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IMAGE COMPRESSION USING NEURAL NETWORK USING BFGS QUASI NEWTON BACK PROPAGATION ALGORITHM

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ABSTRACT

In this paper, new multilayer perceptron's feed forward propagation neural network using BFGS quasi newton algorithm is proposed and it is trained to achieve image compression. As we know that image requires large data and classic image compression techniques such as JPEG and MPEG have serious limitations at high compression rates. In this paper, we shows network parameters such as Mean Square Error (MSE) , Peak Signal to Noise Ratio (PSNR) values and graphs. Its performance evaluation, validations state (consist of alpha=.8 and mc=.2) is shown . In this paper, the input pixels will be used as target values so that assigned Mean Square Error can be obtained, and then the output of the hidden layer will be the compressed image. This paper presents a artificial neural network (ANN)based technique that may be applied to data compression and breaks down large images into smaller blocks (1x64) and eliminates redundant information. At last we concluded this technique uses a artificial neural network training function (trainbfg). Results obtained with proposed technique leads to better compression ratio at the same time preserving the image quality.

Key Words— artificial neural network (ANN), back propagation, multilayer perception's, Mean Square Error (MSE) , Peak Signal to Noise Ratio (PSNR).

I. INTRODUCTION

In communication, Image compression plays an important role. To remove redundancy from image, compression is required. There are mainly two types of image compression techniques, lossy and lossless. The artificial neural network is one of the methods in image compression to remove redundancy as it processes the data in parallel and with limited bandwidth and hence requires less time and therefore, it is superior over any other technique like cosine transform, wavelet etc. Based on neural network models, a learning approach has been developed and it consists of input layer, hidden layer and output layer [1]. In this project, feed forward back propagation algorithm is used to achieve image compression. A two-layer feed forward neural network is used and BFGS Quasi Newton learning rules will be employed for training the network.

In this project, different learning rule is employed to train multilayer neural network and the network is constructed from input layer, hidden layer, and output layer. In this project image should be subdivided into sub blocks and the pixels grey level values within the block will be reshaped into a

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column vector and input given to the neural network through the input layer[2-4]. Input pixels will be used as the target values, and therefore the mean square error could be adjusted as needed.

The network will be trained by back propagation, using BFGs learning algorithm.

II.Back-propagation Artificial Neural Network

The structure of neural network are as given in the fig.

There are three layers

- input layer
- output layer
- hidden layer.

Both of input layers and both of output layers are coupled to hidden layer. The image compression is got by assigning the value of the number of neurons at the hidden layer which is less than that of neurons at input and output layers.[3]

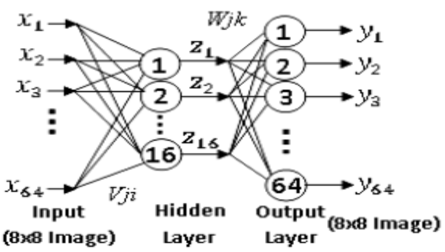


Fig.1

The above neural network could be either linear or nonlinear network according to the transfer function employed in the layers. One of the most common functions employed in different neural networks problems and its equation is Log-sigmoid and it is given as.

The transfer functions employed in trained algorithm are (Purelin) and (transig). Neural networks problems and its equation are as follows

$$f(x) = \frac{x}{1 + \exp(-x)}$$

various other transfer function could be used are (traingda) Gradient descent with adaptive learning rule back propagation, (traingdm) Gradient descent with momentum back propagation ,(traingdx) Gradient descent with momentum and adaptive learning rule back propagation ,(trainlm) Levenberg-Marquardt back propagation, (trainoss) One step secant back propagation, (trainr) Random order incremental training with learning functions, (trainrp) Resilient back propagation (Rprop) trains Sequential order incremental training with learning function.

In a feed forward neural network the output Zj of the jth neuron in the hidden layer is given as-

$$Z_j = f^1(\textstyle\sum_1^N W jiXi + bj)$$

And the output $Y_k$of the kth neuron in the output layer is given by

$$Y_k = f^2(\textstyle\sum_1^M Wkl\ Zl + bk)$$

Function used for back propagation in matlab is {newff(minmax(in31),[4,16],{'tansig','purelin'},'trainbfg')}.

III.Tools and Methodology

In this project a literature survey has been carried out so that we could find and efficient multi-layered neural network[6]. MATLAB software along with its Neural Network and Image Processing toolbox will be used to implement the given technique. The MATLAB2013a software provides various easy to use and readily available built in functions for realizing Neural Network algorithms in quick time(quasi newton method). An extensive study of this will be required as well.

Algorithm to be used BFG quasi newton method .

The usability and utility of the power of neural network for image compression lies on the following three important aspects:

(a) Selection of efficient multi layered network.

(b) Selection of training methods.

(c) Test vector.

IV. The Approach:

Neuron:

The most basic element of the human brain is a specific type of cell, which provides with the abilities to remember, think, and apply previous experiences to our every action. These cells are known as neurons; each of these neurons can connect with up to 200000 other neurons. The power of the brain comes from the numbers of these basic components and the multiple connections between them.

The Artificial Neuron: The basic unit of neural networks, the artificial neurons, simulates the basic functions of natural neurons. Artificial neurons are much simpler than the biological neuron [7]. The fig. below shows the basics of an artificial neuron.

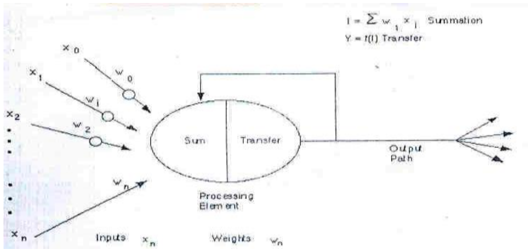


Fig.2

The various inputs to the network are represented by the mathematical symbol, x(n). Each of these inputs are multiplied by a connection weight, these weights are represented by w(n). In the simplest case, these products are simply summed, fed through a transfer function to generate a result and then output. Even though all artificial neural networks are constructed from this basic building block the fundamentals may vary in these building blocks and there are differences.

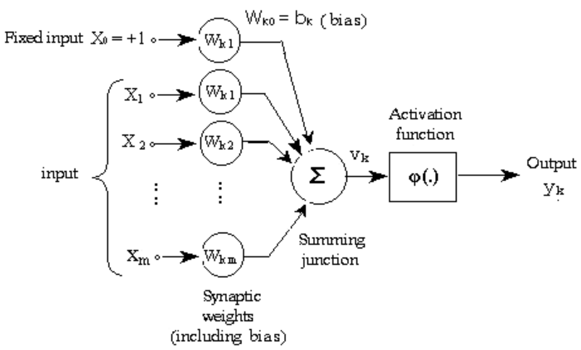


Fig.3

Design: The design goes through a period of trial and error in the decisions before coming up with a suitable neuron design. The design issues in neural networks are complex and are the major concerns of system developers.

Designing a neural network consists of:

- Arrangement of neurons in various layers.
- Taking decision for the type of connections among neurons for different layers, as well as among the neurons within a layer.
- Taking decision of the way a neuron receives input and produces output.
- Determining the strength of connection within the network by allowing the network learns the appropriate values of connection weights by using a training data set.

The process of designing a neural network is an iterative process.

V.Algorithm

Step1: Read the test image

Step2: Divide the 256x256 image into 8x8 blocks of pixels.

Step3: Check each block for the complexity level.

Step4: Initialize the neurons.

Step5: Target scanned vectors to each neuron on the input layer.

Step6: Depending on the weights and the logic involved, perform the operations (TRANSIG).

Step7: Pass them to the hidden layer.

Step8: Again, the same as in step6 (purlin).

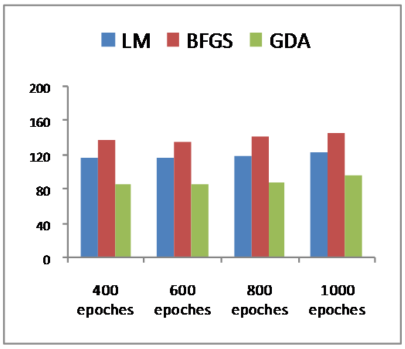
Step9: Reassemble the outputs.

VI.Experimental Results

In order to evaluate the performance of the proposed approach of image compression using BFGs Algorithm .Standard image of baboon is considered from Matlab library. The work is implemented using MATLAB 2013a. The evaluation of the proposed approach in image compression is performed based on the following two factors, PSNR and MSE values.

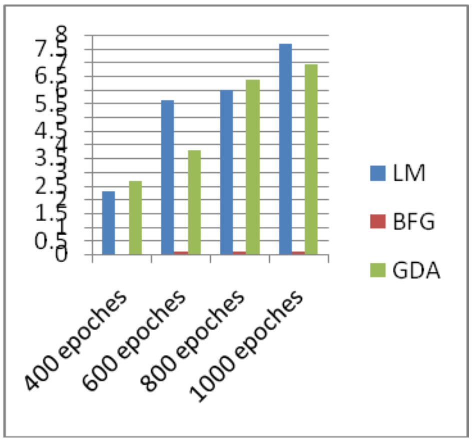
Table 2: Table1: PSNR and MSE values (BFGs algorithm)(a=.5,u=.4)

Epochs	PSNR (dB)	MSE(dB)
100	134.3501	.0042
200	134.4522	.0479
300	134.9802	.0067
400	137.0125	.0141
500	136.8961	.0770
600	135.9871	.0851
700	138.6789	.0844
800	141.8790	.0834
900	144.0001	.0869
1000	146.7685	.1239



PSNR(db) comparison valueswith other algorithm

MSE(db) comparison values



Neural network result using BFG Algorithms Result in MATLAB 2013a

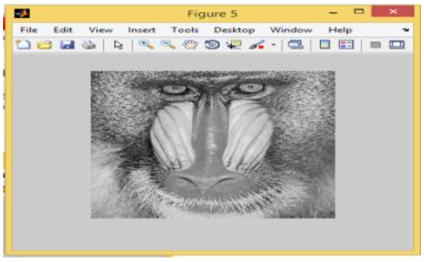


Fig.(a) Original image(256 x 256)

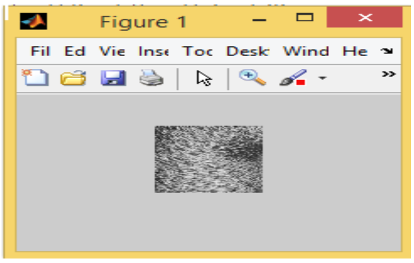


Fig.(b)Trained image(8x8)

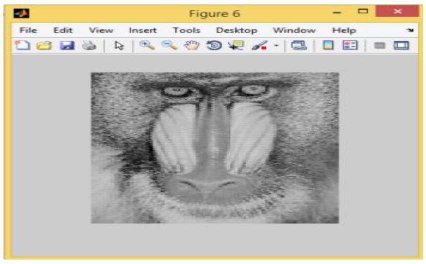


Fig.(c)Compressed image

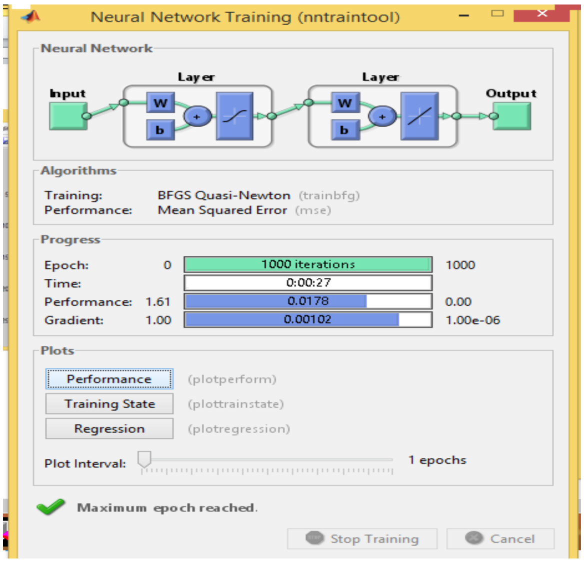


Fig.(d) Neural network simulation training tool using BFGS quasi newton (MATLAB)

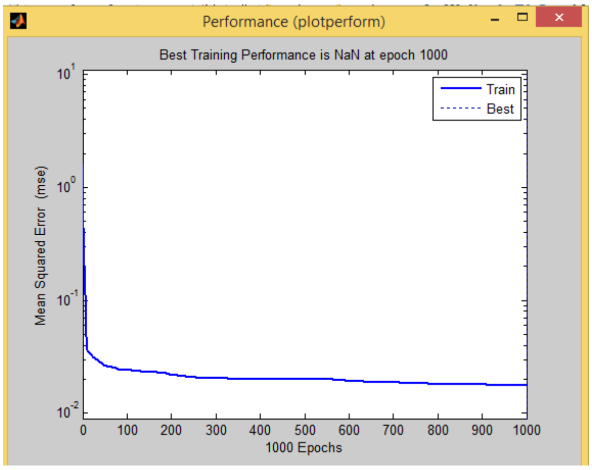


Fig.(e) MSE curve

VII. Conclusion

In this paper, neural network technique is proposed and trained using quasi newton BFGS algorithm for image compression. The neural network is trained with the small 8 × 8 blocks of image and tested. It is observed from the results that BFG algorithm is best among proposed image for parameters like MSE and PSNR. Using this method, a good quality of decompressed image is obtained. It has high PSNR and very less error. Thus, this method achieves high compression. In this technique the neural network is trying to determine the updated weights and biases in each step to minimize the systems errors.

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