Image Compression Using Neural Nerwork

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Abstract: Data requires considerable storage capacity and transmission bandwidth especially in case of Uncompressed multimedia (graphics, audio and video). 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. The recent growth of data intensive multimedia-based web applications has not only sustained the need for more efficient ways to storage and communication technology. Images are forming an increasingly large part of modern communications, bringing the need for efficient and effective compression. Many techniques developed for this purpose include transform coding, vector quantization and neural networks. In this paper, a new neural network method is used to achieve image compression. This work extends the use of 2-layer neural networks to a combination of cascaded networks with one node in the hidden layer . The results show the performance superiority of cascaded neural networks compared to that of fixed architecture training paradigms especially at high compression ratios. The proposed new method is implemented in MATLAB. The results obtained, such as compression ratio and computing time of the compressed images, are presented.

Keyword: Artificial Neural Networks, Image compression with neural network

1.INTRODUCTION

Neural networks are inherent adaptive systems, they are suitable for handling nonstationaries in image data. Artificial neural network can be employed with success to image compression The most important part of a neuron is the multiplier, which performs high speed pipelined multiplication of synaptic signals with weights. As the neuron has only one multiplier the degree of parallelism is node parallelism. Each neuron has a local weight ROM (as it performs the feed-forward phase of the back propagation algorithm) that stores, as many values as there are connections to the previous layer. An accumulator is used to add signals from the pipeline with the neuron's bias value, which is stored in an own register. The aim is to design and implement image compression using Neural network to achieve better SNR and compression levels. The compression is first obtained by modeling the Neural Network in MATLAB. This is for obtaining offline training

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2. NEURAL NETWORKS

2.1 Artificial Neural Networks

Artificial Neural networks are software or hardware systems that try to simulate the human brain functionality. From the beginning of their presence in science, Neural Networks (NNs) are being investigated with two different scientific approaches. First, the biological aspect explores NNs as simplified simulations of the human brain and uses them to test hypotheses about human brain functioning. The second approach treats NNs as technological systems for complex information processing. This thesis is focused on the second approach by which NNs are evaluated according to their efficiency to deal with complex problems, especially in the areas of association,

classification and prediction, but specifically in the area of image processing.

Other advantages include:

Adaptive learning: An ability to learn how to do tasks based on the data given for training or initial experience.

Self-Organization: An ANN can create its own organization or representation of the information it receives during learning time.

Real Time Operation: ANN computations may be carried out in parallel, and special hardware devices are being designed and manufactured which take advantage of this capability.

Fault Tolerance via Redundant Information Coding: Partial destruction of a network leads to the corresponding degradation of performance. However, some network capabilities may be retained even with major network damage

2.2 The Biological Neuron

The most basic element of the human brain is a specific type of cell, which provides with the abilities to remember, think, and apply previous experiences to our every action. These cells are known as neurons; each of these neurons can connect with up to 200000 other neurons. The power of the brain comes from the numbers of these basic components and the multiple connections between them.

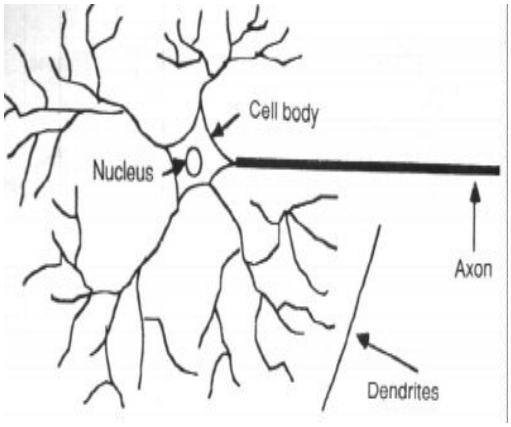
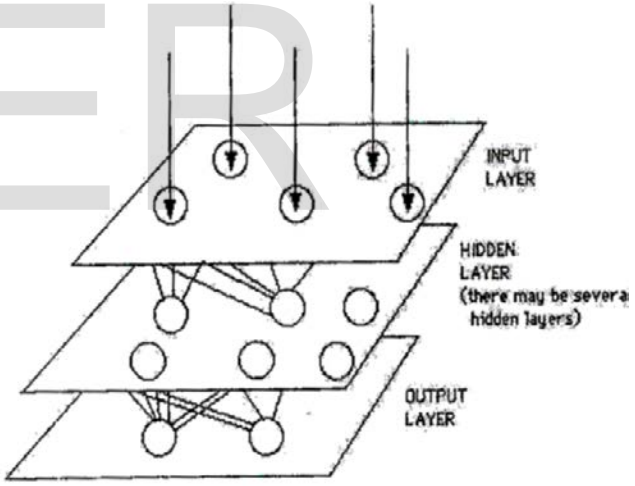


Fig.1

2.3 Layers

Biologically, neural networks are constructed in a three dimensional way from microscopic components. These neurons seen capable of nearly unrestricted interconnections. This is not true in any man-made network. Artificial neural network are the simple clustering of the primitive artificial neurons. This clustering occurs by creating layers, which are then connected to one another. How these layers connect may also vary. Basically, all artificially neural networks have a similar structure of topology. Some of the neurons interface the real world to receive its inputs and other neurons provide the real world with the network's outputs. All the rest of the neurons are hidden form view.

Fig.2



3. PROPOSED IMAGE COMPRESSION WITH NEURAL NETWORK

- A two layer feed-forward neural network and the Levenberg's Marquardt algorithm was considered. Imagecoding using a feed forward neural network consists of the following steps:
- An image, F, is divided into rxc blocks of pixels. Each block is then scanned to form a input vector x (n) of size p=rxc

- It is assumed that the hidden layer of the layer network consists of L neurons each with P synapses, and it is characterized by an appropriately selected weight matrix Wh.
- All N blocks of the original image is passed through the hidden layer to obtain the hidden signals, h(n), which represent encoded input image blocks, x(n) If L<P such coding delivers image compression.
- It is assumed that the output layer consists of m=p=rxc neurons, each with L synapses. Let Wy be an appropriately selected output weight matrix. All N hidden vector h(n), representing an encoded image H,are passed through the output layer to obtain the output signal, y(n). The output signals are reassembled into p=rxc image blocks to obtain a reconstructed image, Fr.

  There are two error matrices that are used to compare the various image compression techniques. They are Mean Square Error (MSE) and the Peak Signal-to-Noise Ratio (PSNR). The MSE is the cumulative squared error between the compressed and the The quality of image coding is typically assessed by the Peak signal-to-noise ratio (PSNR) defined as:

  PSNR=20log 10 [255/sqrt(MSE)]

Image Encoding : The hidden-half of the two-layer network is used to encode images. The Encoding procedure can be described as follows:

$$F \rightarrow X,\ H = (W^h . X)$$

Image Decoding : The image is decoded (reconstructed) using the output-half the two layer network. The decoding procedure is described as follows:

$$Y = (W^y . H),\ Y \rightarrow F$$

4. RESULTS

5. CONCLUSION

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 is a number of scientists arguing that consciousness is a 'mechanical' property and that 'conscious' neural networks are a realistic possibility. Even though neural networks have a huge potential we will only get the best of them when they

are integrated with computing, AI, fuzzy logic and related subjects. Neural networks are performing successfully where other methods do not, recognizing and matching complicated, vague, or incomplete patterns.

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