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AN OVERVIEW OF DIFFERENT METHODS OF DIGITAL IMAGE COMPRESSION OF MEDICAL IMAGES

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ABSTRACT
Digital image in raw form which require large amount of storage capacity. Data compression may be performed to facilitate transmission and storage. The type of medical image and the objective of the study will determine the degree of acceptable compression depending on the reconstructed image, to be exactly same as the original or some unidentified loss may be incurred, two techniques for compression exist lossless and lossy. If compression is used, algorithms recommended by the DICOM standard such as wavelet or JPEG-2000 compression methods should be used. This paper also an overview of DWT and DCT implementation because these are the lossy techniques and also introduce Huffman encoding technique which is lossless. At last implement lossless technique so our PSNR and MSE will go better than the old algorithms and due to DWT and DCT we will get good level of compression and maintains the image quality. The types and ratios of compression used for different imaging studies transmitted and stored by the system.

INTRODUCTION
Compression refers to reducing the quantity of data used to represent a file, image content without excessively reducing the quality of the original data. It also reduces the number of bits required to store and/or transmit digital media. To compress something means that you have a piece of data and you decrease its size. JPEG is the best choice for digitized photographs. The Joint Photographic Expert Group (JPEG) system, based on the Discrete Cosine Transform (DCT),

A. DISCRETE COSINE TRANSFORM (DCT): It has been the most widely used compression method [1][2]. In DCT image data are divided up into n*m number of block. DCT converts the spatial image representation into a frequency map: the average value in the block is represented by the low-order term, strength and more rapid changes across the width or height of the block represented by high order terms. DCT is simple when JPEG used, for higher compression ratio the noticeable blocking artifacts across the block boundaries cannot be neglected. The DCT is fast. It can be quickly calculated and is best for images with smooth edges. JPEG and JPEG-2000 irreversible compression in medical imaging. The impact of JPEG and JPEG-2000 irreversible compression at "safe" compression ratios.

B. DISCRETE WAVELET TRANSFORM (DWT): It has gained widespread acceptance in signal processing and image compression. Huffman coding is a statistical lossless data compression technique. Huffman coding is based on the frequency of pixel in images.

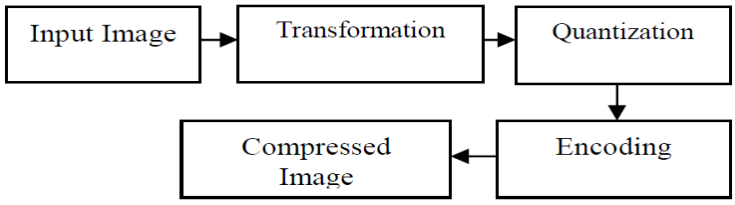


Fig 1.1 Basic Image Compression Block Diagram

There are 2 types of image compression: Reversible Compression and Irreversible compression.

i. REVERSIBLE COMPRESSION (LOSSLESS):
Upon decompression, the image is perfectly reconstructed and numerically identical to the original (i.e. the original and decompressed are perfectly correlated). Run-length encoded (RLE), low-ratio JPEG and the new JPEG lossless compression standard (JPEG-LS) algorithms are examples of lossless compression.

ii. IRREVERSIBLE COMPRESSION (LOSSY):
With irreversible compression, data are discarded during compression and cannot be recovered. Upon compression frequency content to which the human eye is insensitive is removed. Upon decompression, the discarded information cannot be recovered, resulting in some reconstruction interpretation. Consequently, the original image is not identical to the decompressed version. Wavelet and Irreversible JPEG are examples of irreversible compression. JPEG-2000 is a progressive lossless to lossy compression algorithm.

iii. COMPRESSION RATIO:

A compression ratio is the average number of bits per pixel (bpp) before compression divided by the number of bits per pixel after compression. For example, if an 8 bit image is compressed and each pixel is then represented by 1 bit per pixel, the compression ratio = 8/1 = 8. Or equivalently for a 24 bit image, if the compression ratio = 18, the compressed image will have 24/18 = 1.33 bpp. Standards for Irreversible Compression in Digital Diagnostic Imaging within Radiology. There are principally 2 types of irreversible digital compression methods used in medical imaging: DICOM JPEG and DICOM Wavelet (JPEG 2000).

Types of irreversible digital compression

a) DICOM JPEG

The Joint Photographic Experts Group (JPEG) created the JPEG standard for compression of digital images. The JPEG standard was adopted by both the International Standards Organization (ISO) and International Telegraph Union Telecommunications standards sector (ITU-T) as ISO/IEC 10918-1 and ITU-T Recommendation T.81 respectively. JPEG is the most commonly used method for compression of digital images. DICOM Version 3.0 supports the use of JPEG Image Compression. JPEG reduces the size of an image by breaking it into 8x8 blocks and within each block, shifting and simplifying the colors so there is less information to encode.

b) DICOM JPEG 2000

JPEG-2000 is a new image coding system that uses state-of-the-art compression techniques based on wavelet technology. The JPEG-2000 standard was adopted by ISO as ISO/IEC 15444-1 (JPEG 2000), for digital compression and coding of continuous-tone still images. JPEG-2000 was added to the DICOM Version 3.0 supplement 61 as an Encapsulation Format in 2002.

JPEG2000 is a wavelet-based compression algorithm that offers superior compression performance over JPEG at moderate compression ratios. The end result is a much better image quality. With DICOM JPEG-2000 there are no blocking artifacts as evident with JPEG, however at high levels of compression the image appears blurred.

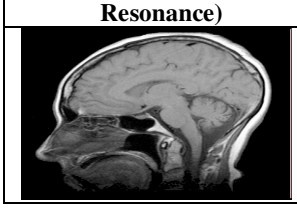
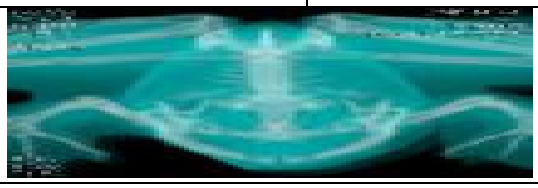
c. DICOM JPEG AND DICOM JPEG-2000 COMPARISON

JPEG-2000 offers many benefits over JPEG:

1. Efficient irreversible and reversible compression within a single unified coding framework.
2. JPEG-2000 supports 24 bit color, and 8, 12 and 16 bit grayscale image data and is the only 16-bit grayscale irreversible compression supported in DICOM.
3. Multiple resolutions within the same compressed image. This allows compressed images to be sent at the best resolution for a particular device without additional storage overhead.
4. Progressive transmission by pixel accuracy and resolution (progressive rendering). This allows for thumbnails and rapid image display at lower resolutions.

MEDICAL IMAGES AND MODALITIES

a) MEDICAL IMAGES: There are different types of medical images like

MRI / FMRI (Function Magnetic Resonance)	Dynamic 3D Ultrasound	PET(Positron emission Tomography)	CT (computerized Tomography)
			

b) DIFFERENT MODALITIES:

i. COMPUTED RADIOGRAPHY / DIGITAL RADIOGRAPHY (CR/DR) : The standard defines the following irreversible compression ratios for CR/DR imaging categories.

ii. COMPUTED TOMOGRAPHY (CT): The standard defines the following irreversible compression ratios for CT imaging categories with a slice thickness of 5mm or greater

iii. ULTRASOUND (US) : The standard defines the following irreversible compression ratios for US imaging categories.

iv. MAGNETIC RESONANCE (MR) : The standard defines the following irreversible compression ratios for MR imaging categories.

v. NUCLEAR MEDICINE (NM)

c) CHALLENGES UNIQUE TO MEDICAL IMAGES: Growing need for storage, Efficient data transmission, Telemedicine, Tele-radiology applications, Real time Tele-consultation, PACS (Picture archiving and communication systems), Compression Algorithms, Lossy / Lossless, Medical Images should always be stored in lossless format, Erroneous Diagnostics and its legal implications.

PARAMETERS TO ANALYZE

All the techniques are the algorithm developed for medical image compression an we can analyze following parameters mainly. To calculate MSE,PSNR,CR is the objective of this Hybrid (DWT,DCT and Huffman coding) scheme. Mean Square Error (MSE), Compression Ratio (CR),Peak Signal to Noise Ratio (PSNR).

The goal is to achieve higher compression ratio while preserving the quality of reconstructed image. The presented hybrid DWT, DCT algorithm for medical image compression is to exploit the properties of both the DWT and DCT take the different medical image size175 kb.

1. MSE: Mean-Square Error: The MSE represents the cumulative squared error between the compressed and the original image. The lower the value of MSE, the lower the error. To compute the PSNR, the block first calculates the mean squared error using the following equation. $MSE = \sum_{i=1}^{x}\sum_{j=1}^{y}(Aij - Bij)^2/x * y$

Where, x: Width of image. y: Height. x*y: number of pixels (or quantities). i:Coloumn J: Rows

2. PSNR (Peak Signal to Noise Ratio): The PSNR computes the peak signal to noise ratio, in decibels between two images. This ratio is often used as a quality measurement between the original and a compressed image. The higher the PSNR, the better the quality of the compressed or reconstructed image. PSNR is generally used to analyze quality of image, sound and video files in dB (decibels).PSNR (dB) = $10*\log\left(\frac{255^2}{MSE}\right)$

3. CR (Compression Ratio):

CR= $\frac{\text{Size of original Image}}{\text{Size of compressed image}}$

CONCLUSIONS

In this paper, includes mainly on the various types of medical image compression techniques and analyzing parameters that are existing and putting it together for literature survey. In these techniques unique characteristics is used to compress medical image. All compression techniques are useful medical image transmission and storage. Everyday new compression technique is evolving selection of high PSNR value will lead to maintain the quality of the image and success in compression process.

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