Comparative Analysis of various Image Compression Algorithm by Segmentation & ANN

Sadia Nishat[1], Dr. L.K.Vishwamitra[2],Ms. Bhavana Gupta

M.Tech Scholar OCT ,Bhopal, 2HOD CSE OCT,Bhopal,3Associate Professor ,OCT, Bhopal

Abstract - This paper involves the investigation of different picture pressure strategies and calculations for regular and compound pictures. „Compound images" are characterized as pictures that contain a blend of content, characteristic (photograph) pictures and realistic pictures. Diverse strategies for computerized picture pressure have been checked on and displayed that incorporate DCT, JPEG and H.264. The discrete cosine change (DCT) is a system for changing over a flag into rudimentary recurrence parts. It is broadly utilized in picture pressure. Here we build up some basic capacities to process the DCT and to pack pictures. JPEG is the prevalent pressure standard utilized solely for still pictures. Each picture is isolated in 8 × 8pixels; each square is then independently packed. When utilizing a high pressure the 8 × 8 squares can be really found in the picture. Because of the pressure system, the decompressed picture isn't a similar picture which has been packed. A H.264 calculation that suits both compound and regular pictures is advantageous in numerous applications including the Internet. Exploratory outcomes demonstrate that the H.264 calculation is better PSNR values for common and compound pictures to think about different systems, it is applicable to various fields of image processing. On the basis of evaluating and analyzing the current image compression techniques this paper presents the Principal Component Analysis approach applied to image compression. PCA approach is implemented in two ways – PCA Statistical Approach & PCA Neural Network Approach. It also includes various benefits of using image compression techniques.

Keywords - leaf disease, k-means clustering, Image segmentation, Neural network.

I. INTRODUCTION

The compression offers a means to reduce the cost of storage and increase the speed of transmission. Image compression is used to minimize the size of image without degrading the feature of the image. Images comprise huge quantities of info that needs abundant storing space, huge broadcast bandwidths and time-consuming for broadcast. Hence it is beneficial to compact the image by keeping simply the vital info wanted to rebuild the image. An image is a matrix of pixel weights. Unvarying color field have huge redundancy. In direction to compact the image, redundancies need be conquered. Wavelet investigation can be castoff to split the info of an image into estimate and detailed sub-signals.

1.1 Image

An image is essentially a 2-D signal processed by the human visual system. The signals representing images are usually in analog form. However, for processing, storage and transmission by computer applications, they are converted from analog to digital form. A digital image is basically a 2- Dimensional array of pixels. Images form the significant part of data, particularly in remote sensing, biomedical and video conferencing applications. The use of and dependence on information and computers continue to grow, so too does our need for efficient ways of storing and transmitting large amounts of data.

*1.2 Image Compressio*n

Image compression addresses the problem of reducing the amount of data required to represent a digital image. It is a process intended to yield a compact representation of an image, thereby reducing the image storage/transmission requirements. Compression is achieved by the removal of one or more of the three basic data redundancies:

1.3 Fundamental of Image Compression

Image Compression is a technique to reducing the size of image to represent the digital image. Compression is obtained by the elimination of one or more of three fundamental data redundancies:

- Coding redundancy: This type of redundancy is present when less than optimal means the smallest length code words are used.
- Inter pixel redundancy: This type of redundancy which outcomes from relationships among the image pixels.
- Psycho visual redundancy: This type of redundancy is owing to data that is disregarded by the human visual system i.e. optically no-vital info.

1.4 The Flow of Compression Coding

Image compression coding is to keep the image into bit-stream as fixed into a lesser space as probable and demonstrate the decoded image in as precise as probable. So think through an encoder & a decoder as revealed in Figure 1.1. When encoder in-takes as unique image file, the image file will be change into a binary data stream (known as the bit-stream). The decoder then in-takes the encrypted bit-stream and decrypts it to generate decoded image. The design of image compression coding is presented in Figure 1.1.

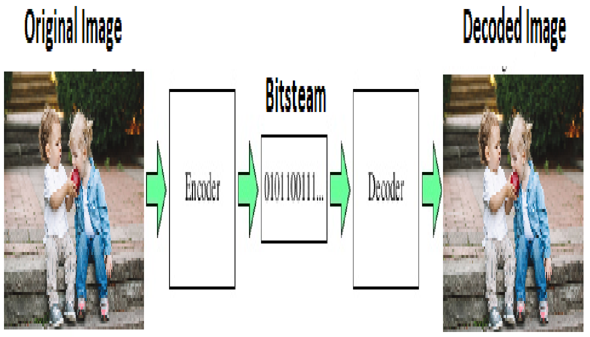


Figure 1.1: The Basic Flow of Image Compression Coding

1.4 1 Reduce the Correlation between Pixels

If the association among any one pixel and its neighboring pixels is precise great, then use image compression or the value of one pixel and its contiguous pixels are identical. Once correlation between the pixels is decreased, then profit of the statistical attribute and the variable length coding theory to decrease the storage amount. This is the most significant role of the image compression algorithm and there are many of relevant processing procedure being suggested.

1.4.2 Quantization

Quantization reduces the accuracy and to produce large compression proportion. For example, the unique image makes use of 8 bits to keep one element for every pixel, if rarer bits such as 6 bits are used to protect the info of the image, then the stocking amount will be condensed and the image can be compacted. The deficiency of quantization is that it is a lossy action, which will outcome into loss of accuracy and non-recoverable alteration.

1.4.3 Entropy Coding

The entropy coding is to attain a smaller amount of normal size of the image. Entropy coding allots code words to the conforming symbols conferring to the possibility of the symbols. In common, the entropy encoders are utilized to compact the data by substituting symbols characterized by identical-size codes with the code words whose size is inversely proportionate to agreeing possibility

1.5 Different Class of Compression Technique

There are two basic type of image compression: lossless and lossy. Both compression types remove data from an image that is not obvious to the viewer, but they remove that data in different ways.

1.5.1 Lossless or Reversible Compression

Lossless compression refers to compression without losing any image information. The decoded pixel values will be the same as encoded pixel values, and lossy compression system corrupts the pixel values so that the uncompressed or reconstructed image is an approximation of the original image. Lossless compression does not include the procedure of quantization, on the other hand make use of image alter and encode methods to deliver a compacted image.

1.5.2 *lossy or irreversible compression*

Lossy compression works by removing image detail, but not in such a way that it is apparent to the viewer. In fact, lossy compression can reduce an image to one tenth of its original size with no visible changes to image quality. Lossy compression is most evident in JPEG images, and removes data from an image that, again, is not obvious to the viewer. For example, if an image contains 10000 pixels of green in different shades, lossy compression will save the color value of one pixel along with the locations of the other green pixels in the image.

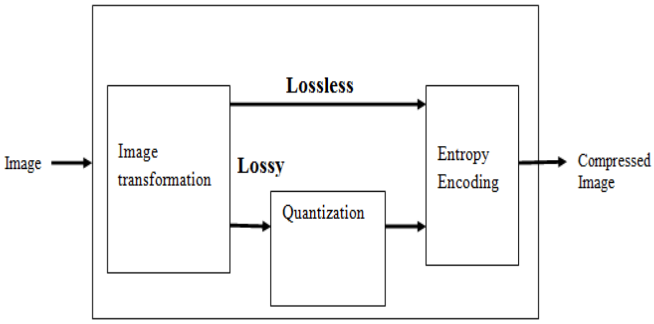


Figure 1.4: Image Compression Frameworks

1.6 *Benefits of Image Compression*

The technical improvements and the initiation of the internet, image documents have become one of the utmost public file kinds to be used and shared nowadays. But then again along with their convenience, image files are huge, building them tough to keep and transfer. Following are the benefits of image compression.

II. WAVELETS & NEURAL NETWORK

A wavelet is a wave that is similar to oscillation with amplitude. It starts from zero, increases, and then drops back to nil. Wavelets are made to have specific characteristics that make them applicable for signal processing. Wavelets can be united, by “reverse, shift, multiply and integrate” method named convolution, with portions of a recognized signal to take info from the strange signal. Wavelets tend to be irregular and asymmetric. The functions are used at various scales, because in practical analysis, different tools expose at various scales.

2.1 Wavelets Based Compression

As mentioned above, JPEG suffers edge effects and blocking artefacts at high compression ratios. Different schemes have been proposed to reduce these artefacts and some of these schemes are discussed in the preceding section. In recent years, novel approaches like wavelet transforms have been used to resolve the problems encountered in JPEG-based compression.

1. Lossless compression: In lossless compression, the original image is recovered exactly after decompression. Unfortunately, with images of natural scenes it is rarely possible to obtain error-free compression at a rate beyond 2:1.

2. Lossy compression: Much higher compression ratios can be obtained if some error, which is usually difficult to perceive, is allowed between the decompressed image and the original image. This is lossy compression. Lossy compression is also acceptable in fast transmission of still images over the Internet. Images with 4096 gray-levels are referred to as 12 bpp (bits per pixel).

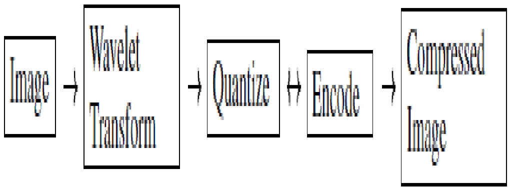


Figure 2.2: Image Compression

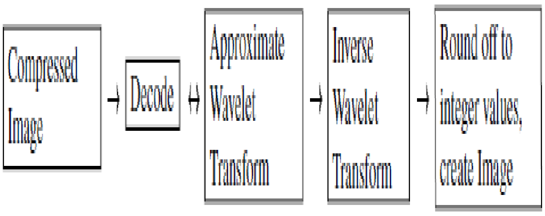


Figure 2.3: Image Decompression

3.1 Neural Networks

A Neural Network (NN) is a data processing model that is inspired by the technique of biological nervous systems, like brain process information. The main component of this model is the novel organization of the information processing model. This model composed by large number of highly interconnected processing elements called neurons, working simultaneously to solve particular problems. NNs, like people, learn by example. An NN is designed for a specific application, like pattern data classification and pattern recognition by learning process. Learning within biological system includes adjustments to the synaptic relations that exist among the neurons. This relations true of NNs as well.

Neural Networks (NNs) are a diverse pattern for calculating:

1. Von Neumann machines are centred on the processing/memory abstraction of personal info processing.

2. NNs are based on the equivalent design of animal brainpowers.

3. NNs are a kind of multi-processor system, with basic processing elements, an extraordinary grade of association, basic scalar messages and adaptive interaction between elements.

3.2 Human Neurons The human brain consists of typical neuron which collects signals from others via a host of fine structures, also called dendrites. The neuron sends out spike of electrical activity through a long as well as thin stand which is known as an axon that splits into several branches.

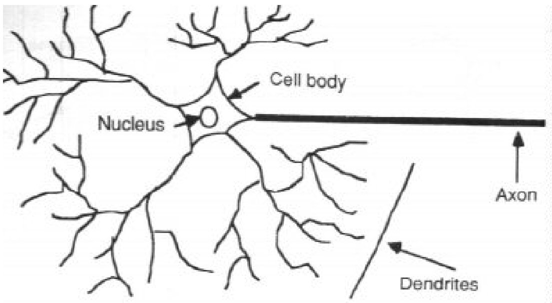


Figure 2.12: Human Neuron

3.3 Artificial Neurons

An artificial neuron is a mechanism that has some inputs and outputs. This neuron has two types of operation mode, the using mode and the training mode. In training mode, the neuron may be trained to fire or not fire, for some specific input on the other hand, in the using mode, when a learned input pattern is identified in the input, their associated outputs turn into the current output. In mathematical terminology neurons inputs are weighted, the output or decision making of each input is dependent on the weight of the specific input.

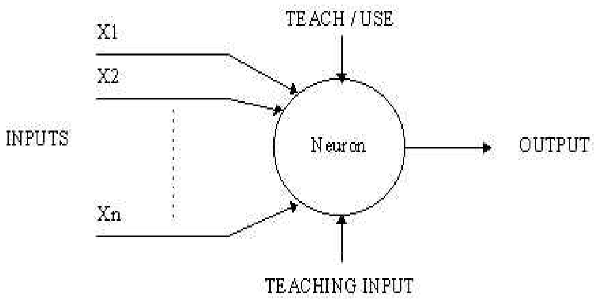


Figure 2.13: Artificial Neuron

III. LITERATURE SURVEY

4.2 A Zero Tree Coding for Compression of ECG Signal Using EZW and SPIRT :- S. Ktata and H. Mahjoubi [1] have evaluated the compression performance and characteristics of zero tree coding compression schemes of ECG applications. Two methods, namely the Implanted Nil tree Wavelet (EZW) and the Set Partition In Hierarchical Tree (SPIHT) are suggested. The EZW is one of the first algorithms to demonstrate the complete influence of wavelet-centered image compression. The SPIHT algorithm is a highly refined version of the EZW algorithm. EZW and SPIHT have achieved notable success in still image coding. Theoretic outcomes are compared with model training with real ECG indications from MIT-BIH arrhythmia databank. The simulation results show that the both methods achieve a very significant improvement in the performances of compression ratio and error measurement for ECG, as compared with some other compression methods.

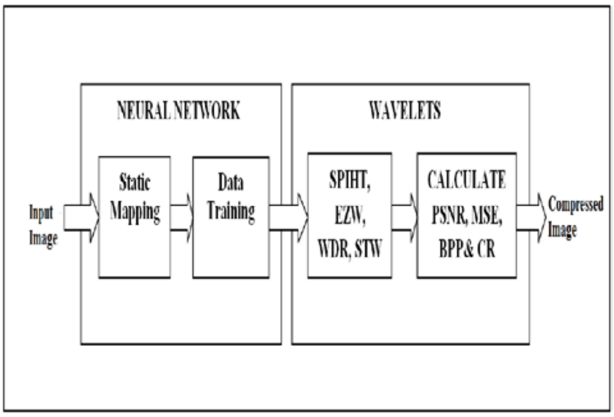
4.3 Image Compression: Wavelet Transform using Radial Basis Function (RBF) Neural Network :- G Boopathi et.al [2] had evaluated a novel technique of Image Compression. In this approach, a technique for image compression as well as decompression is proposed using wavelet transform and vector quantization. In this work a popular neural network technique called Radial Basis Function (RBF) approach is used to generate the code book. A combined approach of image compression based on vector quantization and wavelet transform is proposed using RBF neural network. This approach also will be very helpful for medical imaging, criminal investigation where high precision reconstructed image is required.

4.4 Wavelet Packet and Neural Network Basis Medical Image Compression :- GUO Hui et.al [3] has proposed a new compression scheme based on the use of the organization property of Kohonen's maps in the wavelet packet domain. It is to crumble and rebuild the healing image via wavelet package. Previously the building of the image used neural networks (NNs) in domicile of supplementary coding technique to program constants in wavelet-packet field. By using Kohonen's NNs actions, not only for vector quantizing characteristic, but also for its topological stuff.

4.5 Image Compression using Lifting Wavelet Transform:- Swanirbhar Majumder1 et.al [4] introduced a lifting based DWT method of image compression. Wavelet transform, due to its time frequency characteristics, has been a popular multi tire solution analysis tool. Its discrete version, i.e. DWT has been widely used in various applications till date. The hugely applied version of DWT is convolution based. But for hardware implementation this convolution based system has had problems with floating point numbers.

IV. PROPOSED WORK

The proposed methodology focuses the combination of neural network and four novel wavelets Set Partitioning in Hierarchical Trees (SPIHT), Embedded Zero tree Wavelet (EZW), Wavelet Difference Reduction (WDR) and Spatial-orientation tree wavelet (STW) for image compression as well as comparing them with each other. The image compression methodology proposed here is suitable on those regions of digital images where high accuracy of decoded or reconstructed image is required. These fields are medical imaging, criminal investigations etc. The image of specific quality is needed to be transmitted by sender in order to reconstruct the original image without any loss in image pixels and quality. The proposed methodology is tested on 25 color images and gives better performance parameter as compared to existing work.



The following steps are used in this proposed work:

1. Takes an image as input, then after divide image is divided in number of non overlapping pixel blocks.

2. Apply encoding on these pixel blocks and convert the trained weight set.

3. Select a training input and the corresponding output (training vector) from training set.

4. When the network weights and biases are initialized, and network is ready for training.

5. Training stops if:

a) Number of iterations > epochs.

b) Performance function drops below goal.

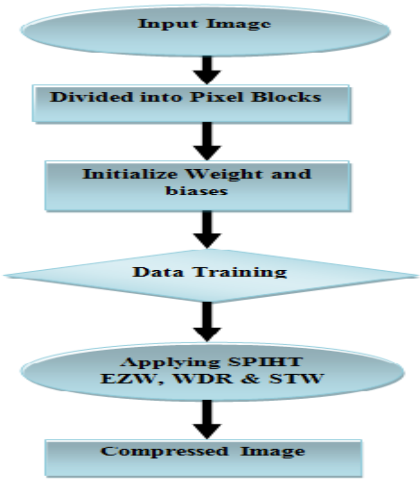
c) Magnitude of the gradient < mingrad.

d) Training time > time seconds of max_fail.

6. Receive output as an image of trained network, which shows the better pixel image and that help us to compress the image and give better compression ratio, better Bit per Pixel (BPP) original images which is compressed with the SPIHT wavelet.

7. Applying SPIHT, EZW, WDR and STW wavelets and calculate performance parameters includes Peak Signal to Noise Ratio (PSNR), Compression Ratios (CR). Mean Squared Error (MSE) and Bit per Pixel (BPP).

5.1 FLOW CHART OF PROPOSED MODEL :- The flow chart of proposed work is shown in figure 4.2. This figure shows the process of applying neural network and different wavelets for compression of image. In this work first takes an image as an input, divide this image into chunks of pixel block, and sends for encoding after that applying neural network for getting good quality image input for wavelets. Getting image through neural network does not have good performance parameters. So this technique used novel wavelets for image compression and calculates performance parameters.



V. IMPLEMENTATION DETAILS & RESULT ANALYSIS

In figure 5.1 displays the static mapping between input and output through neural network. It should not contain I/O delays or feedback, Training indices for cross-validation. The network should train the network and get better network for the trainning.

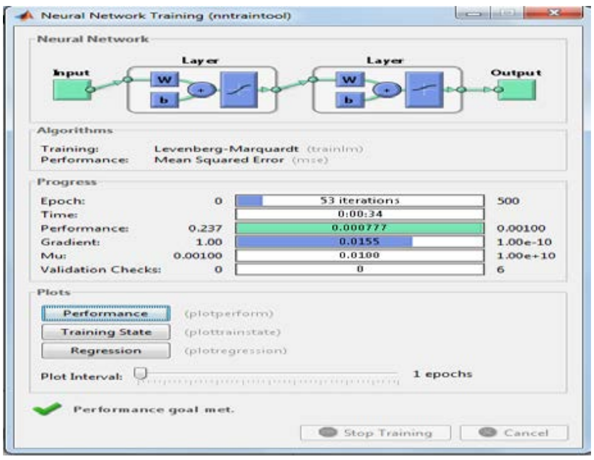


Figure 5.1: Static Mapping between Input and Output through Neural Network

The Figure 5.5 shows the original image compare with trained network and converted to black and white image which shows the better pixel image and that help us to compress the image and give better compression ratio, better Bit per Pixel (BPP). The gradient is calculated using an algorithm called back propagation, which include performing computations backward through the network.

VI. PERFORMANCE EVALUATION RESULTS WITH GRAPH AND TABLES

The evaluation of this work includes 25 color images of different size (In KB). These works used neural Network and novel Wavelets SPIHT, STW, EZW and WDR on these 25 images and calculate results. The following figure and tables show the evaluation of various performance parameters like Mean Squared Error (MSE), Peak Signal-to-Noise Ratio (PSNR), Bit per Pixel (BPP) and Compression Ratios (CR) and their comparison.

6.1 Mean Square Error (MSE) Evaluation The Mean Square Error (MSE) is error metric utilize to compare image compression quality. The lower the value of MSE will decrease the error.MSE is also a network performance function, it evaluate the network's performance in accord with to the mean of squared errors. Following Figure 5.10 and Table 5.1 presents the evaluation of Mean Square Error (MSE) values.

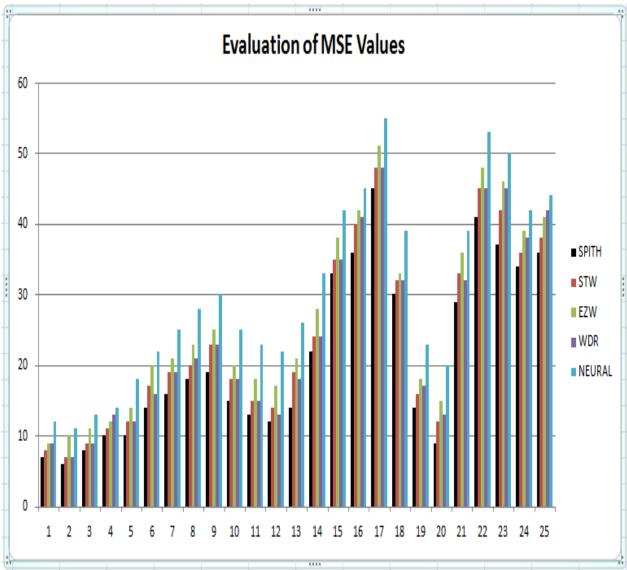
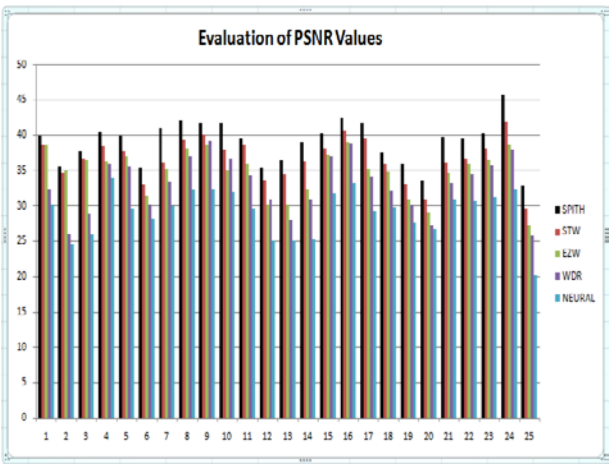


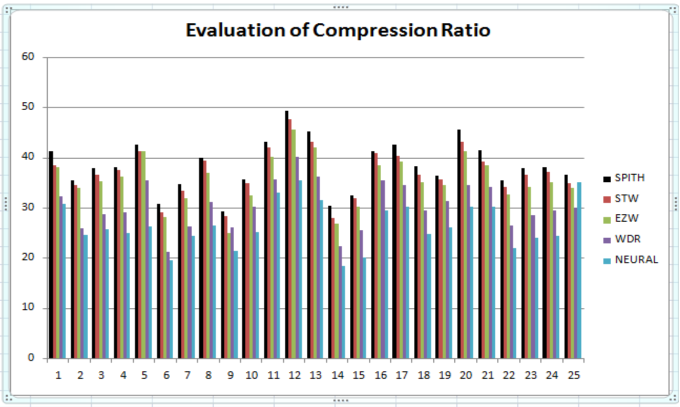
Figure 5.10: Evaluation of MSE Values

IMAGE(jpg)	SPITH	STW	EZW	WDR	NEURAL
1	7	8	9	9	12
2	6	7	10	7	11
3	8	9	11	9	13
4	10	11	12	13	14
5	10	12	14	12	18
6	14	17	20	16	22
7	16	19	21	19	25
8	18	20	23	21	28
9	19	23	25	23	30
10	15	18	20	18	25
11	13	15	18	15	23
12	12	14	17	13	22
13	14	19	21	18	26
14	22	24	28	24	33
15	33	35	38	35	42
16	36	40	42	41	45
17	45	48	51	48	55
18	30	32	33	32	39
19	14	16	18	17	23
20	9	12	15	13	20
21	29	33	36	32	39
22	41	45	48	45	53
23	37	42	46	45	50
24	34	36	39	38	42
25	36	38	41	42	44

6.2 Peak Signal to Noise Ratio (PSNR) Evaluation The PSNR is beneficial for quality assessment between the original image and a compressed image. The high value of PSNR, give good quality of the compressed or recreated image. The PSNR is error metric used to compare image compression quality. PSNR shows the measure of the peak error. Following Figure 5.11 and Table 5.2 presents the evaluation of Peak Signal to Noise Ratio (PSNR) values.



6.3 Compression Ratio (CR) Evaluation :- The Compression ratio is a performance parameter of image compression. It is the ratio of the size of the compressed file and uncompressed file. The high value of Compression Ratio (CR) gives good quality of the compressed image. Following Figure 5.12 and Table 5.3 presents the evaluation of Compression Ratio (CR) values.



VII. CONCLUSION

This dissertation showed an enhancement in performance measures with respect to decoded picture quality, Peak Signal-to-Noise Ratio (PSNR) and Mean Squared Error (MSE), Bit per Pixel (BPP) and Compression Ratios (CR), compared to the existing wavelet and neural network based image compression techniques. The Previous work is in either Image compression through Neural Network, or either with two wavelets. This work used neural network and four novel wavelets for compression of image. Neural network is used for training the input image for wavelets and four wavelets Set Partitioning in Hierarchical Trees (SPIHT), Embedded Zero tree Wavelet (EZW), Wavelet Difference Reduction (WDR) and Spatial-orientation tree wavelet (STW) are used for image compression and calculate performance parameters.

Future Scope

Although our results indicate better quantitative and qualitative performance than previous research, avenues for improvement remain.

The field of image processing has been growing at a very fast speed. The day to day emerging technology requires more and more revolution and evolution in the image processing field. In image processing, the same experiments should also be conducted with other types of neural network to see the different types can improve the performance of the system. The future enhancement says that it should apply genetic algorithm or either fuzzy to make more accurate more advanced.

REFERENCES

[1] Ktata S., Mahjoubi H., "A Zerotree Coding for Compression of ECG Signal Using EZW and SPIHT", IECON 2012-38th Annual Conference on IEEE Industrial Electronics Society, DOI: 10.1109/IECON.2012.6388527, Page 1458-1464, 2012.

[2] Boopathi G., Arockiasamy S., "Image Compression: Wavelet Transform using Radial Basis Function (RBF) Neural Network", India Conference

(INDICON), 2012 Annual IEEE, DOI: 10.1109/INDCON.2012.6420640, Page 340-344, 2012.

[3] GUO Hui, WANG Yongxue, "Wavelet packet and neural network basis medical image compression", E-Product E-Service and E-Entertainment (ICEEE), 2010 International Conference on, DOI: 10.1109/ICEEE.2010.5661560 ,Page1-3,2010.

[4] Majumder Swanirbhar, "Image Compression using Lifting Wavelet Transform", International Conference on Advances in Communication, Network and computing, DOI: 10.1109/CNC.2010, 2010.

[5] Luo Lincong, Feng Hao, Ding Lijun, "Color Image Compression Based on Quaternion Neural Network Principal Component Analysis", Multimedia Technology (ICMT), 2010 International Conference on, DOI: 10.1109/ICMULT.2010.5631456, Page1-4 , 2010.

[6] Rao P.V., Madhusudana S., Nachiketh S.S., Keerthi K., "Image compression using Artificial Neural Network", Machine Learning and Computing(ICMLC), 2010 Second International Conference on, DOI: 10.1109/ICMLC.2010, Page 121-124, 2010.

[7] Ramaprabha T., Mohamed Sathik M., "A Comparative Study of Improved Region Selection Process in Image Compression using SPIHT and WDR", International Journal of Latest Trends in Computing, Volume 1, Issue 2, ISSN: 2045-5364, Page 86-90, December 2010.

[8] [ojitra Yogita, "Performance Analysis of Image Compression: A discrete wavelet Transform based Approach", International Journal of Scientific Engineering and Technology, Volume 1, Issue 3, ISSN: 2277-1581, Page 63-66, July 2012.

[9] Shapiro J., "Embedded Image Coding Using Zero trees of Wavelet Coefficients",

[10] IEEE Transactions on Signal Processing, Volume 41, Page 3445-3462, December 1993.

[11] Zixiang Xiong, Kannan Ramchandran, Michael T. Orchard, and Ya-Qin Zhang, "A Comparative Study of DCT and Wavelet-Based Image Coding", Circuits and Systems for Video Technology, IEEE Transactions on, Volume 9, Issue 5, DOI: 10.1109/76.780358, Page 692-695, August 1999.

AUTHOR'S PROFILE

SADIA NISHAT has received his Bachelor of Engineering degree in Computer Science Engineering from Maulana Azad College of Engineering and Technology, Neora, Patna in the year 2014. At present he is pursuing M.Tech. with the specialization of Computer Science Engineering in Oriental College of Technology, Bhopal. His area of interest Digital Image Processing, Artificial Intelligent, Soft computing.

Dr.L.K. Vishwamitra has received his MCA degree from GEC Jabalpur, in the year 1992. M.Tech. in from VMU Salem, in the year 2005 and PhD from Ajmer in 2014 At present he is working as an Head of the Department at Oriental College of Technology,Bhopal. His area of interest Digital Image Processing, Artificial Intelligent, Soft computing.

Ms. Bhavana Gupta has received his BE degree from MITS Gwalior, in the year 2006. M.Tech. in from SATI Vidisha, in the year 2010 and Currently pursing PhD from RGPV Bhopal.At present he is working as an Associate Professor & M.Tech Coordinator at Oriental College of Technology, Bhopal. His area of interest Digital Image Processing, Artificial Intelligent, Soft computing.