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RESEARCH ARTICLE

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MACHINE LEARNING BASED JPEG BLOCKING ARTIFACTS REMOVAL

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ABSTRACT

Image compression is the process of converting an image file in such a way that it consumes less space than the original space. But also it introduces blocking artifacts. Here JPEG algorithm is used. They are lossy i.e,, some of the information is lost, but only information that is judged to be insignificant. Machine learning techniques are used for prediction of pixel and DCT coefficients. Through this paper, results shows the improved quality of image by removing the blocking artifacts and shows reduction of mean square error.

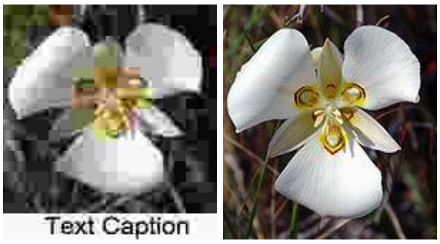
KEY WORDS—Compression of image, JPEG, DCT, Machine learning language, Cascade correlation algorithm

I. INTRODUCTION

Image compression is the method of using the smaller bits than original image.This is made possible by the JPEG method. JPEG is a lossy compression and uses DCT. First, the image is divided into 8 by 8 blocks of pixels. Since each block is processed without reference to the others, we will concentrate on a single block. The color of each pixel as represented by a three-dimensional vector *(R,G,B)* consisting of its red, green, and blue components. In a typical image, there is a significant amount of correlation between these components. For this reason, we will use a *color space transform* to produce a new vector whose components represent *luminance, Y,* and blue and red *chrominance,* C_b and C_r. The luminance describes the brightness of the pixel while the chrominance carries information about its hue. These three quantities are typically less correlated than the (*R, G, B*) components. Furthermore, psychovisual experiments demonstrate that the human eye is more sensitive to luminance than chrominance, which means that we may neglect larger changes in the chrominance without affecting our perception of the image. Since this transformation is invertible, we will be able to recover the *(R,G,B)* vector from the (Y, C_b, C_r) vector. This is important when we wish to reconstruct the image. the changes in the components of the (Y, C_b, C_r) vector are rather mild, as demonstrated by the example above. Instead of recording the individual values of the components, we could record, say, the average values and how much each pixel differs from this average value. In many cases, we would expect the differences from the average to be rather small and hence safely ignored. This is the essence of the Discrete Cosine Transform (DCT), which will now be explained.Then quantization is made.Here due to compression blocking artifacts occurs. We use cascade correlation nueral network technique to remove these blocks and to improve the quality of compressed image along with reduction in MSE.

2.JPEG COMPRESSION AND ITS IMPACTS

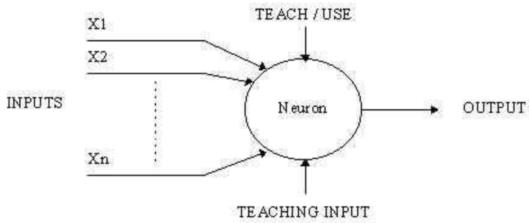
JPEG is a commonly used method of lossy compression for digital images. JPEG compression artifacts blend well into photographs with detailed non-uniform textures, allowing higher compression ratios. Notice how a higher compression ratio first affects the high-frequency textures in the upper-left corner of the image, and how the contrasting lines become more fuzzy. The very high compression ratio severely affects the quality of the image, although the overall colors and image form are still recognizable. However, the precision of colors suffer less (for a human eye) than the precision of contours (based on luminance). This justifies the fact that images should be first transformed in a color model separating the luminance from the chromatic information, before subsampling the chromatic planes (which may also use lower quality quantization) in order to preserve the precision of the luminance plane with more information bits. Next, each 8×8 block of each component (Y, Cb, Cr) is converted to a frequency-domain representation, using discrete cosine transform (DCT). This rounding operation is the only lossy operation in the whole process (other than chroma subsampling) if the DCT computation is performed with sufficiently high precision. As a result of this, it is typically the case that many of the higher frequency components are rounded to zero,and many of the rest become small positive or negative numbers, which take many fewer bits to represent.SO here occurs the problem of blocking of artifacts in compressed image. an aspect of working with JPEG format files that may drastically impact image quality. At the core of Oskar's observation is that when working with a JPEG file, in many programs (potentially even Photoshop which we're verifying), each alteration made will prompt a save in the program before you manually pursue a final save of your changes. The end result is not just one round of data loss due to JPEG compression when you save your final version of an image, but several rounds of data loss reflecting the number revisions made before your final image is saved. I've always known about the theoretical impact of JPEG compression on images, but have never seen a definitive test showing the extent compression can ruin an image until now thanks to Oskar. For those not sold on working with a lossless format such as Photoshop (PSD) upon seeing the results posted below you will likely become a believer.



Original image Compressed image

3.MACHINE LEARNING LANGUAGE

Machine learning is a subfield of computer science′ that evolved from the study of pattern recognition and computational learning theory in artificial intelligence. Such algorithms operate by building a model from example inputs in order to make data-driven predictions or decisions. In machine learning, **artificial neural networks** (**ANNs**) are a family of models inspired by biological neural networks (the central nervous systems of animals, in particular the brain) and are used to estimate or approximate functions that can depend on a large number of inputs and are generally unknown. Artificial neural networks are generally presented as systems of interconnected "neurons" which exchange messages between each other. The connections have numeric weights that can be tuned based on experience, making neural nets adaptive to inputs and capable of learning.



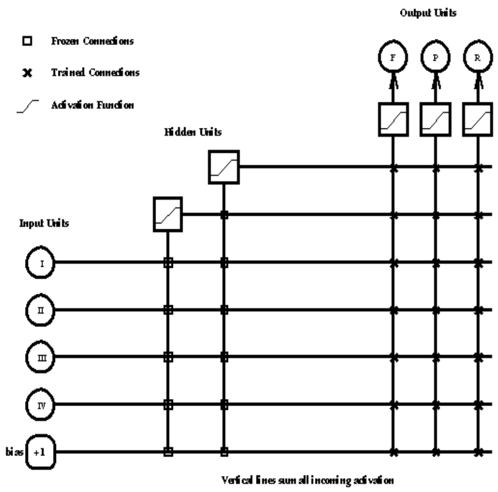
Artificial Neural Network

An artificial neural network is an interconnected group of nodes, akin to the vast network of neurons in a brain. Here, each circular node represents an artificial neuron and an arrow represents a connection from the output of one neuron to the input of another.

4.CASCADE CORRELATION NEURAL NETWORK

Cascade-Correlation is a supervised learning architecture which builds a near minimal multi-layer network topology. The two advantages of this architecture are that there is no need for a user to worry about the topology of the network, and that

Cascade-Correlation learns much faster than the usual learning algorithms. Cascade-Correlation begins with a minimal network, then automatically trains and adds new hidden units one by one, creating a multi-layer structure.Once a new hidden unit has been added to the network, its input-side weights are frozen. This unit then becomes a permanent feature-detector in the network, available for producing outputs or for creating other, more complex feature detectors. Cascade-Correlation combines two key ideas: The first is the cascade architecture, in which hidden units are added to the network one at a time and do not change after they have been added. The second is the learning algorithm, which creates and installs the new hidden units. For each new hidden unit, we attempt to maximize the magnitude of the correlation between the new unit's output and the residual error signal we are trying to eliminate.



Cascade correlation neural network

5.PREDICTION PHASE

Training a neural network model essentially means selecting one model from the set of allowed models (determining a distribution over the set of allowed models) that minimizes the cost criterion. There are numerous algorithms available for training neural network models; most of them can be viewed as a straightforward application of optimization theory and statistical estimation. We present the network with training examples, which consist of a pattern of activities for the input units together with the desired pattern of activities for the output units.We determine how closely the actual output of the network matches the desired output. We change the weight of each connection so that the network produces a better approximation of the desired output.

A.LEARNING DCT COEFFICIENT: The input of the DCT predicted neural network is the quantized 8 by 8 pixel block. The DCT coefficients are predicted corresponding to its index positions.Once the DCT coefficients are predicted, Inverse Discrete Cosine Transform is applied to convert it to the spatial domain.

B.LEARNING PIXEL VALUES: The input to predict pixel value is the value of neighbourhood pixel.So that it predicts the target pixel's value.Here the luminance intensity is predicted.Then all pixel at boundaries are replaced by the predicted pixel. This will reduce the effects of blocking artifacts, because the changes of intensities are larger at boundaries. So the blocking artifacts are noticeable.

6.PROCESSING METHOD

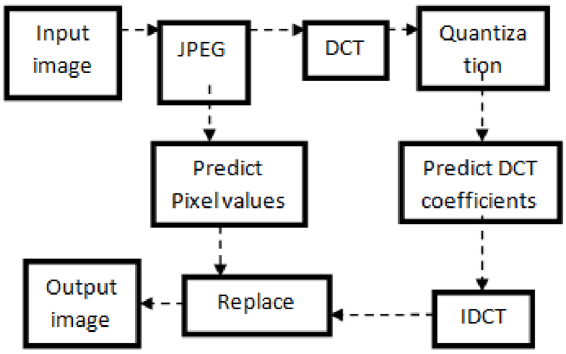
The process starts with the JPEG compression of an image.Here DCT is used.Once the DCT coefficients are quantized, it results in blocking artifacts.Here the coefficients are predicted by cascade correlation algorithm and converted from frequency domain to the spatial domain.

Then its luminance intensity is predicted at image block boundary indexes.Blocking artifacts are noticeable when the pixel intensity at the boundary is larger.

Once the pixel value is predicted,it replaces the pixel block boundaries. After that smoothing takes place. When the image is compressed it introduces ringing effects.So the Guassian filter is used for smoothing process. Therefore the obtained smoothed image will be expressed by,

$$S(K) = I(K) * G \qquad (1)$$

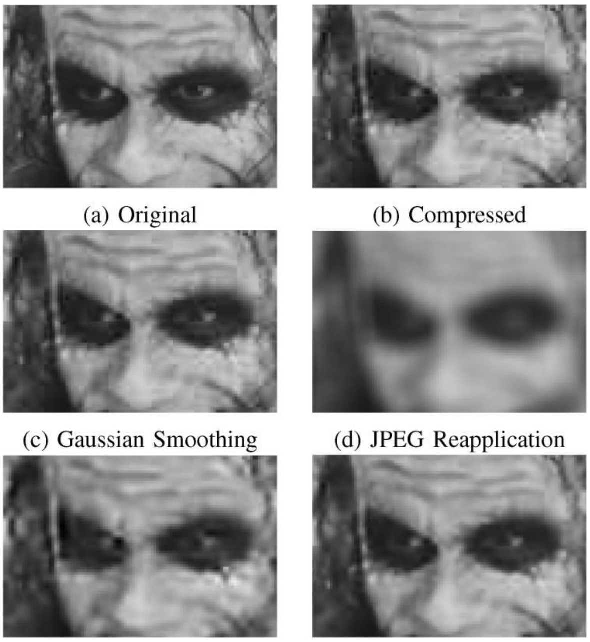
Where S is the new set of smoothened image, I is the original compressed image, G is the Guassian filter and * is the convolutional operator.



Proposed method

7.RESULTS

We tested our method with other neural network technique. This neural network only shows the improved quality of image by removing the artifacts with faster time. The result of our proposed system is shown in the below diagram.



(e) IDFT (f) output image

Proposed method

CONCLUSION

Here proposed method yields high quality imageby removing blicking artifacts in the image. Results also shows the decrease in the mean square error value between original and compressed images.

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