Training Block Effect on Neural Network FOR Image Compression Using Matlab

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Abstract: **This paper presents artificial neural networks used as image processing tools for image compression; present the effect of selecting block in image for training neural network. a direct solution method based neural network for image compression. Digital images require large amounts of memory for storage. Thus, the transmission of an image from one computer to another can be very time consuming. By using data compression techniques, it is possible to remove some of the redundant information contained in images, requiring less storage space and less time to transmit.**

Keywords: **Image compression, Artificial neural network, Training block.**

I. INTRODUCTION

Digital images require large amount of data to represent, image compression is needed in order to store and transmit images economically. Recently neural networks have been shown to be useful for image compression. Artificial Neural Networks (ANNs) have been applied to many problems [3], and have demonstrated their superiority over traditional methods when dealing with noisy or incomplete data. One such application is for image compression. Neural networks seem to be well suited to this particular function, as they have the ability to preprocess input patterns to produce simpler patterns with fewer components [1]. This compressed information (stored in a hidden layer) preserves the full information obtained from the external environment. Not only can ANN based techniques provide sufficient compression rates of the data in question, but security is easily maintained. This occurs because the compressed data that is sent along a communication line is encoded and does not resemble its original form. In [2], e.g., a two layered neural network is used, With the number of units in the input and output layers the same, and the number of hidden units smaller. The network is trained to perform the identity mapping and the compressed image is the output of the hidden layer.

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II. IMAGE COMPRESSION

Image compression is used for reducing the amount of data required to represent a digital image. Compression is achieved by removal of redundancy in data. The three basic data redundancies are coding redundancy, temporal redundancy and irrelevant information. Coding redundancy is result from using code word length of more than data needed. Temporal redundancies result from correlation between pixels of image or between pixels of neighboring image in the sequence of image .Irrelevant information which is due to data that represent information which is ignored by human visual system.

Recently the use of Wavelet Transforms and Discrete Cosine Transform (DCT) for image compression was investigated. The usability and efficiency of these methods depend on the application areas that require either high transmission rate or high quality decompression. Lossless compression algorithm provides a compression which, when decompressed the exact original data can be obtained. This is the case when binary data such as executables and documents are compressed. On the other hand, images might not be reproduced 'exactly', but an approximation of the original image is enough for most purposes as long as the error between the original and the compressed image is tolerable. The general purpose of compression systems is to compress images, but the result is less than optimal [4].

In these methods, the image is normally subdivided into small square blocks of pixels which are then used as the patterns to train the neural network. The size of each block is typically [4 x 4], [8 x 8] or [16 x 16]. A simple method for image compression using feedforward neural network was proposed in this method, a network with a single hidden layer is developed. The number of neurons in the input and output layers is equal to the number of pixels in a block. The hidden layer with less number of neurons can obtain higher compression ratio. This high compression ratio may result in reconstructed image with large error. If hidden layer have large number of neurons then compression ratio decries and quality of reconstructed image increases.

III. NEURAL NET ARCHITECTURE FOR IMAGE COMPRESSION

A neural net architecture suitable for solving the image compression problem is shown in fig.3.1. This type of structure--a large input layer feeding into a small hidden layer, which then feeds into a large output layer, is referred to as a bottleneck type network.

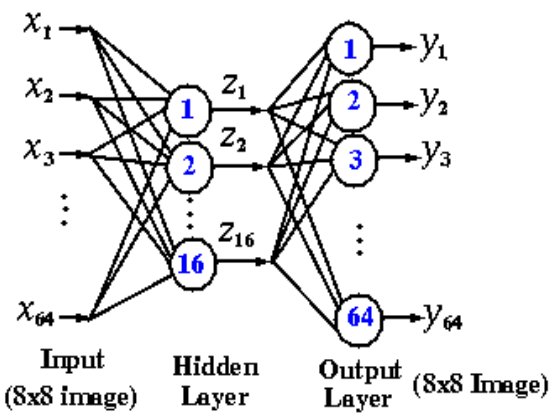


Figure 3.1 Bottleneck-type Neural Net Architecture for Image Compression

The idea is this: suppose that the neural net shown below had been trained to implement the identity map. Then, a tiny image presented to the network as input would appear exactly the same at the output layer.

IV. IMAGE COMPRESSION SCHEME USING THE TRAINED NEURAL NETWORK

In this case, the network could be used for image compression by breaking it in two as shown in the Fig.3.2. The transmitter encodes and then transmits the output of the hidden layer (only 16 values as compared to the 64 values of the original image).

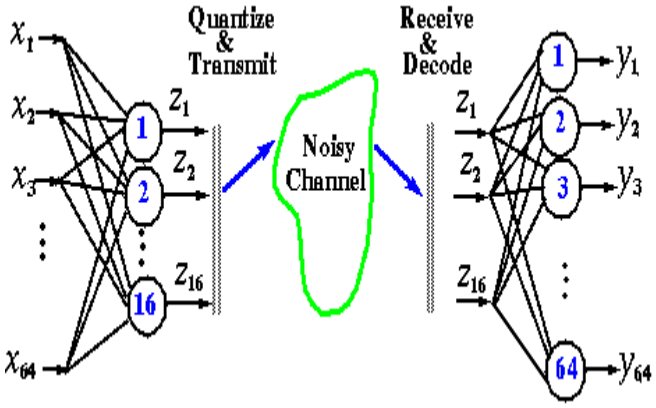


Figure 3.2 Image Compression Scheme using the Trained Neural Net

The receiver receives and decodes the 16 hidden outputs and generates the 64 outputs. Since the network is implementing an identity map, the output at the receiver is an exact reconstruction of the original image.

V. IMPLEMENTATION

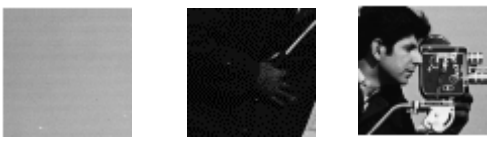
MATLAB is used for implementing program. MATLB provide special Neural Network tool for Artificial Neural Network.

Result of image compression using neural network not only depends on compression ratio but also on which image or part of image is used for training the neural network. If image used for training is of more number of gray level. Then results for other images is more accurate but if image of less number of gray level is used, then result for other images is not much accurate. The number of samples used in training is also affects the results of image compression, more number of sample require more time for training but results are more accurate than less number of samples.

In this MATLAB is used to implement the program. The well-known 'Cameraman' grayscale image (256 x 256) is used for this image compression technique. Each pixel in an image can be denoted as a coefficient, which represents the intensity of the image at that point. Then, the idea of compressing an image is to encode these coefficients with reduced bits and at the same time, retain the quality of the image to satisfactory limits.

The original image used for compression is shown in Figure 4.1. The image blocks used for training are shown in Figure 4.2, which are the part of original image. All training blocks are of size (64 x 64) size. The multi-layer feed-forward neural network is used to compress images. The three-layered back propagation-learning network has been trained with each sub image. The number of neurons in the hidden layer will be taken according to the desired compression ratio. The original image that has been used for compression purposes is a 256 x 256 image. This image can be broken into blocks of size 64 x 64. There will then be 4096 pixels per block. Totally, there will be [64 x 64] = 16 blocks. The 4096 pixels in each block then becomes the input vector to the neural net.

Figure 4.1.Original 'cameraman' image



(a) *(b)* *(c)*

Figure4. 2. Image Block used for training network

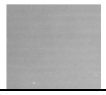
Figure 4.3. (a) Decompressed image

If each pixel is encoded using 8 bits, then the total number of bits to be transmitted without compression is [256 x 256 x 8] for a [256 x 256] pixel image. A [256 x 256] pixel image is split into [64 X 64] pixel sub-images. Then for increasing number of sample for training this block is rearranged in [16 x 256] pixel block.

Figure 4.3.(b) Decompressed image

Figure 4.3.(c) Decompressed image

Table 1. Effect of image block used for training on decompressed image

Image block used for training	PSNR
	19.22 dB
	26.68 dB
	30.15 dB

This block is given as training input to three layer neural network having input and output layer of 16 neurons and hidden layer with 8 neurons. Due to this structure of network we get compressed image at the output of hidden layer.

Table 1 shows that when image block with more gray level is used for training it give high PSNR.

VI. CONCLUSION

Image compression using artificial neural network give better results for network which is trained by image block having more number of gray level. As we decrease the number of neuron in hidden layer got more compression ratio. Image data compression using a 3-layered simple network developed using MATLAB.

VII. FUTURE SCOPE

Artificial Neural Networks is currently used in varies area, it gives good results in image processing. By using new training methods and image processing techniques there is wide area of application for artificial neural network. Integrated with the other fields like Artificial intelligence, fuzzy logic neural networks have a huge potential to perform.

Neural networks have been applied in solving a wide variety of problems. It is an emerging and fast growing field and there is a huge scope for research and development.

VIII. REFERENCES

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