

# **A NEW ENTROPY ENCODING ALGORITHM FOR IMAGE COMPRESSION USING DCT**

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**Abstract-** Digital images contain large amount of information that need evolving effective techniques for storing and transmitting the ever increasing volumes of data. Image compression addresses the problem by reducing the amount of data required to represent a digital image. Image compression is achieved by removing data redundancy while preserving information content. In this paper, a new alternative method for simultaneous image acquisition and compression called adaptive compressed sampling. It also extended the need for image reconstruction on compressed images. Image reconstruction has to be defined in this context. whereas Image enhancement strives to bring out certain features in an image to simplify the extraction of image information, image reconstruction is the attempt to retrieve information that has been lost or obscured in the imaging process itself.

**Keywords-** *Compression, Reconstruction, Discrete Cosine Transform, Quantization, Entropy, Lossless Compression, Lossy Compression.*

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## **1.INTRODUCTION**

Image compression is very important for efficient transmission and storage of images. Demand for communication of multimedia data through the telecommunications network and accessing the multimedia data through Internet is growing explosively. With the use of digital cameras, requirements for storage, manipulation, and transfer of digital images, has grown explosively. These image files can be very large and can occupy a lot of memory. A gray scale image that is 256 x 256 pixels have 65, 536 elements to store and a typical 640 x 480 color image has nearly a million. Downloading of these files from internet can be very time consuming task. Image data comprise of a significant portion of the multimedia data and they occupy the major portion of the communication bandwidth for Image compression model shown here consists of a Transformer, quantizer and encoder.

multimedia communication. Therefore development of efficient techniques for image compression has become quite necessary. A common characteristic of most images is that the neighboring pixels are highly correlated and therefore contain highly redundant information. The basic objective of image compression is to find an image representation in which pixels are less correlated. The two fundamental principles used in image compression are redundancy and irrelevancy. Redundancy removes redundancy from the signal source and irrelevancy omits pixel values which are not noticeable by human eye. JPEG and JPEG 2000 are two important techniques used for image compression.

## **2. RELATED WORK:**

The rapid growth of digital imaging applications, including desktop publishing, multimedia, teleconferencing, and high-definition television (HDTV) has increased the need for effective and standardized image compression techniques. Among the emerging standards are JPEG, for compression of still images [Wallace 1991]; MPEG, for compression of motion video [Puri 1992]; and CCITT H.261 (also known as Px64), for

## **3. PROPOSED WORK**

In this paper a simple entropy encoder algorithm is proposed and implemented. It works on quantized coefficients of the discrete cosine transform. The probability of being nonzero of zig-zag ordered DCT coefficients, decreasing monotonic function of the index. The basic idea of the new approach is to divide the image into 8x8 blocks and then extract the consecutive non-zero coefficients preceding the zero coefficients in each block. In contrast to the Run\_Length decoder, the output of this encoder consists of number of the non-zero coefficients followed by the coefficients themselves for each block. The decompression process can be performed systematically and the number of zero coefficients can be computed by subtracting the number of non-zero coefficients from 64 for each block. After decoding the image we will perform image reconstruction phase. We focus on regression methods that attempt to recover the noiseless high-frequency information corrupted by the limitations of the imaging system, as well as degradation processes such as compression.

### **3.1 DCT**

The discrete cosine transform (DCT) is a technique for converting a signal into elementary

### **3.2 Image transformation**

The input to the DCT module is an 8x8 block of image intensity values, and the output is an 8x8 block of DCT coefficients. For lossless compression of an image, only the reversible colour transform (RCT) is allowed because the pixels can be exactly reconstructed by the inverse RCT. Although it has been defined for lossless image compression, the standard allows it for lossy compression as well.

### **3.3 Image quantization**

The DCT coefficients take on values in a continuous range, whereas the entropy coder requires a finite alphabet source as input. So, the DCT coefficients

compression of video telephony and Teleconferencing.

All three of these standards employ a basic technique known as the discrete cosine transform (DCT). Developed by Ahmed, Natarajan, and Rao [1974], the DCT is a close relative of the discrete Fourier transform (DFT). Its application to image compression was pioneered by Chen and Pratt [1984], to compute the DCT and show how it is used for image compression. It has used these functions in our laboratory to explore methods of optimizing image compression for the human viewer, using information about the human visual system [Watson 1993].

frequency components. It is widely used in image compression. The discrete cosine transform (DCT) helps separate the image into parts (or spectral subbands) of differing importance (with respect to the image's visual quality).

All values are level shifted by subtracting 128 from each value. The Forward Discrete Cosine Transform of the block is then computed.

### **The basic operation of the DCT algorithm is as follows:**

**Step 1:** The input image is N by M;

**Step 2:**  $f(x, y)$  is the intensity of the pixel in row  $x$  and column  $y$ ;

**Step 3:**  $g(u, v)$  is the DCT coefficient in row  $k_1$  and column  $k_2$  of the DCT matrix.

**Step 4:** For most images, much of the signal energy lies at low frequencies; these appear in the upper left corner of the DCT.

**Step 5:** Compression is achieved since the lower right values represent higher frequencies, and are often small - small enough to be neglected with little visible distortion.

**Step 6:** The DCT input is an 8 by 8 array of integers. This array contains each pixel's gray scale level;

**Step 7:** 8 bit pixels have levels from 0 to 255.

need to be rounded to discrete levels before being fed to the entropy coding stage. The process of rounding to discrete levels is called quantization, and the module performing this process is called quantizer. Quantization is an irreversible mapping, and it is the stage where loss is introduced to achieve compression. There is a trade-off between the amount of loss and the number of bits required for representation, and this trade-off is controlled by the quantizer.

### **3.4 Entropy encoding:**

In the entropy coding stage, the 8x8 block of quantization indices of the DCT coefficients (or

shortly quantized DCT coefficients) are compressed. Entropy coder exploits the fact that most of the energy is compacted into low-frequency coefficients, and that many of the high-frequency coefficients are zeros.

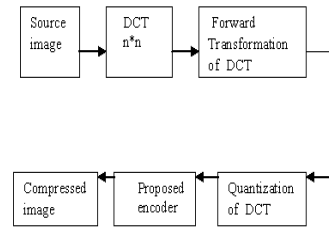


Figure: Image Compression Process

**3.5 Image Inverse Transform**

In image decompression model at the decoder's side, the reverse process takes place, with the obvious difference that the dequantization stage will only generate an approximated version of the original coefficient values e.g., whatever loss was introduced by the quantizer in the encoder stage is not reversible.

**3.6 Image Dequantization**

The transformed image is dequantized to reduce the loss in the image. The quantized data is stored as the pixel values and it is restored. As the number of discrete levels of the quantizer is increased, the introduced loss is decreased, and the number of bits required to represent the quantized coefficients is increased.

**3.7 Image Entropy decoding**

Similar to entropy coding, entropy decoding also can be considered as 2-step process. The first step converts the input bit stream into the intermediate symbols. The second step converts the intermediate symbols into the quantized DCT coefficients. In fact, the output of the second step is the DC difference, the output of DPCM, and the AC coefficients after zig-zag scan. Therefore, the DC difference is then decoded into the quantized DC coefficient, and the AC coefficients are ordered into original order.

**3.8 Image Reconstruction**

After receiving the compressed data, with the aid of spatial correlation in natural image, a receiver can reconstruct the principal content of the original image by iteratively updating the values of coefficients. This way, the higher the compression ratio and the smoother the original image, the better the quality of the reconstructed image.

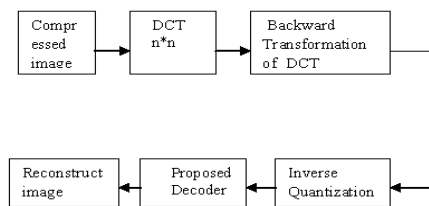


Figure: Image Decompression Process

**4. PERFORMANCE PARAMETER**

Imaging systems may introduce some amounts of distortion or artifacts in the signal, so the quality measures are an important problem. There are several techniques and metrics that can be measured objectively and automatically evaluated by a computer program. Therefore, they can be classified as full-reference (FR) methods and no reference (NR) methods. In FR image quality assessment methods, the quality of a test image is evaluated by comparing it with a reference image that is assumed to have perfect quality. NR metrics try to assess the quality of an image without any reference to the original one.

**4.1 Mean Square Error**

In the image processing the most frequently used measures are deviations between the original and reconstructed images of which the mean square error (MSE) or signal to noise ratio (SNR) being the most common measures. The reasons for these metrics widespread popularity are their mathematical tractability and the fact that it is often straightforward to design systems that minimize the MSE but cannot capture the artifacts like blur or blocking artifacts. The effectiveness of the coder is optimized by having the minimum MSE at a particular conversion.

Calculated MSE in reconstructed image into original image to use the Table (1).

**4.2 Peak signal-to-Noise Ratio**

Larger SNR and PSNR indicate a smaller difference between the original (without noise) and reconstructed image. The main advantage of this measure is ease of computation but it does not reflect perceptual quality. An important property of PSNR is that a slight spatial shift of an image can cause a large numerical distortion but no visual distortion and conversely a small average distortion can result in a damaging visual artifact, if all the error is concentrated in a small important region. This metric neglects global and composite errors PSNR is calculated using Table(1).

Table:1 Picture quality Measures	
<b>Mean Square Error</b>	$MSE = \frac{1}{MN} \sum_{j=1}^N \sum_{k=1}^N (x_{j,k} - \hat{x}_{j,k})^2$
<b>Peak Signal to Noise Ratio</b>	$PSNR = 10 \log (2^{2n} - 1)^2 / MSE = 10 \log 255^2 / MSE$

**5. RESULT AND DISCUSSION**

**5.1 Experimental Result**

A complete compression process has been implemented to test and demonstrate the proposed coder algorithm.

**Generating n\*n blocks**

In RGB space the image is split up into red, blue and green images. The image is then divided into 8x8 blocks of pixels and accordingly the image of wxh pixels will contain WxH blocks. Where  $W = w / 8, H = h / 8$ .

**Quantization**

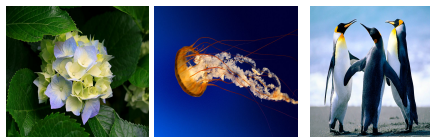
Quantization is the step where the most of the compression takes place. DCT really does not

compress the image, as it is almost lossless. Quantization makes use of the fact that, the high frequency components are less important than the low frequency components.

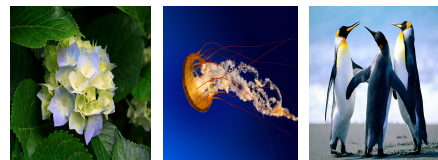
**Entropy coding**

DCT based image compression using blocks of size 8x8 is considered. After this, the quantization of DCT coefficients of image blocks is carried out. The new approach of entropy encoding is then applied to the quantized DCT coefficients. The efficiency of the proposed encoder is analyzed and compared with that obtained after applying Run-length coding method.

a) Original image



b) Reconstructed image



**5.2 Comparative Analysis Result**

Standard objective measures of image quality are Mean Square Error (MSE) and Peak signal to Noise Ratio (PSNR) ,In these case 8 bits per pixel element

PARAMETER ANALYSED	HYDRANGEAS	JELLYFISH	PENQUINS
MSE	4.5034	4.7466	12.7263
PSNR	41.5954	41.3670	37.0838

Table2

**6. CONCLUSION**

Image compression techniques reduce the number of bits required to represent an image by taking advantage of the redundancies. In this paper, image compression techniques using DCT is implemented. DCT is used for transformation in JPEG standard. DCT performs better in the context

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of input image, MSE and PSNR are the common methods the quality of reconstructed image. The following Table gives the quality measures for original image to reconstructed image.

In this quality measures values gives better result for compare to other techniques. PSNR image quality factor is better in Penguins reconstructed the result is 12.7263 for MSE and 37.0838 PSNR with low value indicates a good quality.

that it avoids blocking artifacts which degrade reconstructed images. The technique is particularly amenable to the design of relatively simple, fast decoders and it can be used as a key component in data compression.

**BIOGRAPHY**

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Ms.D.Malarvizhi is a Research scholar in the Department of Computer Science and Engineering, Alagappa University, Karaikudi, Tamilnadu, India. She has received her MCA from Alagappa University, Karaikudi, Tamilnadu in the year of 2011. She has presented her work in national level conferences. Her areas of research interests include Image Processing, Image Compression.

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