Neural Network Based ROI Detection and Hybrid Image Compression

Sayali Mane
ME Scholar,
ENTC Department
ADCET, Ashta

Tamboli S. S.
Assistant Professor,
ENTC Department
ADCET, Ashta

Abstract - *Region of Interest based compression is an efficient method of compression for images with a particular part to be most significant. It is always a better choice to compress the ROI with lossless compression while the rest of image with lossy compression technique. This paper proposes lossless compression for medical image (ROI) and near lossless compression for the rest of the image. Image other than ROI may contain information that is useful, that is why it is appropriate to use near lossless compression for the rest of the image. In this method of compression, PSNR obtained is remarkable and compression ratio can be increased by increasing the base value which is in power of two. Image compression is essential where images need to be stored, transmitted or viewed quickly and efficiently. The artificial neural network is a recent tool in image compression as it processes the data in parallel and hence requires less time and is superior over any other technique. The reason that encourage researchers to use artificial neural networks as an image compression approach are adaptive learning, self-organization, noise suppression, fault tolerance and optimized approximations. In this method of compression, medical image will be compressed completely loss less by using morphological operations. In this paper region of interest (ROI) is detected by Artificial Neural Network (ANN) & then compress the part of ROI using lossless method & the part other than ROI compressed by using lossy method. The reason, wavelet method of compression preferred for the rest of the image is, despite of insignificance of region of image other than ROI.*

Keywords **–** CR (Compression ratio), Mean square error, Near lossless compression, PSNR (Peak signal to noise ratio), ROI (Region of Interest).

I. Introduction

In this era of digital science, the transmission of information takes place worldwide by means of communication channels. This information has to be transmitted faster in a very compact size. Reducing the size of data content sent, increases the rate of transmission and saves the energy required for transmission. During image transmission, it becomes necessary to compress image without degrading its quality. Mainly, image compression techniques can be classified in two groups -1) lossy compression techniques and 2) lossless image

compression. Lossy compression techniques achieve a high compression ratio, but it compromises the quality of recovered image.

Lossless compression achieves high quality of recovered image (high PSNR) but unable to achieve a good compression ratio. Method of compression, which can achieve good CR without risking the quality of recovered image (high PSNR) can be the best substitute for these two compression techniques.

Neural networks (NNs) have been used for image compression for their good performance. However, the image compression convergence time is not efficient. If an image can be sorted in half of its original size yet has a reasonable resolution, 50% of storage capacity can be saved and the transmission speed will be improved by up to 100%. To achieve a successful image size reduction, the image quality should not be compromised.

I1 Problem Formulation

To propose a novel ROI based hybrid algorithm to compress the image based on priority of regions. Medical imaging is one of the best techniques for monitoring the person's health condition which is used widely nowadays. Also some of diseases can be detected using medical imaging methods. One of the problems that physicians encounter with it to store the medical images. This storage occupy more area for storing images long time as there is need to keep the record of numerous patients. So there is need to compress the image to be resolved in a variety of medical images. The rapid and reliable digital transmission and storage of medical and biomedical images would be tremendous boon to the practice of medicine. Patients in urban areas or even in rural areas could have convenient access to second opinions. Patients readmitted in hospitals could have earlier imaging studies instantly available. Rather than waiting for others to finish hard copy films, medical and surgical teams collaborating on patient care could have simultaneous access to imaging studies on monitors throughout the hospitals. So this long term rapid transmission is prohibitive without image compression, to reduce the size of file. To compress the size of medical images is also useful in helping radiologist or surgeons to examine the previous data of their patient; in order to detect pathologic or abnormal regions, and planning suitable treatment, magnetic resonance images are used. To make the Medical Images more useful and process able, there is need to reduce the transmission time and storage space for the images. The image may become more visual too, by compressed as it will also help to reduce transmission errors as less data will be transmit, also reduce the cost.

2.1 Objectives

The objectives of the proposed work are,

1) Detect the Region of Interest (ROI) by performing

a) Morphological operations

b)Segmentation

2) Design and implement Neural Network to find area of interest.

3) Compare the results of first and second step.

4) Carry lossless compression for ROI.

5) Perform lossy compression for rest of the image.

6)Analyze performance of developed algorithm with existing algorithms in terms of mean square error, Peak signal to noise ratio, compression ratio etc.

2.2 Region of Interest

The medical image includes three parts in image. These are ROI (region of interest), non ROI and background. These part have their own advantages. ROI is the most critical part of the image that located over very small regions of the image. Non ROI is also included so that user can easily find out the most critical part from the whole image 1.Part other than image contents is known as background and most ignored part of the image. In medical field, these critical parts needed to be compressed with high quality compression without any loss than other parts of image. The critical parts from the image obliged to be transmitted first or at higher need amid the transmission for telemedicine purposes.

I1I Related Work

In Related work, both lossy and lossless compression methods have been discussed but these techniques have following flaws.

1 Discrete Wavelet Transform (DWT) based ROI coding techniques has a drawback that it increases Computational complexity as it works with floating point 4.

2 Discrete Cosine transform coding techniques has also some drawbacks.

To overcome these flaws new technique has been proposed. In this paper DWT for lossy compression and Arithmetic coding used for NROI. Lossless for ROI part of an image have been proposed for the efficient Compression. The current work begins with the pre-processing of medical image to remove the noise from an image. Then segmentation is applied to divide the image into two uniform parts i.e. ROI and non ROI. Finally compression is performed to reduce the storage and network bandwidth. Here two compression methods are used. After these results are compared with the parameters Compression Ratio (CR), PSNR and MSE.

Training Procedure of Neural Network

During training procedure data from a representative image or a class of images is encoded into a structure of the hidden and output weight matrices.

Step1: Read the test image

Step2: Divide the image into blocks of pixels.

Step3: Scan each block for the complexity level.

Step4: Initialize the neurons.

Step5: Apply 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 (PURELIN).

Step9: Reassemble the outputs.

Step10: Train the neural network and remain the weights.

IV Comparison Parameters

4.1 Mean Square Error

Two commonly used measures for quantifying the error between images are Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR). The MSE between two images f and g is denoted by

$$\mathbf{MSE} = \frac{\mathbf{1}}{\mathbf{N}} \sum_{\mathbf{j,k}} (\mathbf{f[j,k]} - \mathbf{g[j,k]})\mathbf{\hat{}2}$$

where the sum over j; k denotes the sum over all pixels in the images, and N is the number of pixels in each image.

4.2 Compression Ratio

The compression ratio is calculated as the ratio of number of bits required to represent original image to the number of bits required to represent compressed codestream.

$$CR = \frac{\textbf{Number of bits required to represent original image}}{\textbf{Number of bits required to represent compressed codestream}}$$

4.3 Peak-Signal to Noise Ratio (PSNR):

The PSNR is most commonly used as a measure of quality of reconstruction of lossy compression codec's (e.g., for image compression). The signal in this case is the original data, and the noise is the error introduced by compression. When comparing compression codec's it is used as an approximation to human perception of reconstruction quality, therefore in some cases one reconstruction may appear to be closer to the original than another, even though it has a lower PSNR (a higher PSNR would normally indicate that the reconstruction is of higher quality). The PSNR is calculated by using following formula.

V Methodology

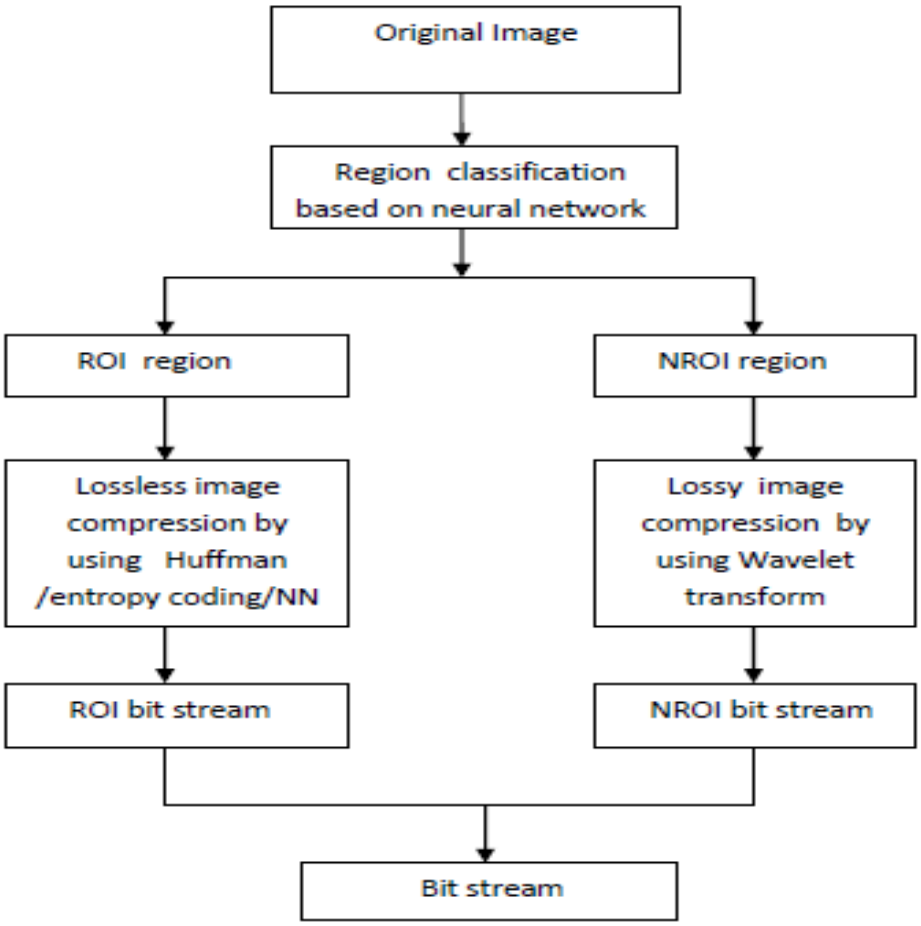
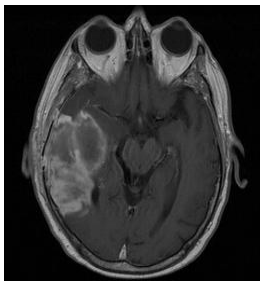


Fig: Flow chart of proposed system

VI Experimental Results

In this section implementation of proposed method is discussed. The experimental result shows the proposed method works better than existing methods. Figure shows reconstructed image with both proposed and existing method.



Original Image

ROI Image

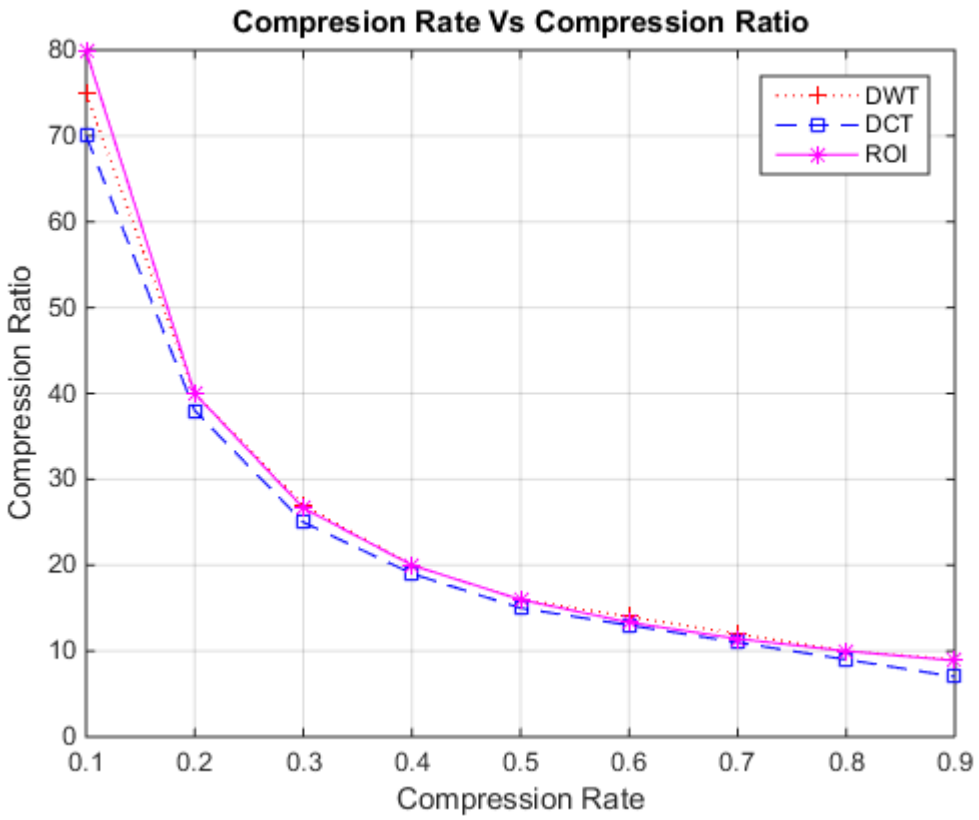
DWT Method

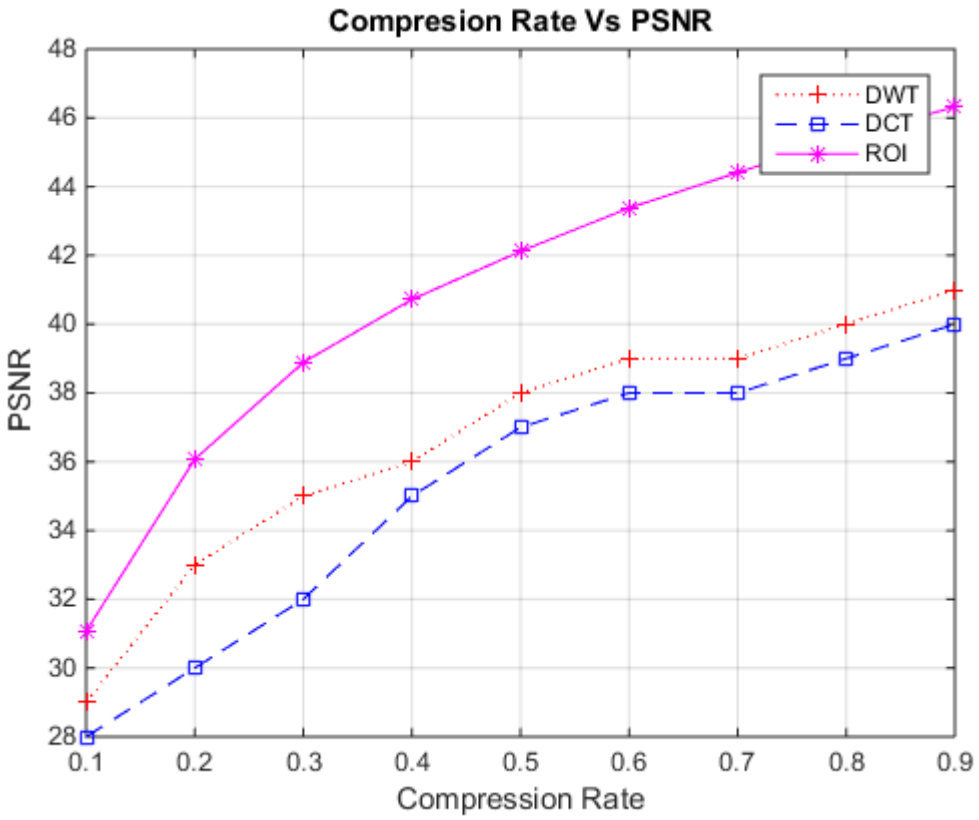
DCT Method

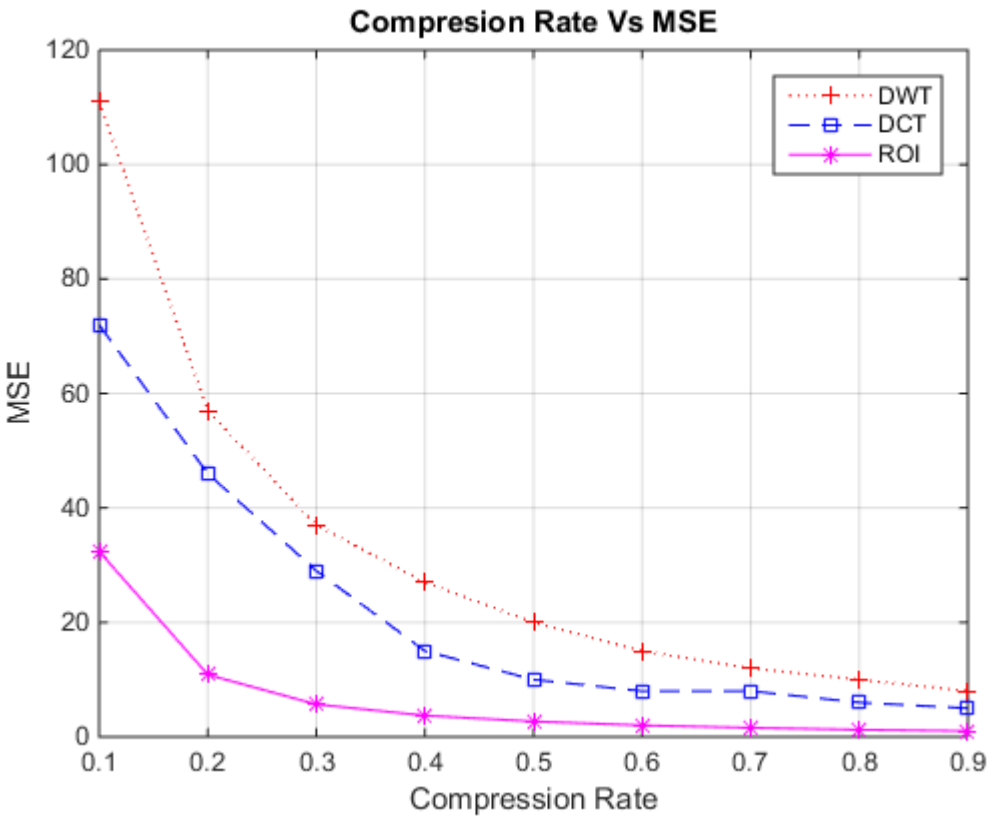
Compression Rate	Original Image								
	ROI Method			DWT Method			DCT Method		
	CR	PSNR	MSE	CR	PSNR	MSE	CR	PSNR	MSE
0.1	79.89	31.34	32.39	75	27	111	70	28	72
0.2	39.97	36.07	10.87	40	30	57	38	30	46
0.3	26.65	38.89	05.69	27	31	37	25	32	29
0.4	19.99	40.72	03.73	20	33	27	19	35	15
0.5	15.99	42.12	02.70	16	34	20	15	37	10
0.6	13.33	43.38	02.02	14	35	15	13	38	08
0.7	11.42	44.41	01.59	12	36	12	11	38	08
0.8	9.99	45.45	01.25	10	37	10	09	39	06
0.9	8.88	46.32	01.02	09	38	08	07	40	05

From tabular values the graphs have been drawn as given below. Graph is plotted between Compression rate versus CR, PSNR and MSE.

Graph shows high compression ratio for ROI method but without degrading quality of the images. But in case of DWT and DCT, It decreases the picture quality due to high compression.


Compresion Rate Vs Compression Ratio
Compression Ratio
Compression Rate
DWT
DCT
ROI
0
10
20
30
40
50
60
70
80
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9


Compresion Rate Vs PSNR
PSNR
Compression Rate
DWT
DCT
ROI
28
30
32
34
36
38
40
42
44
46
48
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9



VII Conclusion and Future Scope

Image compression extensively used in real time applications where data is transmitted over network. In this Paper, “Arithmetic coding” lossless compression of ROI and “DWT” compression for non-ROI area is implemented. From the outcomes, the proposed strategies have demonstrated a low Mean Squared Error rate, high PSNR and High Compression Ratio when contrasted with the past methods i.e. DCT and DWT. According to the

Experiments performed so far as, it proved that the proposed techniques provide moreAccurate and faster results than the previous techniques. The future work is to increase PSNR, CR values and work with more parameters.

Acknowledgements

We would like to express our gratitude towards all those who help us to complete this paper.

VIII References

[1] B. Brindha and G. Raghuraman, "Region based lossless compression fordigital images in telemedicine application, " in Communications andSignal Processing (cusp), 2013 international Conference on. iEEE,2013, p. 537-540.

[2] G. K. Wallace, "The JPEG still picture compression standard, " inConsumer Electronics, IEEE Transactions on, vol. 38, 1992, p. xviiiXXXIV.

[3] S. Han and N. Vasconcelos, "Object-based regions of interest for imagecompression, " in Data Compression Conference, 2008. DCC 2008.IEEE, 2008, pp. 132-141.

[4] S. Suchitra and K. Wahid, "Hybrid DWT-DCT algorithm for biomedicalimage and video compression applications, " in Information SciencesSignal Processing and their Applications (lSSPA), 2010 10thinternational Conference on. IEEE, 2010, pp. 280-283.

[5] M. Moorthi and R. Amutha, "A near Lossless compression method formedical images, " in Advances in Engineering, Science and Management(lCAESM), 2012 International Conference on. IEEE, 2012, pp. 39-44.

[6] A. S. Mamatha and V. Singh, "Near Lossless Image CompressionSystem, " in Microelectronics and Electronics (PrimeAsia), 2012 AsiaPacific Conference on Postgraduate Research in. IEEE, 2012, pp. 35-41.

[7] K. Sandeep and A. N. Rajagopalan, "Human Face Detection in ClutteredColor Images Using Skin Color, Edge Information., " in iCVGiP, 2002.

[8] H. H. K. Tin, "Robust Algorithm for Face Detection in Color Images."