### Lossy Image Compression Using DCT

**Darshan Gandhi 1611069**

**Rushabh Chheda 1611070**

**Nipun Iyer 1611081**

1. **Abstract**

Due to the increasing requirements for transmission of images in computer, mobile environments, the research in the field of image compression has increased significantly. Image compression plays a crucial role in digital image processing, it is also very important for efficient transmission and storage of images. When we compute the number of bits per image resulting from typical sampling rates and quantization methods, we find that Image compression is needed. Therefore development of efficient techniques for image compression has become necessary .This paper is a survey for lossy image compression using Discrete Cosine Transform, it covers JPEG compression algorithm which is used for full-colour still image applications and describes all the components of it.

**2.Introduction**

Lossy data compression has of course a strong negative connotation and sometimes it is doubted quite emotionally that it is at all applicable in medical imaging. However, please note that many imaging systems for angiography primarily acquire images as a 1024\*1024 pixel matrix while they transfer only 512\*512 pixels per image to local storage and to exchange media. In this step, part of the image information is irreversibly lost. So this is an example for a method of data compression that is lossy but that provides a digital image recording format that is presently widely accepted in cardiology. Therefore, instead of banning lossy compression in general, we should discuss objective criteria for the acceptability of specific methods of lossy data compression in coronary angiography.

We all know different strategies for tolerable lossy data reduction also from daily life. For instance, nobody will read all the information offered in a newspaper, so the overall process of information distribution by newspapers is an example of lossy information handling. The first step in this traditional type of ‘information processing’ occurs when the editors divide the incoming events into groups such as world politics, economy, local affairs, and sports. Each of these groups is presented on one (or several) specific pages of the newspaper. Moreover, on each of these pages, large headings draw the attention to those topics that are most important. Note that this first step of the overall process is essentially lossless.

By entering the Digital Age, the world has faced a vast amount of information. Dealing with this vast amount of information can often result in many difficulties. We must store, retrieve, analyze and process Digital information in an efficient way, so as to be put to practical use. In the past decade many aspects of digital technology have been developed. Specifically in the fields of image acquisition, data storage and bitmap printing. Compressing an image is significantly different than compressing raw binary data. Images have certain statistical properties which can be exploited by encoders specifically designed for them so, the result is less than optimal when using general purpose compression programs to compress images. One of many techniques under image processing is image compression. Image compression have many applications and plays an important role in efficient transmission and storage of images. The image compression aims at reducing redundancy in image data to store or transmit only a minimal number of samples And from this we can reconstruct a good accession of the original image in accordance with human visual perception.

**3.Methodology**

Image Compression addresses the problem of reducing the amount of data required to represent the digital image. We can achieve compression by removing of one or more of three basic data redundancies:

1) Spatial Redundancy or correlation between neighboring pixel.

2) Due to the correlation between different colour planes or spectral bands, the Spectral redundancy is founded.

(3) Due to properties of the human visual system ,the Psycho-visual redundancy is founded.

We find The spatial and spectral redundancies when certain spatial and spectral patterns between the pixels and the colour components are common to each other and the psycho-visual redundancy produces from the fact that the human eye is insensitive to certain spatial frequencies.

Various techniques can be used to compress the images to reduce their storage sizes as well as using a smaller space.

We can use two ways to categorize compression techniques.

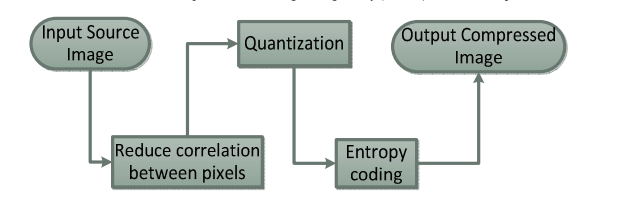
1)Lossy Compression System

Lossy compression techniques is used in images where we can sacrifice some of the finer details in the image to save a little more bandwidth or storage space.

2)Lossless compression system Lossless Compression System aims at reducing the bit rate of the compressed output without any distortion of the image. The bit-stream after decompression is identical to the original bitstream.

3)Predictive coding It is a lossless coding method, which means the value for every element in the decoded image and the original image is identical to Differential Pulse Code Modulation (DPCM).

4)Transform coding Transform coding forms an integral part of compression techniques. the reversible linear transform in transform coding aims at mapping the image into a set of coefficients and the resulting coefficients are then quantized and coded. the first attempts is the discrete cosine transform (DCT) domain

****

Three closely connected components form a typical lossy image compression system, they are (a) Source Encoder (b) Quantizer and (c) Entropy Encoder.

(a) Source Encoder (or Linear Transformer) It is aimed at decorrelating the input signal by transforming its representation in which the set of data values is sparse, thereby compacting the information content of the signal into smaller number of coefficients. a variety of linear transforms have been developed such as Discrete Cosine Transform (DCT), Discrete wavelet Transform (DWT), Discrete Fourier Transform (DFT)

(b) Quantizer Aquantizer aims at reducing the number of bits needed to store transformed coefficients by reducing the precision of those values. Quantization performs on each individual coefficient i.e. Scalar Quantization (SQ) or it performs on a group of coefficients together i.e. Vector Quantization

(c) Entropy Coding Entropy encoding removes redundancy by removing repeated bit patterns in the output of the Quantizer. the most common entropy coders are the Huffman Coding, Arithmetic Coding, Run Length Encoding (RLE) and Lempel-Ziv (LZ) algorithm

DCT TRANSFORMATION

The most popular technique for image compression, over the past several years, was Discrete cosine transform (DCT). Its selection as the standard for JPEG is One of the major reasons for its popularity. DCT is used by many Non-analytical applications such as image processing and signal-processing DSP applications such as video conferencing. The DCT is used in transformation for data compression. DCT is an orthogonal transform, which has a fixed set of basis function.Dct is used to map an image space into a frequency.

DCT has many advantages:

(1) It has the ability to pack energy in the lower frequencies for image data.

(2) It has the ability to reduce the blocking artefact effect and this effect results from the boundaries between sub-images become visible

**4.Performance Criteria in Image Compression**

We can estimate the performance by applying the following two essential criteria: the compression ratio (CR )and the quality measurement of the reconstructed image( PSNR)

(a) Compression ratio The Compression ratio (CR) is the ratio between the original image size and the compressed image size.

CR = n1/n2

(b) Distortion measure Mean Square Error (MSE) is a measure of the distortion rate in the reconstructed image.



(c) PSNR has been accepted as a widely used quality measurement in the field of image compression.

****

**5. Conclusion**

Image compression is used for managing images in digital format. This survey paper has been focused on the Fast and efficient lossy coding algorithms JPEG for image Compression/Decompression using Discrete Cosine transform. We also briefly introduced the principles behind the Digital Image compression and various image compression methodologies .and the jpeg process steps including DCT, quantization , entropy encoding.

**6. References**

**1)**<http://www.uni-kiel.de/Kardiologie/dicom/1999/compression1.html>

2)<https://en.wikipedia.org/wiki/Discrete_cosine_transform>

3)<https://users.cs.cf.ac.uk/Dave.Marshall/Multimedia/node231.html>

4)<http://www.svcl.ucsd.edu/courses/ece161c/handouts/DCT.pdf>

5)<https://arxiv.org/pdf/1405.6147.pdf>

6)<https://in.mathworks.com/mwaccount/profiles/incomplete?uri=https%3A%2F%2Fwww.mathworks.com%2Fhelp%2Fimages%2Fdiscrete-cosine-transform.html>

7)<https://www.math.cuhk.edu.hk/~lmlui/dct.pdf>