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Image Compression with Neural Network

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ABSTRACT

With many techniques available for image compression, the challenge to find the most efficient technique among them still prevails. Digitized images have replaced analog images as digital photographs in many different fields. In their unrefined form, digital images have need of a remarkable memory capacity for storage and large amount of bandwidth for transmission. In the last few decades, many researchers have been devoted to develop new techniques for image compression. More recently, wavelets have become a cutting edge technology for compressing the images by extracting only the visible elements. Our work presents implements the decomposition based Wavelet technique with it types such as Coiflets filter, Symlet filters and Daubechies filter and also neural network based Gradient technique been implemented. Also, a non-uniform threshold technique based on average intensity values of pixels in each sub band has been proposed to remove the insignificant wavelet coefficients in the transformed image. Experimental results are obtained to compare the Neural network based Gradient approach better to compress the image. But by fortunally, neural network technique does not work with 3-D images i.e color images. Here wavelet based technique, compactly supported (Daubechies) is tested on various images using two important performance parameters – MSE and PSNR results in best as compared to other coiflet and Symlet for compression of images in 3-D as well as in 2-D.

Key Word: Coiflet, Symlet, Daubechies, Gradient, Wavelet, Compression.

1. INTRODUCTION:

Digital images consist of discrete picture elements called pixels. Associated with each pixel is a number that is the average radiance of relatively small area within a scene. The size of this area affects the reproduction of detail within the scene. As the pixel is reduced, more detail is preserved in the digital representation. Digital image can be displayed at any desired scale.

Data compression is defined as the process of encoding the data using a representation that reduces the overall size of the data. This reduction is possible when the original data set contains some type of redundancy. Digital image compression is a field that studies the methods for reducing the total number of bits required to represent an image. This can be achieved by eliminating various types of redundancy that exist in the pixel value. The large amount of data is used to represent visual information often overtaxes the capability of current computer system. Image compression can significantly help by reducing this data storage requirement. This enables fast transmission of images and it can also provide enhanced data security. So therefore image compression is an important tool in imaging environment. Furthermore, the role of image compression becomes increasingly important as the amount of imaging data produced per year grows exponentially, the number of imaging applications increases, and the transmission of digital images is already the largest portion of data traffic in many computer networks.

Reducing the storage requirement is equivalent to increasing the capacity of the storage medium and hence communication bandwidth. Data is represented as a combination of information and redundancy. Information is the portion of data that must be preserved permanently in its original form in order to correctly interpret the meaning or purpose of the data. Redundancy is that portion of data that can be removed when it is not needed or can be reinserted to interpret the data when needed. Most often, the redundancy is reinserted in order to generate the original data in its original form. A technique to reduce the redundancy of data is defined as Data compression. The redundancy in data representation is reduced such a way that it can be subsequently reinserted to recover the original data, which is called decompression of the data.

Neural networks are inherent adaptive systems; they are suitable for handling non-stationeries in image data. Artificial neural network can be employed with success to image compression. The advantages of realizing a neural network in digital hardware are:

- Fast multiplication, leading to fast update of the neural network.
- Flexibility, because different network architectures are possible.
- Scalability, as the proposed hardware architecture can be used for arbitrary large network, considered by the no. of neurons in one layer.

The greatest potential of neural networks is the high speed processing that is provided through massively parallel VLSI implementations. The choice to build a neural network in digital hardware comes from several advantages that are typical for digital systems:

1. Low sensitivity to electric noise and temperature.
2. Weight storage is no problem.
3. The availability of user-configurable, digital field programmable gate arrays, which can be used for experiments.
4. Well-understood design principles that have led to new, powerful tools for digital design

The crucial problems of neural network hardware are fast multiplication, building a large number of connections between neurons, and fast memory access of weight storage or nonlinear function look up tables.

The most important part of a neuron is the multiplier, which performs high speed pipelined multiplication of synaptic signals with weights. As the neuron has only one multiplier the degree of parallelism is node parallelism. Each neuron has a local weight ROM (as it performs the feed-forward phase of the back propagation algorithm) that stores, as many values as there are connections to the previous layer. An accumulator is used to add signals from the pipeline with the neuron's bias value, which is stored in an own register.

2. LİTERATURE SURVEY

Previous Research work on ***"Image Compression with GRADIENT Neural Network and Wavelet based filters."*** in the literature survey starting from 2011-2014 was studied which helped me to complete my work and enhance my knowledge. I studied so many papers and some of them are given below:

S. Sridhar (2014), in this author gets problem in evaluating the picture quality of an image compression system with difficulty in describing the amount of degradation in reconstructed image, in this their proposed work was carried out by the application of different hand designed wavelet families like Haar, Daubechies, Biorthogonal, Coiflets and Symlets etc on a variety of bench mark images. In this the relative merits of different Wavelet transform techniques are evaluated using objective fidelity measures- PSNR and MSE, results obtained provide a basis for application developers to choose the right family of wavelet for image compression matching their application. It was observed that Daubechies family wavelet Daubechies8 produced highest PSNR of order 48.6538 for Medium detail image1, while the Biorthogonal family wavelet Bior6.8 produced highest CR of order 63.4034 for the same Medium detail image1. In the case of color images it was observed that Biorthogonal family wavelet Bior3.3 and Symlet family wavelet Sym6 produced better PSNR and CR values of order 27.0686 and 57.1390 for the same color image1-ganesh.The results obtained clearly indicate that Biorthogonal functions offer good compression performance than remaining ones; however the Daubechies functions do perform better in statistical terms. Since each wavelet filter gives a different performance for different fidelity metrics and different images, they concluded that compression performance depends on the size and content of the image therefore it is appropriate to tailor the choice of wavelet based on image size and content for desired quality of reconstructed image [21]. **M V. Subbarao (2013)** defines the Image compression is playing a key role in the development of various multimedia computer services and telecommunication applications. The ideal image compression system must yield good quality compressed images with good compression ratio, while maintaining minimal time cost. The goal of image compression techniques is to remove redundancy present in data in a way that enables image compression technique. There are numerous loss and lossless image compression techniques. Wavelet-based image compression provides substantial improvements in picture quality at higher compression ratios. In this paper both of these methods for compression of images to obtain better quality [17]. **J. Mishra and R K. Jena (2013)** describes a comparative study of compression algorithms is presented. An objective picture quality measures like Peak Signal to Noise Ratio (PSNR), Mean Square Error (MSE) are used to measure the picture quality and comparison is done based upon the results of these quality measures. Singular Value Decomposition (SVD) based intelligent image compression achieves better results as compared to other compression standard [7]. **G. kaur (2013)** prescribes the Image compression is the application of Data compression on digital images. This paper entails the study of various image compression

techniques and algorithms. Different techniques for digital image compression have been reviewed and presented that includes DFT, FFT, DCT and DWT. Wavelets , however has an advantage over older techniques that it doesn't have any blocking artifacts as in DCT. It is easy to implement and reduces the computation time and resources required. The discrete wavelet transform uses filter banks for the construction of the multi resolution time-frequency plane. The Discrete Wavelet Transform analyzes the signal at different frequency bands with different resolutions by decomposing the signal into an approximation and detail information. The decomposition of the signal into different frequency bands obtained by successive high pass g[n] and low passes h[n] filtering of the time domain signal. Also, a new algorithm for image compression using Fast Wavelet Transform has been proposed as FWT reduces the problems of border distortions in Image Compression [6]. **V. Krishnanaik and Dr. G M. Someswar (2013)** defines images have large data capacity. For storage and transmission of images, high efficiency image compression methods are under wide attention. In this paper we implemented a wavelet transform, DPCM and neural network model for image compression which combines the advantage of wavelet transform and neural network. Images are decomposed using Haar wavelet filters into a set of sub bands with different resolution corresponding to different frequency bands. Scalar quantization and Huffman coding schemes are used for different sub bands based on their statistical properties. The coefficients in low frequency band are compressed by Differential Pulse Code Modulation (DPCM) and the coefficients in higher frequency bands are compressed using neural network. Using this scheme we can achieve satisfactory reconstructed images with increased bit rate, large compression ratios and PSNR [22].

3. METHODOLOGY

Steps for Implementation:

1. Start
2. Read the Original Image.
3. Apply the Wavelet based filters algorithm on original image or apply the GRADIENT algorithm on same image with the help of neurons weightage. In case, of GRADIENT Algorithm check the neuron values for set and reset and then proceeds to the next step.
4. Repeat the step 2, 3, 4.
5. Apply the inverse of wavelet Based filters or GRADIENT algorithm as per applicable.
6. Reconstruct the output image and calculate the different parameters.
7. Stop.

4. RESULT & DISCUSSION:

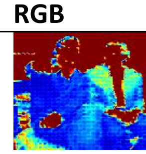
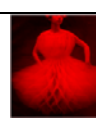
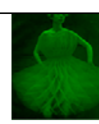
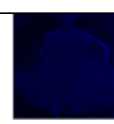
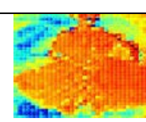
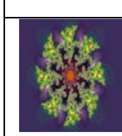
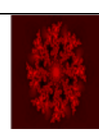
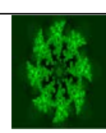
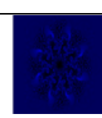
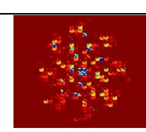
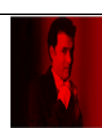
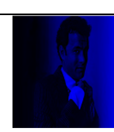
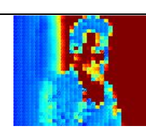
Original Image	**Red Color Image**	**Green Color Image**	**Blue Color Image**	**Compressed Image in RGB**
				
				
				
				

Figure 1: Tested Images on different colors i.e RGB using NN

In figure 1 shows the original images which are tested for compression on using GRADIENT NN. In this we get on running 3 different color images while compressing i.e Red, Green, Blue. We get compressed image which does not show good quality picture in colors as Gradient

Neural Networks does not works for color images i.e. 3-D. But it works better for Gray Scale images i.e 2-

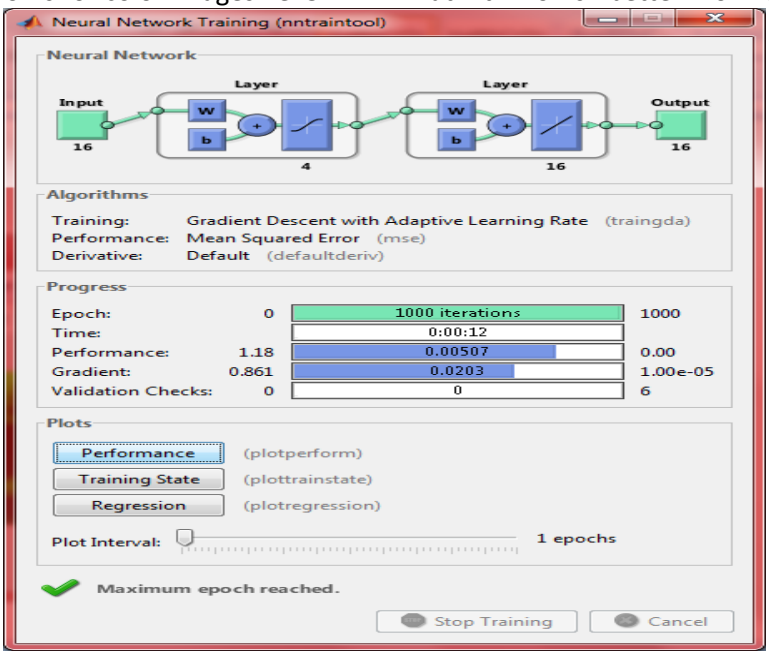


Figure2: Neural Network Running Process with GRADIENT Algorithm

Table 1: Original images, compressed images with its PSNR, MSE values using Gradient NN

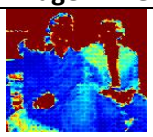
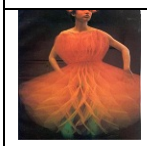
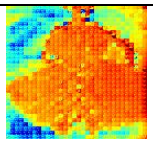
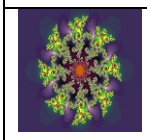
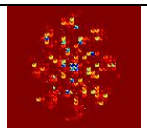
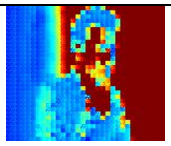
Original Image	Compressed Image in RGB	PSNR	MSE
		R: 69.79 G: 70.23 B: 71.13 Avg: 70.3848	R: 0.00683 G: 0.00616 B: 0.00501 Avg: 0.006
		R: 72.61 G: 74.51 B: 75.68 Avg: 74.26635	R: 0.00356 G: 0.00230 B: 0.00176 Avg: 0.002541
		R: 69.81 G: 68.72 B: 70.51 Avg: 69.6801	R: 0.00679 G: 0.00874 B: 0.00578 Avg: 0.007103
		R: 72.10 G: 71.36 B: 71.29 Avg: 71.58234	R: 0.00401 G: 0.00475 B: 0.00483 Avg: 0.004533

Table 2: Original images, compressed images with its PSNR, MSE values using Coiflet Technique (Wavelet Filter)

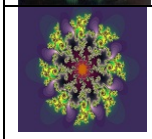
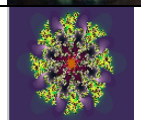
Original Image	Compressed Image in RGB	PSNR	MSE
		58.3642	0.094768
		57.36323	0.119332
		59.55464	0.072047
		74.56662	0.002272

Table 3: Original images, compressed images with its PSNR, MSE values using Daubechies Technique (Wavelet Filter)

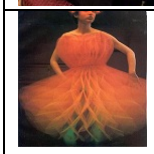
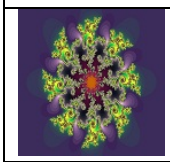
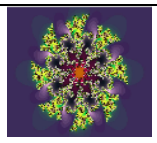
Original Image	Compressed Image in RGB	PSNR	MSE
		56.38073	0.149626
		55.17722	0.197405
		59.02287	0.081432
		65535 (Inf)	0(Less than 1)

Table 4: Original images, compressed images with its PSNR, MSE values using Symlet Technique (Wavelet Filter)

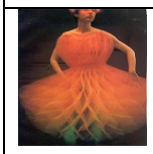
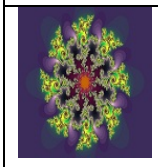
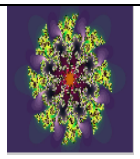
Original Image	Compressed Image in RGB	PSNR	MSE
		58.16944357	0.099114
		57.60596748	0.112845
		59.12953531	0.079456
		73.08739118	0.003194

Table 5: Comparison of wavelet based filters with GRADIENT Neural with its PSNR, MSE values

Sr.No	Type of technique for compression	Original Image	PSNR	MSE
1	Graident Neural Network (Average of RGB Color)		74.26635	0.002541
2	Wavelet – Type Coiflet		57.36323	0.119332
3	Wavelet– Type Symlet		57.60596748	0.112845
4	Wavelet– Type Daubechies		55.17722	0.197405

In above all table 1 to 4 we have shown original images, compressed images as an output with quality parameters such as PSNR and MSE. In last table 5 comparison of one image is shown with different techniques of wavelet and Neural network that gives better output in the form of image compression. Out of all compression techniques our best technique in comparison to parameters values PSNR and MSE in term of overall is neural network Gradient technique. Next to it in wavelets techniques is Coiflet filter of Wavelet family. NN does not works better for 3-D images i.e colored images.

5. CONCLUSION & FUTURE WORK

The dissertation, "Image Compression with GRADIENT Neural Network and Wavelet based filters." has been successfully programmed using MATLAB and tested.

The computing world has a lot to gain from neural networks. Their ability to learn by example makes them very flexible and powerful. Furthermore there is no need

to devise an algorithm in order to perform a specific task; i.e. there is no need to understand the internal mechanisms of that task. They are also very well suited for real time systems because of their fast response and computational times which are due to their parallel architecture. Neural networks also contribute to other areas of research such as neurology and psychology. They are regularly used to model parts of living organisms and to investigate the internal mechanisms of the brain. Perhaps the most exciting aspect of neural networks is the possibility that some day 'conscious' networks might be produced. There are a number of scientists arguing that consciousness is a 'mechanical' property and that 'conscious' neural networks are a realistic possibility. In this, result is analyzed on wavelet filters also in which coiflet is best as compared its own family for 3-D and 2-D image compression. Overall neural network technique known as Gradient is best then wavelet based filters but it cannot work best for 3-D images.

Even though neural networks have a huge potential we will only get the best of them when they are integrated with computing, AI, fuzzy logic and related subjects. Neural networks are performing successfully where other methods do not, recognizing and matching complicated, vague, or incomplete patterns.

Artificial Neural Networks is currently a hot research area in image processing and it is believed that they will receive extensive application to various fields in the next few years. In contrast with the other technologies, neural networks can be used in every field such as medicine, marketing, industrial process control etc. This makes our application flexible and can be extended to any field of interest. Integrated with the other fields like Artificial intelligence, fuzzy logic neural networks have a huge potential to perform. Neural networks have been applied in solving a wide variety of problems. It is an emerging and fast growing field and there is a huge scope for research and development.

6. REFERENCES:

1. Amir Said and William A. Pearlman. “A new fast and efficient image codec based on set partitioning in hierarchical trees [J]”. IEEE Transactions on Circuits and Systems for Video Technology Volume 6 Issue 3, Page No.243-250, 1996.
2. Anjana, Mrs Shreeja “Image Compression: An Artificial Neural Network Approach” International Journal Of Computational Engineering Research volume 2 Issue 8 , Page No 53-58 , December 2012.
3. Asha Lata , Permender Singh “Review of Image Compression Techniques” International Journal of Emerging Technology and Advanced Engineering Volume 3 Issue 7, Page No 461-464, July 2013 .
4. Birendra Kumar Patel, Prof. Suyash Agrawal “Image Compression Techniques Using Artificial Neural Network” International Journal of Advanced Research in Computer Engineering & Technology Volume 2 Issue 10, Page No 2725-2729, October 2013.
5. Farnoosh Negahban, Mohammad Ali Shafieian, and Mohammad Rahmanian" Various Novel Wavelet – Based Image Compression Algorithms Using a Neural Network as a Predictor"J. Basic. Appl. Sci. Res., Volume 3, Issue 6, Page No 280-287, 2013.
6. Gaganpreet kaur, Sandeep Kaur" Comparative Analysis of Various Digital Image Compression Techniques Using Wavelets " International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3 Issue 4,Page No 115-123, April 2013.
7. Jibanananda Mishra, Ranjan kumar Jena “Objective Quality Measures Comparison of Intelligent Image Compression” International Journal of Emerging Technology and Advanced Engineering Volume 3 Issue 10, October 2013.
8. Kiran Bindu, Anita Ganpati, Aman Kumar Sharma “A COMPARATIVE STUDY OF IMAGE COMPRESSION ALGORITHMS” International Journal of Research in Computer Science Volume 2, Issue 5, Page No. 37-42, 2012.
9. K.H.Talukder, and K.Harada, “Haar Wavelet Based Approach for Image Compression and Quality Assessment of Compressed Image,” IAENG International Journal of Applied Mathematics, 2007.
10. K.Siva Nagi Reddy, Dr.B.R.Vikram, L.Koteswara Rao, B.Sudheer Reddy “Image Compression and Reconstruction Using a New Approach by Artificial Neural Network” International Journal of Image Processing Volume 6 Issue 2, Page No 68-85, 2012.
11. M. Egmont-Petersen, D. de. Rid Processing with Neural Networks Journal on Pattern Recognition, Volume. 35 Issue. 10, Page No. 22792301, 2002.
12. M. J. Nadenau, J. Reichel, and M. Kunt, “Wavelet Based Color Image Compression: Exploiting the Contrast Sensitivity Function,” IEEE Transactions Image Processing, Volume 12 Issue1, Page No. 58, 2012.
13. M. Marimuthu, R. Muthaiah and P. Swaminathan “Review Article: An Overview of Image Compression Techniques” Research Journal of Applied Sciences, Engineering and Technology Volume 4 Issue 24, Page No 5381-5386, December 2012.

14. Mr.Chandresh K Parmar, Prof.Kruti Pancholi "A Review On Image Compression Techniques" Journal Of Information, Knowledge and Research In Electrical Engineering Volume 02 Issue 02, Page No 281-284, October 2013.

15. Mr.Murali Mohan.S , Dr. P.Satyanarayana "Performance Analysis of Neural Network Architecture Combined with DWT for Image Compression" International Journal of Advanced Information Science and Technology Volume.20 Issue.20, December 2013.

16. Mr. S. SridharM.I.S.T.E, V.Venugopal, S. Rames3, S.Srinivas and Sk. Mansoob "Wavelets and Neural Networks based Hybrid Image Compression Scheme" International Journal of Emerging Trends & Technology in Computer Science Volume 2 Issue 2, Page No 195-200, March – April 2013.

17. M. Venkata Subbarao " Hybrid Image Compression using DWT and Neural Networks " International Journal of Advanced Science and Technology Volume 53, Page No 31-40 , April 2013.

18. Narayanan Sreekumar, Dr. S.Santhosh Baboo "Neural Network based Complex Image Compression using Modified Levenberg-Marquardt method for Learning" International Journal of Computer Science and Technology Volume. 2 Issue 2, Page No349-354, June 2011.

19. Prachi Tripathi " Image Compression Enhancement using Bipolar Coding with LM Algorithm in Artificial Neural Network "International Journal of Scientific and Research Publications, Volume 2 Issue 8, August 2012.

20. Pranob K Charles,Dr. H.Khan,Ch.Rajesh Kumar,N.Nikhita ,Santhosh Roy,V.Harish ,M.Swathi "Artificial Neural Network based Image Compression using Levenberg-Marquardt Algorithm" International Journal of Modern Engineering Research Volume.1 Issue.2, Page No-482-489, 2011.

21. S. Sridhar, "Wavelet Transform Techniques for Image Compression – An Evaluation", I.J. Image, Graphics and Signal Processing, 2014, 2, 54-67, Published Online January 2014 in MECS.

22. V. Krishnanaik, Dr. G. Manoj Someswar, K.Purushotham, A.Rajaiah " Implementation of wavelet Transform, dpcm and neural network For image compression "International Journal Of Engineering And Computer Science ISSN:2319-7242 Volume 2 Issue 8, Page No. 2468-2475, August, 2013.