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CONTENTS

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   RESULTS & DISCUSSION

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A MEDICAL IMAGE COMPRESSION TECHNIQUE

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ABSTRACT
This paper addresses the area of the image compression of medical images. An approach to compress the medical set of images is presented here. The proposed work aimed at the compression of DICOM images. DICOM is a standard for handling, storing, printing and transmitting information in Medical Imaging. These medical images are volumetric consisting of a series of sequence of slices through a given part of the body. In the proposed algorithm, DICOM (Digital Imaging and Communications in Medicine) Images are decomposed using Haar Wavelet transform, the wavelet co-efficient are encoded using SPIHT (Set Partioning In Hierarchial Trees). The quality of the images are evaluated by various quality measures at various bit rates and decomposition levels.

KEYWORDS
Medical Images, DICOM (Digital Imaging and Communications in Medicine, HAAR Wavelet, Set Partioning in Hierarchial Trees(SPIHT), DICOM Previewer, X-ray Images.

INTROUCTION
Visual Communication plays a vital role in today's environment in several areas such as Communication, Multimedia, Transmission, Storage of remote sensing images, Education and Business Documents, and Medical Images etc. In Medical environment, storing and retrieial of large set of images (e.g the factors of Volumetric data sets, Sequence of images, image databases) makes the Compression essential.

Image Compression is the changing field with different kinds of methods. Images can be compressed by using two different kinds of compression techniques, Lossy (or) Lossless Compression Techniques. Lossy Compression technique doesnot give the exact recovery of the images whereas Lossless Compression gives the exact replication of images.

In Compression of images, JPEG and Wavelet Compression methods are most popular methods recommended by Medial Community. In Lossless Compression, JPEG Image Compression is the Standard Method. Wavelet Compression has been proved to be very effective in the field of Medical Imaging.

Two Component algorithm, CDF and SPIHT combination is used to compress the MRI images very effectively. This paper brings out the compression of images using Haar Wavelet and SPIHT. A set of X-ray images are used for experiments. The Discrete Wavelet Tranform of the image is calculated by Haar Wavelet Transform. The decomposed wavelets are encoded by SPIHT. This method gives the better compression ration compared with other standard methods.

The various picture quality measures, Mean Squared Error (MSE), Peak Signal to Noise Ration (PSNR), Average Difference (AD), Structural Content (SC) atre used to study the performance of the compression in this method.

This paper is organized as follows: Section 2 discuss brief review of medical image compression. In Section 3, Overview of wavelets is discussed. Section 4 gives Haar Wavelet Transform. Section 5 describes about SPIHT Coder. Section 6 presents the proposed coding method for a set of DICOM images, X-Ray images. Section 7 shows the experimental results of the proposed methods. Section 8 discusses the performance of compression by this method using various X-ray images. Section 9 gives the Conclusion.

DICOM IMAGES
DICOM (Digital Imaging and Communications in Medicine) is a standard for handling, storing, printing, and transmitting information in medical imaging. DICOM differs from some, but not all, data formats in that it groups information into data sets. That means that a file of a chest X-Ray image, for example, actually contains the patient ID within the file, so that the image can never be separated from this information by mistake. This is similar to the way that image formats such as JPEG can also have embedded tags to identify and otherwise describe the image.

A DICOM data object consists of a number of attributes, including items such as name, ID, etc., and also one special attribute containing the image pixel data (i.e. logically, the main object has no "header" as such: merely a list of attributes, including the pixel data). A single DICOM object can only contain one attribute containing pixel data. For many modalities, this corresponds to a single image. But note that the attribute may contain multiple "frames", allowing storage of cine loops or other multi-frame data.

MEDICAL IMAGE COMPRESSION
Medical Image Compression plays a vital role in the hospitals in many applications. It helps PACS to reduce the file Sizes on their Storage and Retrieving Process. A typical 16 bit mammogram image may be 4500 pixels by 4500 pixels in dimensionfor a file size of 40 megabytes. This makes larger storage space, finds difficult in transmitting the images over the network (i.e from one hospital to another to get the diagnostic procedure). The combination of improvement in technology and suitable image compression techniques makes the process easier and safer in the Medical Imaging. The 3-D Medical data sets needs efficient image compression, solving the transmission problems.

Most of the algorithms exist are focused on the lossless methods as the medical community is reluctant to adopt lossy techniques owing to the legal and regulatory issues that are raised. The existing compression algorithms focused on the medical image are JPEG and Wavelets. The JPEG is adopted by the DICOM group in DICOM image File Format, but wavelet compression algorithm is getting popular. The different wavelet compression algorithms are, Said and A. Pearlman developed a SPIHT coding algorithm, a refined version of embedded zero tee wavelet coder(EZW), A. R. Golderbank, Ingrid Daubechies, Wim Sweldens and Boon-Lock Yeo developed Lossless Image Compression using Integer to Integer wavelet transforms, K. Vidhya and S. Shenbagadevi developed two component medical image compression algorithm using CDF and SPIHT.

HAAR WAVELET

It is the simplest orthonormal wavelet which is best in terms of memory consumption and despite other wavelets without any influence of edge, is completely recursive. Haar wavelet does not possess overlap windows and only reflects the changes between two adjacent pixels.

It uses just two functions as scale and wavelet; it calculates average and difference of a pair. Each step in the forward haar transform calculates a set of wavelet coefficients and a set of averages. If a data set contains n elements, there are n/2 averages and n/ 2 coefficient values. Scaling and Wavelet functions for haar wavelet are given in (1) & (2) respectively. Where So to Sn_1 are image data, a is averaging, d is differencing.

$a = (S_i + S_{i+1}) / 2$ ----------(1)

$d = (S_i - S_{i+1}) / 2$ ----------(2)

Haar average is calculated by the scaling function and coefficient is calculated by the wavelet function. Haar wavelet operates first on adjacent horizontal elements and then on adjacent vertical elements. As each transform is computed the energy in the data is relocated to the top left hand comer. After each transformation the dimensions of resulted image cut into two halves.

SPIHT CODER

SPIHT technique is based on a wavelet transform and differs from conventional wavelet compression only in how it encodes the wavelet coefficients. SPIHT is based on three concepts:

(1) Exploitation of the hierarchical structure of thewavelet transform by using tree-based organization of the coefficients,

(2) Partial ordering of the transformed coefficients by magnitude,

(3) Ordered bit plane transmission of refinement bits for the coefficient values.

PROPOSED ALGORITHM

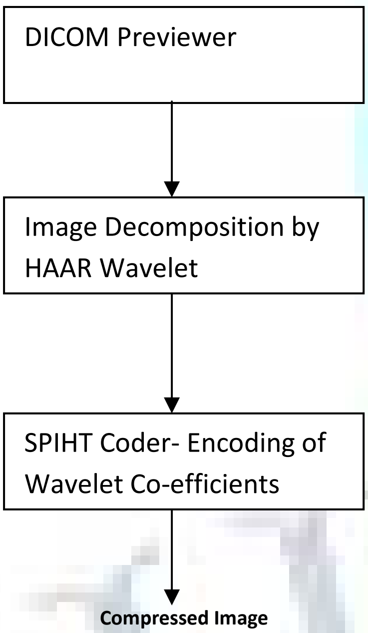
The previewer gives a list of files from a selected directory. These medical images are volumetric consisting of a series of sequences of slices through a given part of the body. To maintain uniform quality for all sequences of slices a single slice is encoded and compressed bitstream is sent to the decoder. After the encoder and decoder finish all the slices in a sequence, it shifts to process the next sequence of slices. The block diagram of proposed method is shown in below. DICOM Images (X-ray) images are decomposed using Haar Wavelet Transform. The algorithm starts at the coarsest sub band in the sub band pyramid. SPIHT captures the current bitplane information of all the DWT coefficients and organizes them into three subsets:

(1) List of Significant Pixels (LSP),

(2) List of Insignificant Pixels (LIP) and

(3) List of Insignificant Sets of Pixels (LIS).

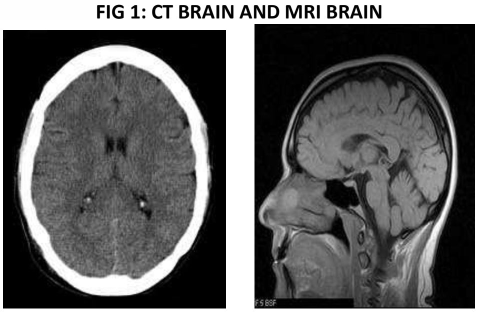
LSP constitutes the coordinates of all coefficients that are significant. LIS contains the roots of insignificant sets of coefficient. Finally, LIP contains a list of all coefficients that do not belong to either LIS or LSP and are insignificant. During the encoding process these subsets are examined and labeled significant if any of its coefficients has a magnitude larger than a given threshold. The significance map encoding (set partitioning and ordering pass) is followed by a refinement pass, in which the representation of significant coefficients is refined. These thresholds used to test significance are powers of two, so in its essence, the SPIHT algorithm sends the binary representation of the integer value of wavelet coefficients.



SIMULATION RESULTS

Medical Image compression is both a popular research problem in image compression and an important application in its own right. 8-bit 512x512 images were tested to evaluate the performance of the COMBINED TECHNIQUE OF Haar Wavelet and SPIHT. Fig1 and Fig 2 gives the input and the compressed image.

FIG 1: CT BRAIN AND MRI BRAIN



Haar Wavelet is used to decompose the image and SPIHT is used to compress the decomposed image. The standard objective measure of image quality PSNR is used to discuss the performance of the compression of medical images using this techniques. The PSNR value for the CT and MRI image is listed n the table.

S.No	PSNR
CT	39.2
MRI	36.1

CONCLUSION

A wavelet based compression with set partitioning in hierarchical trees brings out good performance in DICOM series of images for medical image compression. The statistical data shows that proposed algorithm brings better performance than standard compression algorithms. To study the performance, subjective measures PSNR is taken. The Proposed algorithm appears to give extremely good performance for medical image compression, and may be very useful in practical implementations of teleradiology and digital picture archiving and communications (PACS) systems.

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