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A Review on Enhancement in Compression of Radiograph Image Using Wavelets and Neural Network

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Abstract— Image compression is the technique of reducing the size of image file without degrading the quality of the image Bandwidth conservation is an important issue in case of multimedia communication. Uncompressed multimedia (graphical, audio and video) data requires considerable storage capacity and transmission bandwidth. Despite rapid progress in mass-storage density, processor speeds and digital communication system performance, it demands for data storage capacity and data-transmission bandwidth continuously to outstrip the capabilities of available technologies. So to solve this problem an efficient multimedia communication scheme is proposed which is based on Wavelet. This Paper shows Better image compression by using different wavelet with the help of Neural network. This paper shows the objectives and methodology used for compressing radiograph image with help of back propagation algorithm.

Keywords-Image compression, wavelet, Back Propagation, Neural network, Radiograph

INTRODUCTION.

Uncompressed multimedia (graphics, audio and video) data requires considerable storage capacity and transmission bandwidth. To enable modern high bandwidth required in wireless data services such as mobile multimedia, email, mobile, internet access, mobile commerce, mobile data sensing in sensor networks, home and medical monitoring services and mobile conferencing, there is a growing demand for rich content cellular data communication, including Voice,Text, Image and Video.

One of the major challenges in enabling mobile multimedia data services will be the need to process and wirelessly transmit very large volume of this rich content data. This will impose severe demands on the battery resources of multimedia mobile appliances as well as the bandwidth of the wireless network[1]. While significant improvements in achievable bandwidth are expected with future wireless access technology, improvements in battery technology will lag the rapidly growing energy requirements of the future wireless data services. One approach to mitigate this problem is to reduce the volume of multimedia data transmitted over the wireless channel via data compression technique such as JPEG, JPEG2000 and MPEG.

1.1Need Of Compression

In the last decade, there has been a lot of technological transformation in the way we communicate. This transformation includes the ever present, ever growing internet, the explosive development in mobile communication and ever increasing importance of video communication.

Data Compression is one of the technologies for each of the aspect of this multimedia revolution. Cellular phones would not be able to provide communication with increasing clarity without data compression. Data compression is art and science

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of representing information in compact form. Despite rapid progress in mass-storage density, processor speeds, and digital communication system performance, demand for data storage capacity and data-transmission bandwidth continues to outstrip the capabilities of available technologies. In a distributed environment large image files remain a major bottleneck within systems.

Image Compression is an important component of the solutions available for creating image file sizes of manageable and transmittable dimensions. Platform portability and performance are important in the selection of the compression/decompression technique to be employed.

1.2Four Stage Model Of Data Compression

Almost all data compression systems can be viewed as comprising four successive stages of data processing arranged as a processing pipeline (though some stages will often be combined with a neighboring stage, performed "off-line," or otherwise made rudimentary).

The four stages are :

A.Preliminary pre-processing steps.

B.Organization by context.

C.Probability estimation.

D.Length-reducing code.

The ubiquitous compression pipeline (A-B-C-D) is what is of interest.

With (A) we mean various pre-processing steps that may be appropriate before the final compression engine. Lossy compression often follows the same pattern as lossless, but with one or more quantization steps somewhere in (A). Sometimes clever designers may defer the loss until suggested by statistics detected in (C); an example of this would be modern zero tree image coding.

(B) Organization by context often means data reordering, for which a simple but good example is JPEG's "Zigzag" ordering. The purpose of this step is to improve the estimates found by the next step.

(C) A probability estimate (or its heuristic equivalent) is formed for each token to be encoded. Often the estimation formula will depend on context found by (B) with separate 'bins' of state variables maintained for each conditioned class.

(D) Finally, based on its estimated probability, each compressed file token is represented as bits in the compressed file. Ideally, a 12.5%-probable token should be encoded with three bits, but details become complicated.

1.3Image Compression techniques

A digital image, or "bitmap", consists of a grid of dots, or "pixels", with each pixel defined by a numeric value that gives its color. The term data compression refers to the process of reducing the amount of data required to represent a given quantity of information. Now, a particular piece of information may contain some portion which is not important and can be comfortably removed. All such data is referred as Redundant Data. Data redundancy is a central issue in digital image compression. Image compression research aims at reducing the number of bits needed to represent an image by removing the spatial and spectral redundancies as much as possible.

A common characteristic of most images is that the neighboring pixels are correlated and therefore contain redundant information. The foremost task then is to find less correlated representation of the image. In general, three types of redundancy can be identified**:**

A.*Coding Redundancy*: If the gray levels of an image are coded in a way that uses more code symbols than absolutely necessary to represent each gray level, the resulting image is said to contain coding redundancy

B.*Inter Pixel Redundancy*:The Information of any given pixel can be reasonably predicted from the value

of its neighboring pixel. The information carried by an individual pixel is relatively small.

In order to reduce the inter pixel redundancies in an image, the 2-D pixel array normally used for viewing and interpretation must be transformed into a more efficient but usually 'non visual' format.

C.*Psycho visual Redundancy*:Certain information simply has

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less relative importance than other information in normal visual processing. This information is said to be Psycho visually redundant, it can be eliminated without significantly impairing the quality of image perception.

In general, an observer searches for distinguishing features such as edges or textual regions and mentally combines them in recognizable groupings. The brain then correlates these groupings with prior knowledge in order to complete the image interpretation process.

1.4.Picture Quality Measures

Digital image is represented as matrix, where M denotes number of columns and N number of rows. $x_{j,k}$ and $x'_{j,k}$ denotes pixel values of original image before compression and degraded image after compression.

Mean Square Error (MSE) =

$$\frac{1}{N}\sum_{j=1}^{M}\sum_{K=1}^{N}\left(x_{j,k}-x'_{j,k}\right)^2$$

Peak Signal to Noise Ratio (PSNR) = $10\log\frac{(2^n-1)^2}{MSE}$ =

$$10\log\frac{255^2}{MSE}$$

Normalized Cross-Correlation (NK) =

$$\sum_{j=1}^{M}\sum_{k=1}^{N}x_{jk}.x'_{jk}/\sum_{j=1}^{M}\sum_{k=1}^{N}x_{jk}^2$$

Average Difference (AD) =

$$\sum_{j=1}^{M}\sum_{k=1}^{N}(x_{jk}-x'_{jk})/MN$$

Structural Content (SC) =

$$\sum_{j=1}^{M}\sum_{k=1}^{N}x_{jk}^2/\sum_{j=1}^{M}\sum_{k=1}^{N}x'^2_{jk}$$

Maximum Difference (MD) = $Max\left(\left|x_{j,k}-x'_{j,k}\right|\right)$

Picture Quality Scale (PQS) = $b_0+\sum_{i=1}^{3}b_iZ_i$

II. WAVES AND WAVELETS

A wave is an oscillating function of time or space and is periodic. In contrast, wavelets are localized waves. They have their energy concentrated in time or space and are suited to analysis of transient signals.[2] While Fourier Transform and STFT use waves to analyze signals, the Wavelet Transform uses wavelets of finite energy[3]. The Discrete Wavelet Transform (DWT), which is based on sub-band coding, is found to yield a fast computation of Wavelet Transform. It is easy to implement and reduces the computation time and resources required. Sampled input image is decomposed into various frequency sub-bands or sub-band signals. Splitting of signal into two parts shown in Figure 1. A two dimensional decomposition can be applied over the image. A simple example of level 2 decomposing is shown in Figure 2

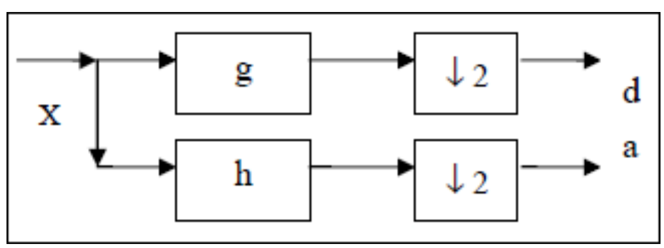

Fig. 1 Splitting of signal into two parts.

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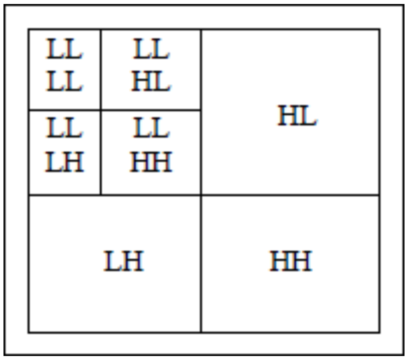

Fig 2 Two levels of 2-D DWT decomposition.

The original image is subdivided into four parts. The LL band contains low frequency contents of the signal, where as HH band contains high frequency contents of the signal, which is having less importance than LL band.

III.NEURAL NETWORK

The term neural network was traditionally used to refer to a network or circuit of biological neurons. The modern usage of the term often refers to artificial neural networks, which are composed of artificial neurons or nodes.

Backpropagation

It is a supervised learning method, and is a generalization of the delta rule. It requires a dataset of the desired output for many inputs, making up the training set.[3] It is most useful for feed-forward networks (networks that have no feedback, or simply, that have no connections that loop). Backpropagation requires that the activation function used by the artificial neurons (or "nodes") be differentiable.

The goal of any supervised learning algorithm is to find a function that best maps a set of inputs to its correct output. An example would be a simple classification task, where the input is an image of an animal, and the correct output would be the name of the animal.

IV.OBJECTIVES

1. Selection of best wavelet for medical Radiographs.
2. Compress input image with each wavelet with fixed CR
3. Find the following parameters to make comparison
4. MSE, PSNR, Correlation, Average difference, Normalized absolute error, Structural content.
5. Comparison with implemented paper based upon following parameters:MSE,PSNR,CR
6. image compression based on hierarchical back propagation neural network and results are analyzed.

V. METHODOLOGY USED

1. Selection of best wavelet for medical Radiographs.
   - Compress input image with each wavelet with fixed CR.
   - Find the following parameters to make comparison -MSE, PSNR, Correlation, Average difference, Normalized absolute error, Structural content.
2. Make database using selected wavelet.
3. Save each with its optimum compression ratio using subjective and objective evaluation.
4. Train and testing of neural network.
5. Apply input image to neural network with unknown CR.
6. Compress this image with CR defined by neural network.
7. Comparison with implemented paper based upon following parameters
   - CR
   - PSNR
   - MSE

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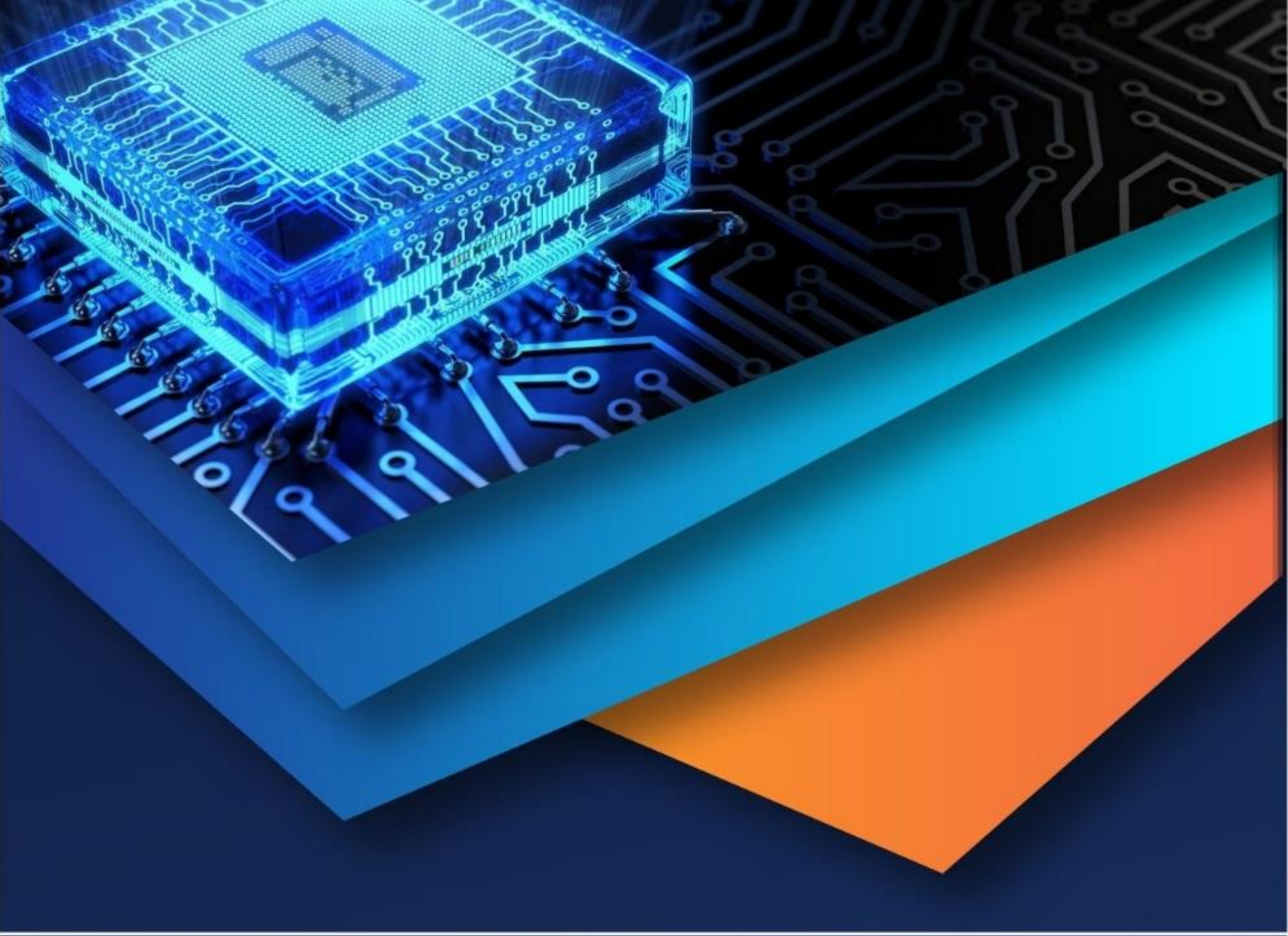

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