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Image Compression with Neural Network

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Abstract: In the last few decades, many researchers have been devoted to develop new techniques for image compression 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.. 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.

Keywords: Coiflet, Symlet, Daubechies, Gradient, Wavelet, Compression

1. INTRODUCTION

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 re inserted 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.

1.2 Principles Behind compression

A common characteristic of most images is that the neighboring pixels are correlated so it contains redundant information. The task is to find less correlated representation of the images. The two fundamental components of compression are redundancy and irrelevancy reduction. Redundancy reduction aims at removing duplication from the signal source (image). Irrelevancy reduction omits parts of signal that will not be noticed by signal receiver. In general three types of redundancy can be identified.

1) Coding redundancy
2) Inter-pixel redundancy
3) Psycho-visual redundancy

1.3Advantages of Data Compression

i. It reduces the data storage requirements.
ii. The audience can experience rich-quality signals for audio-visual data representation.
iii. Data security can also be greatly enhanced by encrypting the decoding parameters and transmitting them separately from the compressed database files to restrict access of proprietary information.
iv. The rate of input-output operations in a computing device can be greatly increased due to shorter representation of data.
v. Data Compression obviously reduces the cost of backup and recovery of data in computer systems by storing the backup of large database files in compressed form.

1.4 Disadvantages of Data Compression

i. The extra overhead incurred by encoding and decoding process is one of the most serious drawbacks of data compression, which discourages its use in some areas.
ii. Data compression generally reduces the reliability of the records.
iii. Transmission of very sensitive compressed data through a noisy communication channel is risky because the burst errors introduced by the noisy channel can destroy the transmitted data.
iv. Disruption of data properties of a compressed data, will result in compressed data different from the original data.

In many hardware and systems implementations, the extra complexity added by data compression can increase the system's cost and reduce the system's efficiency, especially in the areas of applications that require very low-power VLSI implementation .

2. Wavelet compression

Wavelet means a "small wave" the smallness implies to a window function of finite

length. Wavelet is a function that satisfy certain mathematical requirement and are used in representing data or other function. Wavelet compression involves a way of analyzing an uncompressed image in a recursive fashion, resulting in series of higher resolution images. The primary steps of wavelet compression are performing a Discrete Wavelet Transformation (DWT), quantization of the wavelet space image sub-band, and then encoding these sub-band that do the image compression. Image decompression, or reconstruction is achieved by carrying out the above steps in reverse and inverse order that is decode, de-quantize and inverse Discrete Wavelet Transformation.

3. Neural Network

A neural network is a highly interconnected network with a large number of processing elements called neurons in an architecture inspired by the brain. A neural network can be viewed as comprising eight components which are neurons, activation state vector, signal function, pattern of connectivity, activity aggregation rule, activation rule, learning rule and environment. They are considered as the possible solutions to problems and for the applications where high computation rates are required.

The neural network is designed with three layers, one input layer, one output layer and one hidden layer. The input layer and output layer are fully connected to the hidden layer. Compression is achieved by designing the number of neurons at the hidden layer, less than that of neurons at both input and the output layers. Image compression is achieved by training the network in such a way that the coupling weight scale the input vector of N-dimension into a narrow channel of K-dimension with K less than N, at the hidden layer and produce the optimum output value which makes the quadratic error between input and output minimum.

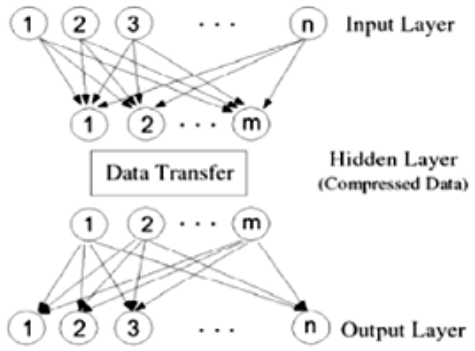

Figure1: Simple compression model

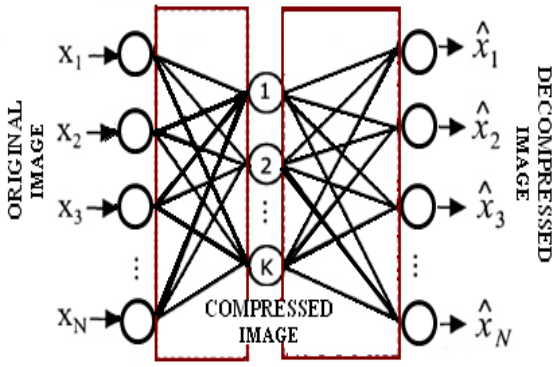

Figure2: Compression model of NN

The compression process is described below:

1. Read image pixels and then normalize it to range [0-1].
2. Divide the image into non-overlapping blocks.
3. Rasterizing the pixels and apply to the input layer.
4. Compute the outputs of hidden layer units by multiplying the input vector by the weight matrix (V).
5. Store the outputs in a compressed file after renormalization.
6. Stop.

4.LITERATURE REVIEW

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 .

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 .

5. PROPOSED METHODOLOGY

It is an effort to further grasp the fundamentals of MATLAB and validate it as a powerful application tool. There are basically different files. Each of them consists of m-file and figure file. These are the programmable files containing the information about the images and wavelet based filters algorithm and GRADIENT algorithm to compress the image. In this work, we firstly upload the image in any extension in the given window**.** Then there will be a running of

the Wavelet based filters directly and saving their parameter value in Excel sheet and GRADIENT algorithm is implemented on the images and gives the results of the compressed images and various parameters such as PSNR and MSE values and Correlation values etc will be calculated.

6.CONCLUSION

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..

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