagram shows the image compression model based on neural network and DWT.

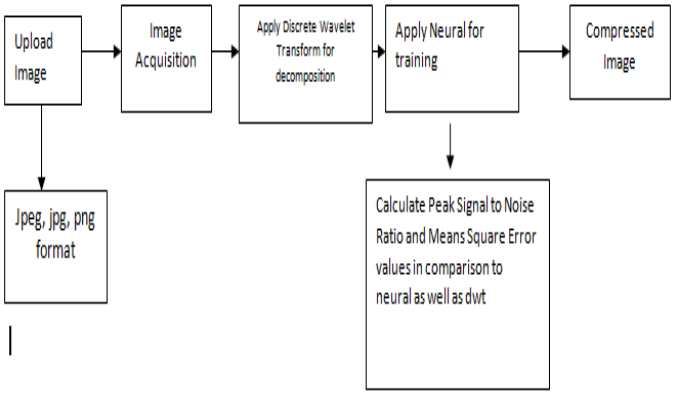

Figure. 3 Proposed Simulation Model

The following are the segments of implementation model:

- **Image Acquisition**

Firstly step is image acquisition and capturing of image is done through Samsung Phone based camera of 5 Mega Pixel. Captured image size is less than 300 KB.

- **Select Noise Level**

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. In this different noise levels are added in original image such as 20%, 40%, etc.

- **Select Wavelet Family**

Here the original image undergoes discrete wavelet transformation. The DWT is a transform which can map a block of data in the spatial domain into the frequency domain. The DWT returns information about the localized frequencies in the data set.

- **Apply Neural Network**

Here we get a compressed image using the neural networks.

- **Reconstruction**

The results are kept and the quantization stage from the compression is earmarked. The parts of the image are then prepared for the inverse discrete wavelet transform [9]. The wavelets packets are subjected to the inverse DWT. Afterwards, the final reconstructed image may be showed.

4. PSEDUO CODE OF SIMULATION MODEL

Step 1:

Start
Initial image= Input image;
Input image→ various sub-images using 2-Level DWT;
For (each of sub image)
Vector quantization for each sub band;
then transmitted to the decoder;
End;
If (PSNR < Threshold T_h)
Move to step 2;
Else
Stop;
End;

Step 2:
At the encoder end
Initial image (I.I) = obtained sub bands;
For (each image)
Sub bands are reconstructed→ this is the reconstructed image (R.I);
End;
go to step 3;
Step 3:
Apply Neural Network.
Training Phase
Testing Phase
Images are compressed using their optimum compression ratios using DWT prior to training the neural networks [10].

5. RESULTS AND IMPLEMENTATION

In this proposal, an effective compression method based on DWT and NN is developed and the implementation is done in MATLAB environment. For testing large dataset has been used and also for justification.

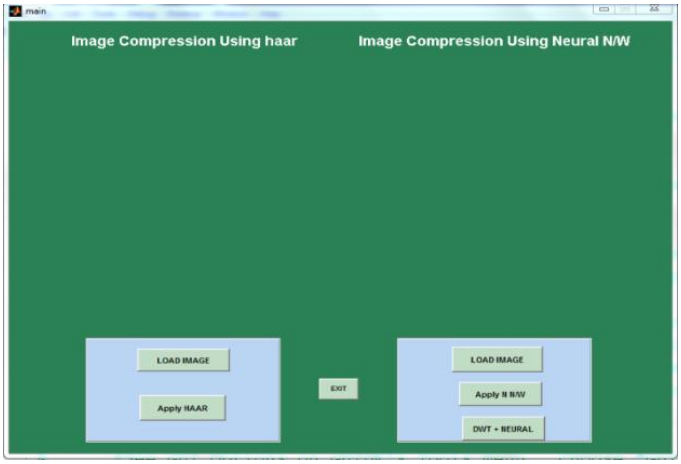

Figure no: 5.1 Main Image

Above window is the main window of the proposed work. Its working is described as follows: upload the image, apply haar, Secondly panel represent a load image, apply neural network and DWT + NN.

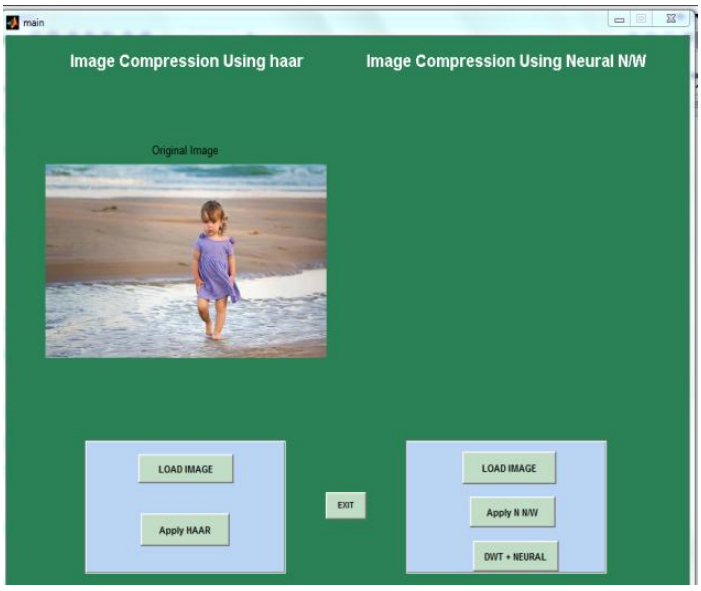

Figure. 5.2 Upload main image

This figure shows that upload an original image having user interface controls for the proposed system as implemented in Graphical user interface in MATLAB

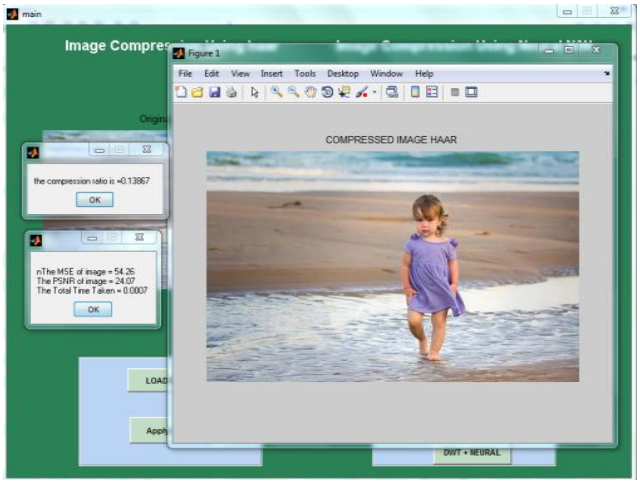

Figure.5.3 Compress Image

The above figure shows the compress image using HAAR wavelet and shows the results in the message box in terms of Peak signal to noise ratio, Mean Square Error, Total time taken to compress image and the compression ratio

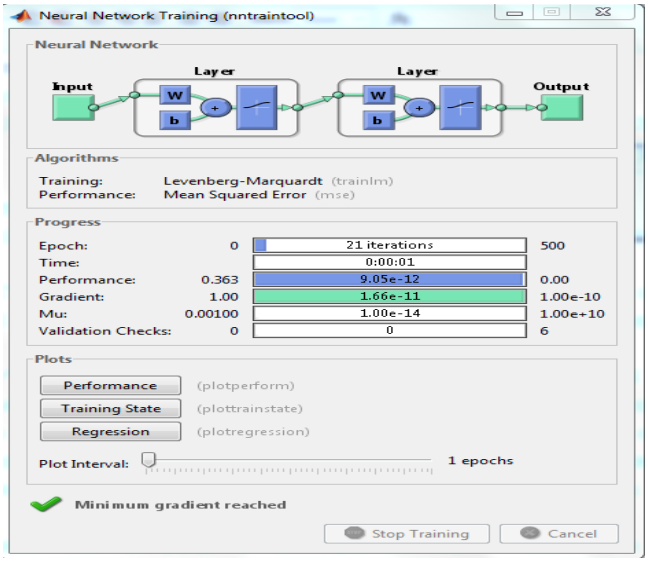

Figure. 5.4 Neural tool box

The above figure shows the neural network tool box having neural architecture based on training set and the targets and shows three layers which deals with the input layer, Output layer and hidden layer. The network deals with the number of epochs which deals with number of iterations to train the network and also the validation through which the performance is evaluated.

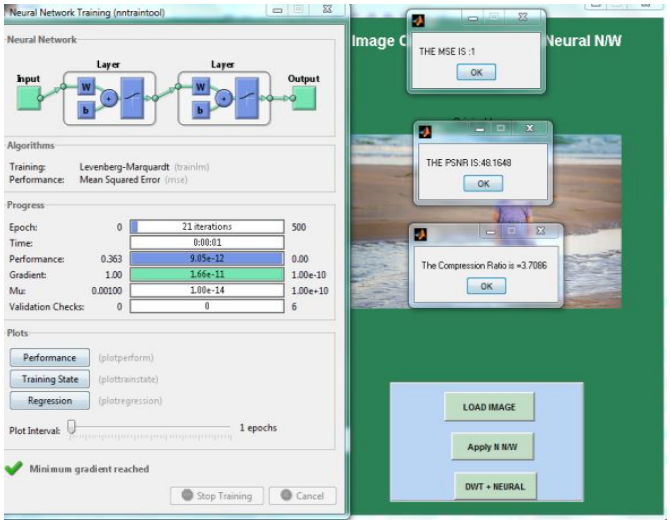

Figure.5.5 Compression using neural and DWT

The above figure shows the neural network and discrete wavelet transform hybridization to compress the image and evaluated using mean square error, Peak signal to noise ratio and compression ratio and shows that the proposed system is having high performance than the HAAR wavelet which shows that the proposed technique performs efficiently.

5. CONCLUSION AND FUTURE SCOPE

The implementation of the proposed method used the discreet wavelet transform and neural network where the quality of the compressed images is not a secondary factor at the high compression ratios as in JPEG format. The main advantage of this proposed technique is that noise is not at high level when using Neural Network as it was found in JPEG technique. It has also been concluded that the Hybrid image compression is to combine Discrete Wavelet Transform (DWT) and Neural Network (NN) with high compression ratio with good quality compressed image is observed. From the result evaluation it has been concluded that proposed technique effectively compressed the image. The future work relies on implementing a suppression technique that can reduce the number of iterations in neural network and increase convergence speed of our proposed algorithm effectively.

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