BLOCK BASED COMPRESSION OF COLOR MEDICAL IMAGES USING NEURAL NETWORKS

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Abstract- In this paper, a Color Medical image compression model is built with the use of deep neural network for efficient transmission and storage of medical images. It uses back propagation compression algorithm (BPCA). The entire work is done with MATLAB software with the Graphical User Interface (GUI) window. The proposed system is aimed to achieve high compression ratio for the medical image with near to zero distortion and also maintain the quality that is near to original as in medical image compression. Even a small loss in the vital portion of the image leads to wrong interpretation. The medical images such CT, MRI, X-rays are given as input and large images are split into smaller windows and redundant information such as coding redundancy, inter pixel redundancy and psycho visual redundancy are removed. BPCA is used for training the network and reducing the error to minimum. This finds applications in telemedicine and telemetry applications.

Keywords : Color Medical Image, Back Propagation Compression, Neural Network, PSNR, CR .

1 INTRODUCTION

The technique or process of visualizing the interior parts of human body for the purpose of treatment or therapy or analysis of organs or tissues or the function of body as Medical Imaging. Medical imaging also establishes a database of normal functioning of organs and their structural description to make it possible to identify abnormalities or anomalous behavior of body. The applications of medical imaging requires high quality image for analysis and interpretation. Especially medical diagnosis and analysis and other tele-medicine applications is generally based on magnetic resonance imaging, X-Ray, computer tomography, ultrasound imaging etc. The raw image data obtained from such techniques occupy several Mega-bytes(sometimes Giga-Bytes) of disk space. These images should be stored in any hospitals for at least two decades and in some cases it is transmitted to the physician for future medical diagnosis or legal purposes. These images are also used in case of telemedicine application. To speed up the transmission (via wired or wireless medium) and to minimize the computer storage space, generally medical images are compressed into smaller files.

During compression and decompression, the medical images must maintain all original details and retain the quality of images at the time of reconstruction. Hence there is a challenging task to deal the transmission and storage of medical images with high diagnostic quality. There are many techniques available to compress the image and are generally categorized into two categories namely - lossy compression and lossless compression. Lossy compression obtains High compression ratio but with a compromise in terms of quality where as in lossless compression high quality is possible with low compression ratio.

2. LITERATURE REVIEW

2.1 "Near lossless medical image compression using block BWT–MTF and hybrid fractal compression techniques."

C. Peter Devadoss, B. Sankaragomathi proposed and tested for compression of medical images such as ultrasound, MRI, CT and X-Ray images using ROI based medical image compression. It also uses block BWT–MTF and hybrid fractal compression technique. For the compression for NROI region, hybrid fractal compression is used as it overcomes longer encoding time of conventional fractal techniques. The block BWCA is implemented to compress the ROI region.

2.2 "Effective lossy and lossless color image compression with Multilayer Perceptron."

PL. Chithra, A. Christoper Tamilmathi proposed a compression algorithm that eliminates the need of quantization table, entropy coding and produced the constant bit rate compression. Low computation complexity of the reconstructed image is obtained in this algorithm. Performance of the proposed back propagation compression is evaluated on the basis of how it performs with lossy and loseless compression, hidden layers of different size and finally on the basis of different types of activation function for analyzing merits of individual function based on three ways.

2.3 "Image Compression Technique: A Neural Network Approach."

Engr. Orland Delfino Tubola, Gladys Tapar Obmerga, Harold Taroy Asuncion proposed an artificial neural network system for the application of compression of gray scale images. Neural networks are well suited to the task of processing the image data because of its organizational structure and it provides an internal representation of data, which is needed in the process of image compression. Neural network approaches to image compression has shown major performance results which is better than other methods.

3. PROPOSED WORK

3.1 Image Compression.

The proposed scheme focuses on compression of color medical images using neural network. The GUI created in MATLAB is used as front-end to interact with the user. As the user feeds the input medical images, the RGB format of the input image converted to the YCbCr format then decomposed into the three isolated independent components such as Y, Cb and Cr which is then divided into 8x8 blocks. These uncompressed blocks are firstly encoding by mapping. A mapper is used to reduce some data redundancies like spatial and temporal redundancies. Some of the mapping techniques are RLC, Predictive coding, etc. The next stage in compression is quantization. Quantization table of each RGB component is stored and used in entropy table for reference. The compression flow is given in Fig.1

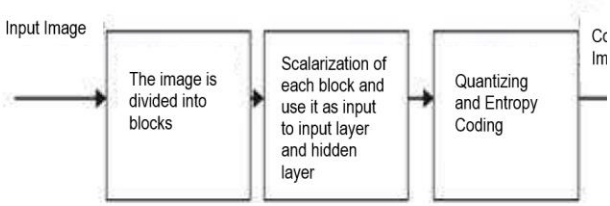

Fig.1 Block diagram of flow of compression

3.2 Back Propagation Algorithm.

Back propagation Algorithm (BPA) is one of the best training algorithms for multi-layer forward network model as well as single-layer network. The performance of BPA is used to improve the constant bit rate transferring with low computational complexity and generate a better reconstructed image. BPA is best suited for image compression process in deep neural network. The proposed BPA has three layers, namely - input, hidden and output layer. It has 64 Input neurons (nodes) and 16 hidden neurons(nodes) and 64 output neurons(nodes) as shown in fig.2.

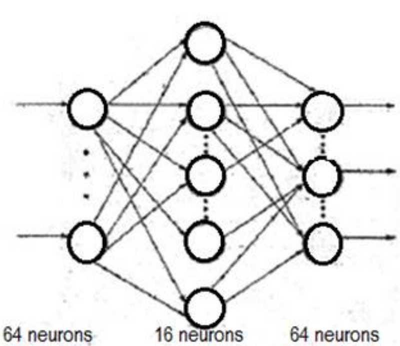

Fig.2 Neural network model

3.3 Building a Network

The chosen number of input and output neurons should be the same and decision about its quantity must be assessed properly as it depends on the whole system. Blocks of size 8x8 pixels are extracted from the images as shown in Fig.3, which means that values of 64 pixels used in network training are presented to the network input layer. Therefore, input layer and output layer has 64 neurons and decide the number of neurons in the hidden layer that is free, as well as making sure it doesnt exceed the input layer.

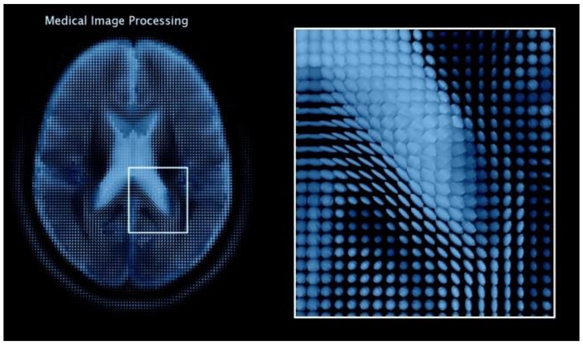

Fig.3 Image division as 8x8

3.4 Network Training

The Network Training is done using the most suited back propagation algorithm. This algorithm modifies the weights of the network for the training. The desired output has been provided so that the weights circulating in the network will be updated by the algorithm according to the quadratic error between output and the desired one. The error must be in its highest minimum value so as to achieve the goal. The weight matrices are remembered by the model and these stored parameters provides the possibility of presenting to the network a completely new image that is also still need to be processed. For the weights (W) in the network according to the gradient rule, new value is calculated using (1).

Wt(new) = Wi (old) + α(Y - O) Xi ……. (1)

where ,

α - constant for learning rate.

Xi - input of the neuron i.

O - expected output from the neuron.

Y - calculated output from the neuron.

.3.5 Decompression

The reconstruction of the compressed image involves the reading the stored data (compressed image) to set as hidden layer outputs and then, again using the previously stored weight matrices, calculating the network output. This process of reconstruction the image is called post processing. The decoder (decompression) has two stages: a symbol decoder and an inverse mapper. The reason why decoder do not have quantizer is because the quantizer is irreversible. Fig4 illustrates the flow of reconstruction.

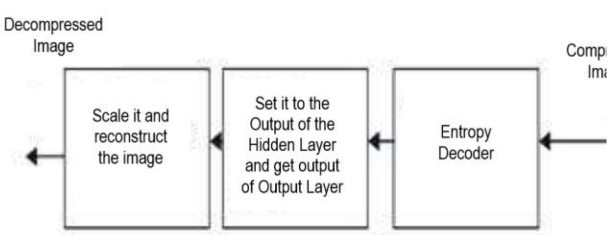

Fig.4 Flow of reconstruction

4. EXPERIMENTAL RESULTS

After several testing with various images in various format the results can be described using few compression parameters. These parameters determine the degree of compression that has taken place in the proposed system.

4.1 Compression Ratio.

Compression ratio is defined as the ratio of storage size of original image to the storage size of compressed image.

$$CR = \frac{Original\ File\ Size}{Compressed\ File\ Size}$$

4.2 Mean Square Error.

The mean squared error is computed based on the original image and the decompressed image. It should be as small as possible so that the quality of the reconstructed image is near to the original image. For the better compression MSE should be very less or Zero.

$$MSE=\frac{1}{NM}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1}[\hat{f}(x,y)-f(x,y)]$$

4.3 Peak signal-to-noise ratio.

The PSNR is the difference between the original image and the reconstructed image. The larger the PSNR value, the better will be the reconstructed image quality.

$$PSNR=10\log_{10}\frac{255^2}{MSE}$$

4.4 Bit Rate.

Bit Rate is calculated as the average number of bits per pixel for the encoded image.

Table 1 shows performance of Back Propagation Algorithm with various medical images.

TABLE 1

IMAGE	CR	PSNR	MEMORY (kb)	EXECUTION TIME (ms)
CT	1.035	42.3719	30.10	278.722
MRI	1.042	46.7436	29.20	668.380
PET	1.053	50.276	22.4	652.367

5. CONCLUSION

A neural network-based color image compression technique has been used for efficient compression and decompression of medical images. This proposed scheme suggests that artificial neural network can be used for Medical Imaging application for Medical Image Compression. The back-propagation algorithm is well suited for processing image data due to its organizational structure and it provides an internal representation of data. Neural network approaches to color medical image compression have performed better than other standard approaches. Thus, it should be considered as an alternative method in this field.

6. REFERENCE

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