A Research on Image Processing using Digital Image Compression Technique

Isha Shokeen[1], Mr. Puneet Sharma[2]

[1]M. Tech. Scholar, CSE Department, Sat priya group of institute, Rohtak Haryana
[2]Asst. Professor CSE Department, Sat priya group of institute, Rohtak, Haryana

Abstract: Digital images are needed in various applications, such as transmission of images over communication channels varying widely in their bandwidths, display at different resolution depending on the resolution of a display device, etc. In this work, we are trying to do something different what they (Dugad and Ahuja) done in their algorithms for image compression. We are also try to extend their approach and modified versions to images and studied their performances at different level of compression for an image. The Discrete Cosine Transform (DCT) is an example of transform coding. The current JPEG standard uses the DCT as its basis. The relocates the highest energies to the upper left corner of the image. The lesser energy or information is relocated into other areas. The DCT is fast. It can be quickly calculated and is best for images with smooth edges like photos with human subjects. The Inverse Discrete Cosine Transform (IDCT) can be used to retrieve the image from its transform representation.

Index Terms: **MATLAB R2010a (version7.10.0) platform.**

1. Introduction

Every day, an enormous amount of information is stored, processed and transmitted digitally. Companies provide business associates, investors and potential customers with financial data, annual reports, investors and product information over the data. Because much of this on-line information is graphical or pictorial in nature, the storage and communication is immense. Methods of compressing the data prior to storage and or transmission are of significant practical and commercial interest. Image compression addresses the problem of reducing the amount of data required to represent a digital image. The underlying basis of the reduction process is the removable of redundant data. From the mathematical view point, this amounts to transforming a2-D pixel array into a statistically uncorrelated data set. The transformation is applied prior to storage or transmission of the image. At some later time, the compressed image is decompressed to reconstruct the original image or an approximation of it. Uncompressed multimedia (graphics, audio and video) data requires considerable storage capacity and transmission bandwidth. 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 outstrips the capabilities of available technologies. The recent growth of data intensive multimedia based web applications have not only sustained the need for more efficient ways to encode signals and images but have made compression of such signals central to storage and communication technology.

While most research on multimedia applications has focused on compression standards, synchronization issues, storage representations: and little work has been reported on techniques for manipulating digital data in real time. But the problems we would encounter is implementing this approach on current workstations would stem from two sources [10]:

i) the volume of data to be manipulated (26.3 Mbytes per second for uncompressed640x480 24-bit video at 30 frames per second)

ii) and the computational complexity of image compression and decompression. For that we need to perform the operations directly on the compressed data. A common way to exploit the latter property is to quantize the coefficients. For that the four basic algebraic operations are, i) Scalar Addition, ii) Scalar Multiplication,

 iii) Pixel-Wise Addition, iv) and Pixel-Wise Multiplication [10].

Many advanced video applications require manipulations of compressed video signals. Specifically, we focus on some efficient compression algorithms in transform domain like discrete cosine transform (DCT) with or without motion compensation (MC) which is useful in many video manipulation functions such as overlapping, translation, scaling, pixel multiplication, rotation, and linear filtering. These algorithms can be applied to general Orthogonal Transforms,

like DCT, DFT, and DST. The proposed transform-domain approach can increase the computation efficiency. This new decoding algorithm can also be applied to efficiently from MPEG to JPEG [11]. However, DCT is well known for its highly efficient coding performance but in low bitrate coding, it produces undesirable block artifacts that are visually not pleasing. We investigate a modified DCT computation scheme, to be called the subband DCT (SB-DCT), that provides a simple, efficient solution to the reduction of the block artifacts while achieving faster computation. The PSNR is enhanced and blocking artifacts are reduced, the SB-DCT will achieve better compression than conventional DCT-based coding [5].

2. Literature Analysis

The DCT being a linear unitary transform is distributive over matrix multiplication. The earlier approaches to down sampling in the compressed domain start with the problem stated in the time domain and then carry out its equivalent operation in the compressed domain. But the down sampling operation directly in the compressed domain leads to computationally much faster algorithms [12]-[13].The down sampled image obtained by this method contains all the low-frequency DCT-coefficients of the original image. This in turn, implies that one can obtain an up sampled image by prediction for the original image. This contains all the low-frequency DCT-coefficients of the original image from the down sampled image [13]. In 2002, Dugad and Ahuja have developed an elegant computational model for converting the DCT blocks of an image to the DCT blocks of its reduced version. Similarly, for image doubling, they could directly convert its DCT blocks to the DCT blocks of the enlarged version. These conversions could be performed by multiplying the blocks with a given set of matrices and finally adding the intermediate results to the final DCT representations [4]. In 2008, LeiWang, JiajiWu, Licheng Jiao, Li Zhang and Guangming Shi proposed a scheme which they called Reversible Integer Discrete Cosine Transform (RDCT). Which is derived from the matrix factorization theory? In this case PSNR of RDCT based method is higher. Three basic data redundancies can be categorized in the image compression standard.

1. Spatial redundancy due to the correlation between neighbouring pixels.
2. Spectral redundancy due to the correlation between the colour components.
3. Psycho-visual redundancy due to properties of human visual system. The spatial and spectral redundancies are present because certain spatial and spectral patterns between the pixels and the color components are common to each other, whereas psycho-visual redundancy originates from the fact that the human eye is in-sensitive to certain spatial frequencies. The principle of image compression algorithms are
 1.) reducing the redundancy in the image data and (or)
 2.) producing a reconstructed image from the original image with the introduction of error i.e. insignificant to the intended applications. The aim here is to obtain and acceptable representation of digital image while preserving the essential information contained in that particular data set.
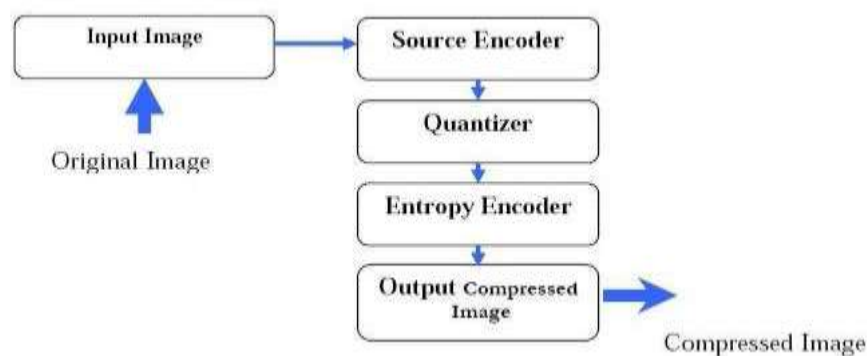

Figure 1: Flow Chart

First the original digital image is usually transformed into another domain where itis highly de-correlated by using some transform. This de-correlation concentrates the important image information into a more compact form. The compressor then removes the redundancy in the transformed image and stores it into a compressed file or data stream. In the second stage, quantization block reduces the accuracy of the transform output in accordance with some pre - established fidelity criterion. Also this stage reduces the psycho-visual redundancy of the input image. Quantization operation is a reversible process and thus may be omitted when there is a need of error free or lossless compression. In the final stage of the data compression model the symbol coder creates a fixed or variable length code to represent the Quantized output and maps the output in accordance with the code. Generally a variable length code is used to represent the mapped and quantized data set. It assigns the shortest code words to the most frequently occurring output values and thus reduces coding redundancy. The operation in fact is a reversible one. The decompression reverses the

compression process to produce the recovered image. The recovered image may have lost some information due to compression, and may have an error distortion compared to the original image [1].

3. Image Compression Models

A compression system consists of two distinct structural blocks: an Encoder and Decoder. An input image is f(x; y) is fed into the encoder, which creates set symbols from the input data. After transmission over the channel, the encoded representation is fed to the decoder where a reconstructed output image ^ f(x; y) is generated. In general, ^f(x; y) may or may not be an exact replica of f(x; y). If it is, the system is error free or information preserving; if not, some level of distortion is present in the reconstructed image.

Both the encoder and decoder shown consist of two relatively independent functions or sub blocks. The encoder is made up of source encoder, which removes input redundancies, and a channel encoder, which increases the noise immunity of the source encoder's output. As would be expected, the decoder includes a channel decoder followed by channel decoder. If the channel between the encoder and decoder is noise free(not prone to error), the channel encoder and decoder are omitted, and the general encoder and decoder become the source encoder and decoder, respectively.
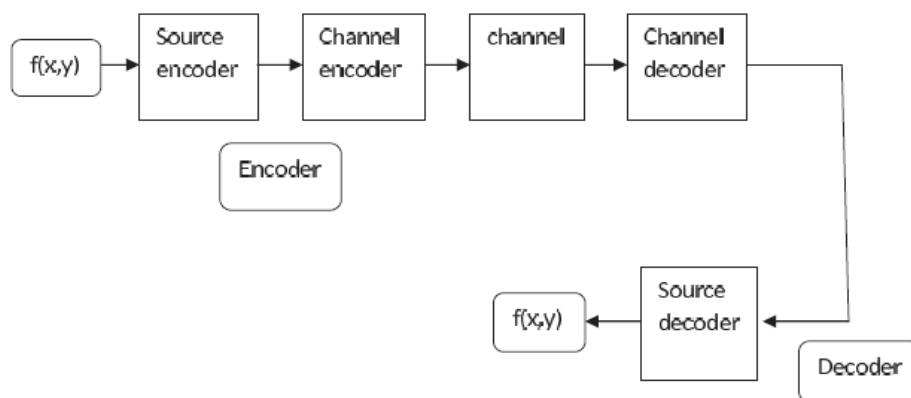

Figure 2: A general compression system model

4. Simulation and Results

To support analytical results, has been conducted in two-dimensional DCT for which we follow the steps as shown in first algorithm fig. (3). On the basis of performance parameter that is slightly higher PSNR and less compression ratio in second, algorithm for Image Compression using Sub band DCT and Direct Quantization Matrix gives the better results as compare to the first, algorithm which is, algorithm for Image Compression using Direct Quantization Matrix.
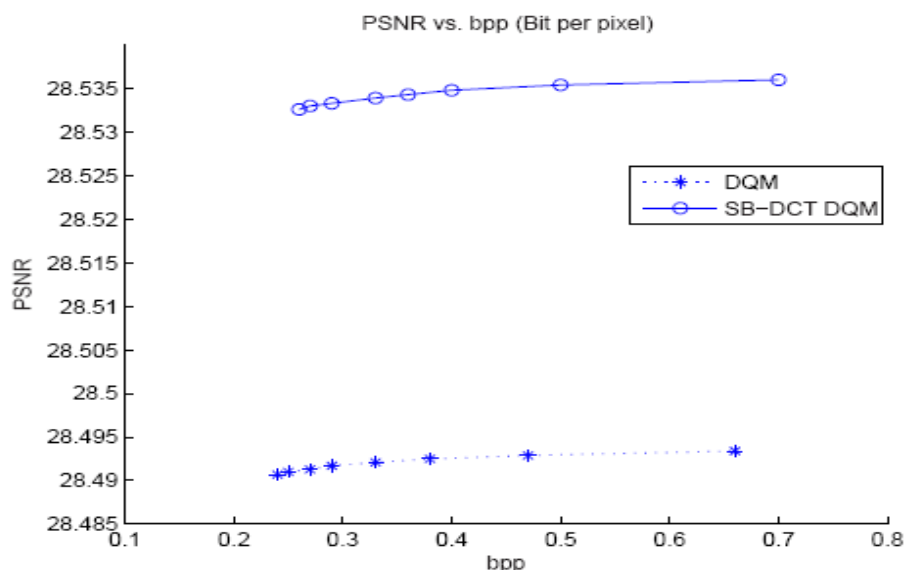

Figure 3: Plot for PSNR vs. bpp

In fig.4, Rician channel is used for comparison with different modulation techniques. We can see in above fig.3 that at particular 10^{-3} BER, SNR is 12.8dB when user is 1; SNR is 15.7dB when users are 2; SNR is 18.8dB when users are 8. It has been observed that there is constantly increase in SNR value i.e. 3dB when users are increasing.
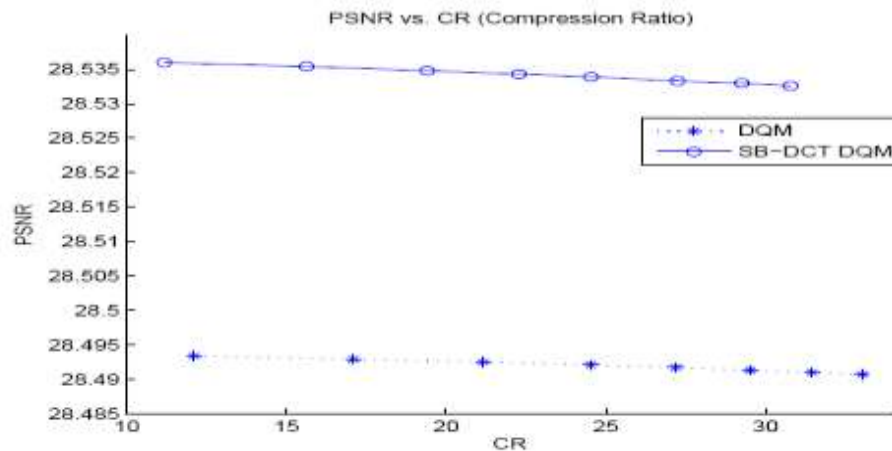

Figure 4: Plot for PSNR vs. CR

Conclusions

In this thesis we proposed, modifications to the algorithms proposed by Jayanta Mukherjee and Sanjit K. Mitra are suggested. With the proposed modifications we found that results are improved visually in many cases. This thesis proposed two algorithms for image compression in which we set a thresh-old which we can vary it very easily. And it should be studied that the proposed modifications considerably increase the computation faster than using simply dct2. But our prime importance is image compression in real time applications like video conferencing where data are transmitted through a channel. Using JPEG standard DCT is used for mapping which reduces the interpixel redundancies followed by quantization which reduces the psycho-visual redundancies.

References

[1]. Rafael C. Gonzalez and Richard E. Woods " Digital Image Processing", 2nd Edition, PHI Publications, New Jersey U.S.A., 2011.
[2]. Tamal Bose, " Digital Signal And Image Processing", John Wiley & Sons Inc.,New Jersey U.S.A., 2004.
[3]. Anil K. Jain "Fundamentals of Digital Image Processing", PHI Publications, New Jersey U.S.A., 1989.
[4]. Jayant Mukherjee and Sanjit K. mitra, "Image Resizing in the Compressed DomainUsing Subband DCT", IEEE TRANSACTIONS ON CIRCUITS AND SYSTEM FOR VIDEO TECHNOLOGY, VOL. 12, NO. 7, JULY 2010.
[5]. Sung-Hwan Jung, Sanjit K. mitra and Debargha Mukherjee, "Subband DCT : Defination, Analysis and Applications", IEEE TRANSACTIONS ON CIRCUITS AND SYSTEM FOR VIDEO TECHNOLOGY, VOL. 6, NO. 3, JUNE 1996.
[6]. Qingwen Hu and Sethuraman Panchanathan, Senior Member, IEEE "Image/Video Spatial Scalability in Compressed Domain, IEEE TRANSACTIONS ON INDUS- TRIAL ELECTRONICS, VOL. 45, NO. 1, FEBRUARY 2012.
[7]. Rafael C. Gonzalez, Richard E. Woods and Steven L. Eddins "Digital Image Processing Using MATLAB", Pearson Education, First Indian Reprint, 2004.
[8]. Sanjit K. Mitra "Digital Signal Processing", 3rd Edition, Tata McGraw-Hill, Special Indian Edition, 2008.
[9]. Rudra Pratap "Getting Started With MATLAB 7 ", OXFORD UNIVERSITY, PRESS, Indian Edition, 2007.