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Comparison between different Compression and Decompression Techniques on MRI Scan Images

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Abstract— **The main objective of this paper is to distribute the medical images to different hospitals and among the staff of the same medical centre within short span of time and efficiently. A lot of hospitals handle their medical image data with computers. The use of computers and a network makes it possible to distribute the image data among the staff efficiently. As the health care is computerized new techniques and applications are developed, among them are the MR and CT techniques. MR and CT produce sequence of images (image stacks) each along the cross-section of an object. The amount of data produced by these techniques is vast and this might be a problem when sending the data over a network. To overcome this problem image compression has been introduced in the field of medical. Medical image compression plays a key role as hospitals, move towards film- less imaging and go completely digital compression. Image compression will allow Picture Archiving and Communication Systems (PACS) to reduce the file sizes on their storage requirements while maintaining relevant diagnostic information. To achieve higher degree of compression we have to selected lossy compression technique. This project is an approach to improve the performance of medical image compression while satisfying both the medical team who need to use it, and the legal team who need to defend the hospital against any malpractice resulting from misdiagnosis owing to faulty compression of medical images. This paper is focused on selecting the most appropriate wavelet function for a given type of biomedical image compression. In this project we studied the behavior of different type of wavelet function with different type of biomedical images and suggested the most appropriate wavelet function that can perform optimum compression for a given type of biomedical image. The wavelet function that gives the maximum compression for a specific type of biomedical image will be the most appropriate wavelet for that type of biomedical image compression.**

Index Terms—**Compression, Diagnostics, PACS, Wavelet Function**

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I. Introduction

In recent years, many studies have been made on wavelets. An excellent overview of what wavelets have brought to the fields as diverse as biomedical applications, wireless communications, computer graphics or turbulence. Image compression is one of the most visible applications of wavelets. The rapid increase in the range and use of electronic imaging justifies attention for systematic design of an image compression system and for providing the image quality needed in different applications. A typical still image contains a large amount of spatial redundancy in plain areas where adjacent picture elements (pixels, pels) have almost the same values. It means that the pixel values are highly correlated. In addition, a still image can contain subjective redundancy, which is determined by properties of a human visual system (HVS) [3]. An HVS presents some tolerance to distortion, depending upon the image content and viewing conditions. Consequently, pixels must not always be reproduced exactly as originated and the HVS will not detect the difference between original image and reproduced image. The redundancy (both statistical and subjective) can be removed to achieve compression of the image data. Higher compression ratios will produce lower image quality and vice versa. Quality and compression can also vary according to input image characteristics and content. Transform coding is a widely used method of compressing image information. In a transform-based compression system two-dimensional (2-D) images are transformed from the spatial domain to the frequency domain. An effective transform will concentrate useful information into a few of the low-frequency transform coefficients. An HVS is more sensitive to energy with low spatial frequency than with high spatial frequency. Therefore, compression can be achieved by quantizing the coefficients, so that important coefficients (low-frequency coefficients) are transmitted and the remaining coefficients are discarded. Very effective and popular ways to achieve compression of image data are based on the discrete cosine transform (DWT) and discrete wavelet transform (DWT).
Current standards for compression of still (e.g., JPEG) and moving images (e.g., MPEG-1, MPEG-2) use DWT, which represents an image as a superposition of cosine functions with different discrete frequencies . The transformed signal is a function of two spatial dimensions, and its components are called DWT coefficients or spatial frequencies. DWT coefficients measure the contribution of the cosine functions at different discrete frequencies. DWT provides excellent energy compaction, and a number of fast in recent years,

many studies have been made on wavelets. An excellent overview of what wavelets have brought to the fields as diverse as biomedical applications, wireless communications, computer graphics or turbulence. Image compression is one of the most visible applications of wavelets. The rapid increase in the range and use of electronic imaging justifies attention for systematic design of an image compression system and for providing the image quality needed in different applications.

A. *Magnetic Resonance Imaging*

MRI - images are similar to CT images except they show up the details of soft tissue better. MRI scans do not use X-rays but use a strong pulsed magnetic force to polarize cells - line up the (electrons) and measure the energy given off by the electrons when they bounce back into their normal orbits in-between pulses.

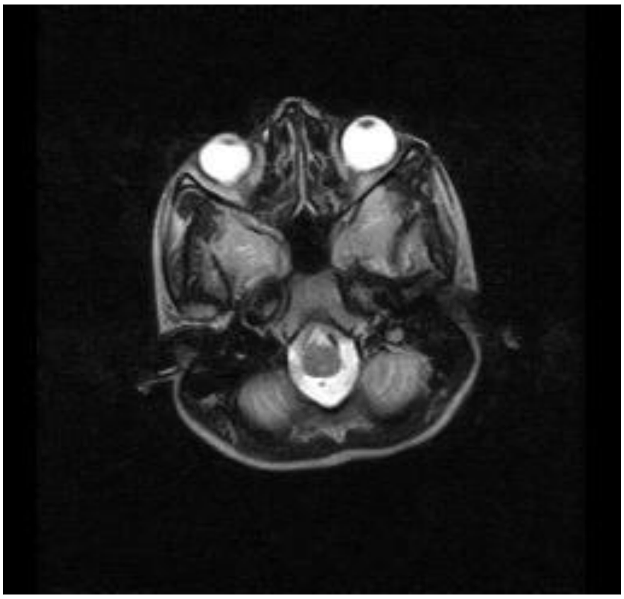


Fig. 1 MRI image

II. IMAGE COMPRESSION

Image compression is the process of encoding information using fewer bits (or other information-bearing units) than an encoded representation would use through use of specific encoding schemes. Compression is useful because it helps reduce the consumption of expensive resources, such as hard disk space or transmission bandwidth (computing). On the downside, compressed data must be decompressed, and this extra processing may be detrimental to some applications. For instance, a compression scheme for image may require expensive hardware for the image to be decompressed fast enough to be viewed as it's being decompressed (the option of decompressing the image in full before watching it may be inconvenient, and requires storage space for the decompressed image).

The design of data compression schemes therefore involves trade-offs among various factors, including the degree of compression, the amount of distortion introduced (if using a lossy compression scheme), and the computational resources required to compress and uncompress the data. Image compression is minimizing the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level. The reduction in file size allows more images to be stored in a given amount of disk or memory space. It also reduces the time required for images to be sent over the Internet or downloaded from Web pages.

A. *Lossy image compression*

A lossy compression method is one where compressing data and then decompressing it retrieves data that may well be different from the original, but is close enough to be useful in some way. Lossy compression is most commonly used to compress multimedia data (audio, video, still images), especially in applications such as streaming media and internet telephony. On the other hand lossless compression is required for text and data files, such as bank records, text articles, etc.

Lossy compression formats suffer from generation loss: repeatedly compressing and decompressing the file will cause it to progressively lose quality. This is in contrast with lossless data compression.

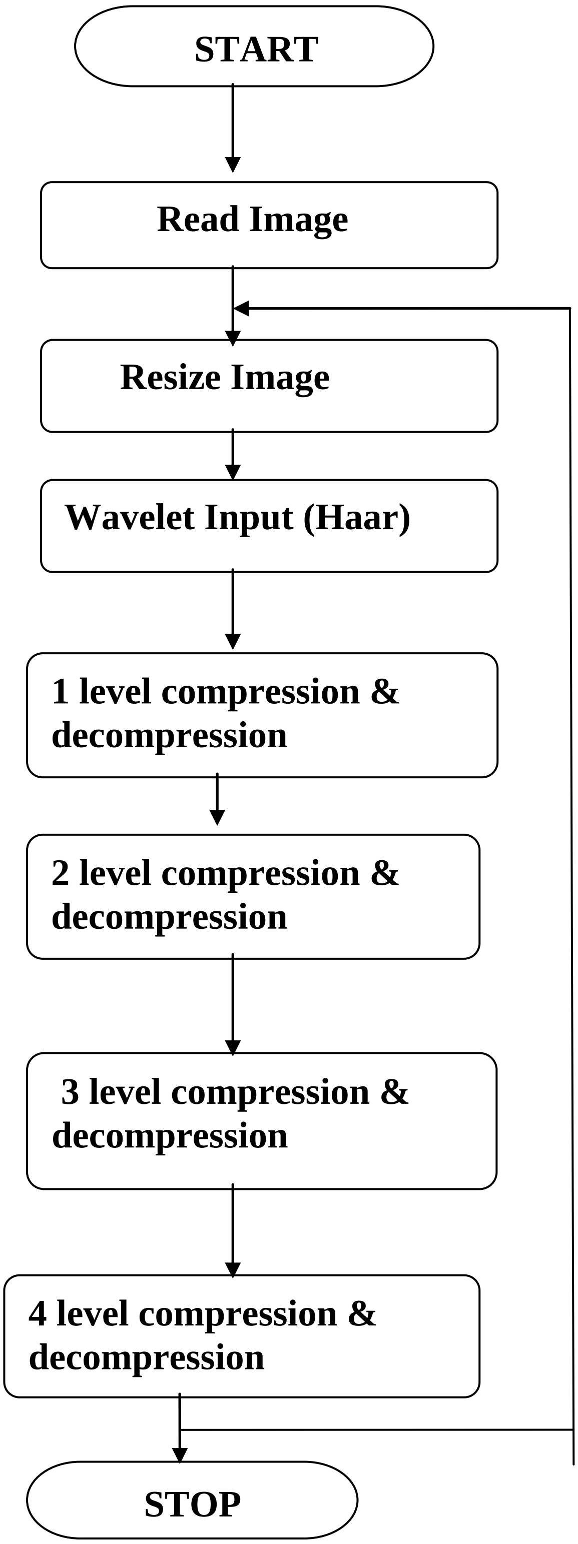
Information-theoretical foundations for lossy data compression are provided by rate-distortion theory. Much like the use of probability in optimal coding theory, rate-distortion theory heavily draws on Bayesian estimation and decision theory in order to model perceptual distortion and even aesthetic judgment.

B. *Lossless Image Compression*

Lossless or reversible compression refers to compression techniques in which the reconstructed data exactly matches the original. Lossless compression denotes compression methods, which give quantitative bounds on the nature of the loss that is introduced. Such compression techniques provide the guarantee that no pixel difference between the original and the compressed image is above a given value. It finds potential applications in remote sensing, medical and space imaging, and multispectral image archiving. In these applications the volume of the data would call for lossy compression for practical storage or transmission. However, the necessity to preserve the validity and precision of data for subsequent reconnaissance, diagnosis operations, forensic analysis, as well as scientific or clinical measurements, often imposes strict constraints on the reconstruction error. In such situations lossless compression becomes a viable solution, as, on the one hand, it provides significantly higher compression gains vis-à-vis lossless algorithms, and on the other hand it provides guaranteed bounds on the nature of loss introduced by compression.

Another way to deal with the lossy-lossless dilemma faced in applications such as medical imaging and remote sensing is to use a successively refinable compression technique that provides a bit stream that leads to a progressive reconstruction of the image. Using wavelets, for example, one can obtain an embedded bit stream from which various levels of rate and distortion can be obtained. In fact with reversible integer wavelets, one gets a progressive reconstruction capability all the way to lossless recovery of the original. Such techniques have been explored for potential use in tele-radiology where a physician typically requests portions of an image at increased quality (including lossless reconstruction) while accepting initial renderings and unimportant portions at lower quality, and thus reducing the overall bandwidth requirements. In fact, the new still image compression standard, JPEG 2000, provides such features in its extended form.

III. FLOW CHART



IV. STEPS INVOLVED IN COMPRESSING AND DECOMPRESSING OF IMAGE

Step 1: Firstly we will take the sample image.
Step 2: After that we will convert that image in 256*256 dimensions.
The number of rows in input image are = 256
The number of columns in input image are = 256
Step 3: Mention the wavelet to be used (Haar).
Step 4: We will do the 1 level compression & decompression
Step 5: We will do the 2 level compressions & decompression
Step 6: We will do the 3 level compressions & decompression
Step 7: We will do the 4 level compressions & decompression
Step 8: Similarly the above 4 steps will be repeated for the other three (Daubechies , Biorthogonal & Coiflets) wavelets.

V. RESULT AND DISCUSSIONS

In our study we have applied different Wavelet functions on different MRI scan images and have obtained 4 level compression & decompression of the images & calculated their compression ratio. After analysis we have found that, for MRI Images 'Haar' gives better result in comparison to other Wavelet functions it provide compression ratio approximately 95%. We analyzed that the compression ratio obtained after each compression and decides which wavelet function can provide maximum compression ratio for a MRI scan image.

VI. EXPERIMENTAL RESULTS

A. Haar Level Compression and Decompression

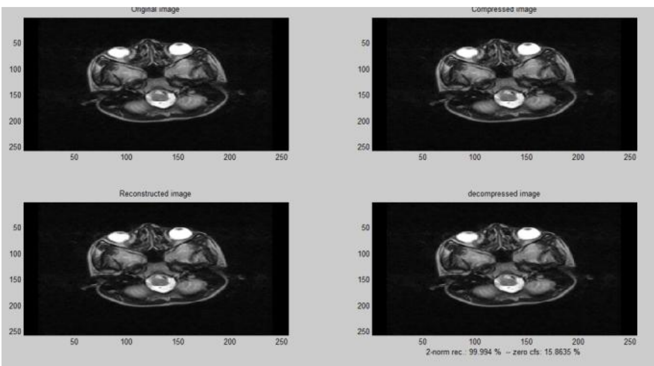


Fig 1.1.Haar first level compresson and decompression

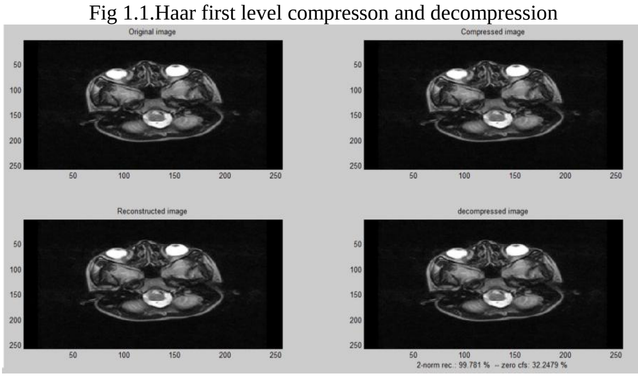


Fig. 1.2 Haar 2-level compression and decompression

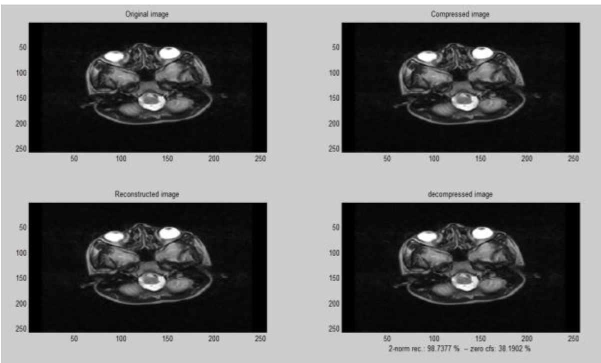


Fig 1.3. Haar 3-level compression and decompression

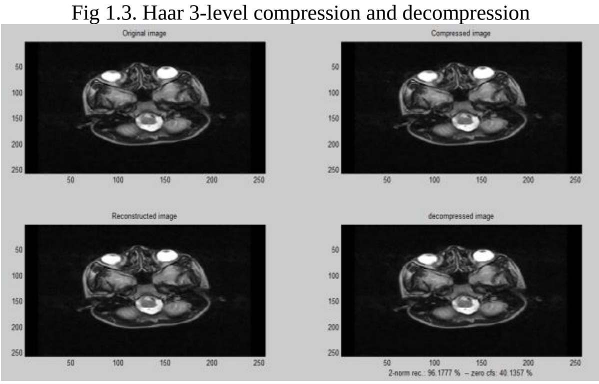


Fig. 1.4 Haar 4-level compression and decompression

B. Db2 Level Compression and Decompression

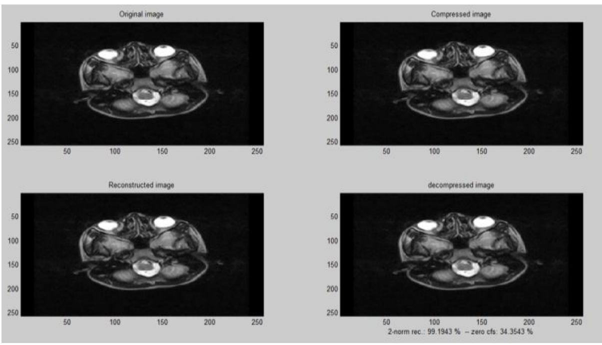


Fig.1.5 level-1 compression and decompression of db2

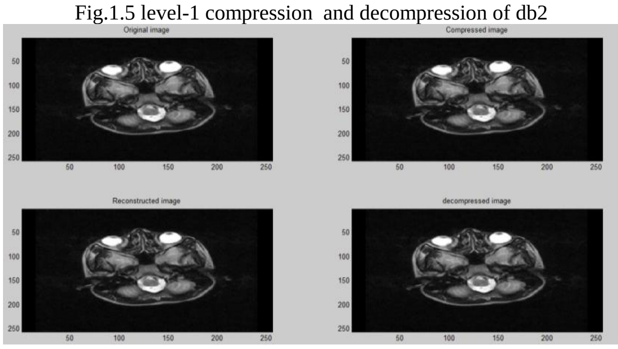


Fig. 1.6 Level-2 compression and decompression of db2

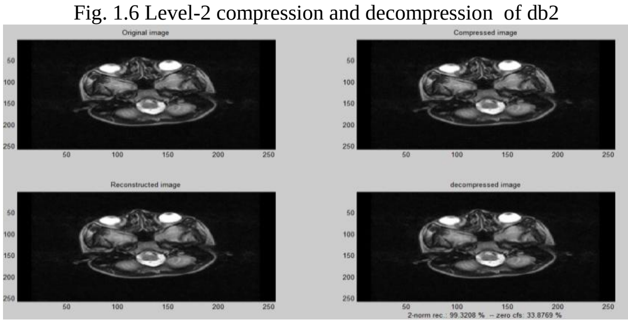


Fig. 1.7 level-3 compression and decompression by db2

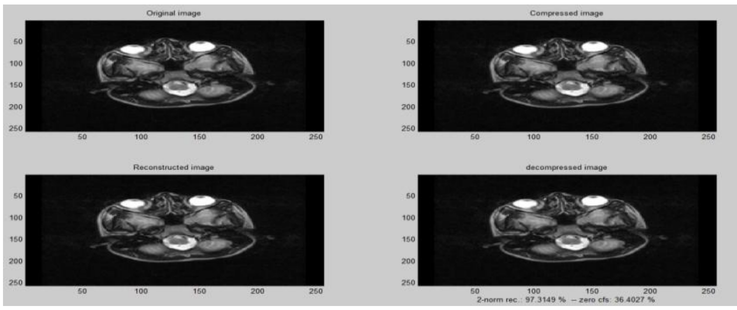


Fig. 1.8 level-4 compression and decompression using db2

C. Compression and Decompression using Bior1.3

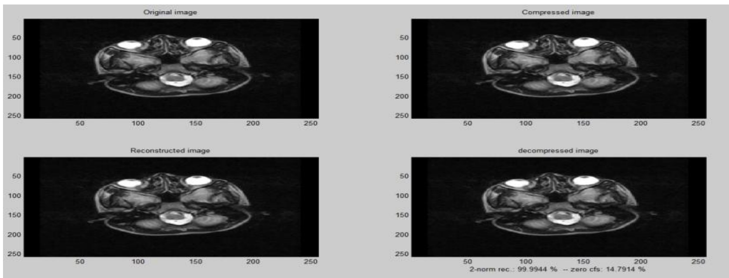


Fig. 1.9 1-level compression and decompression using Bior1.3

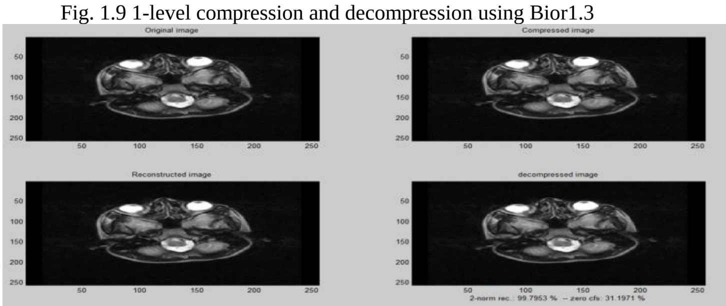


Fig. 1.10 2-level compression and decompression using Bior1.3

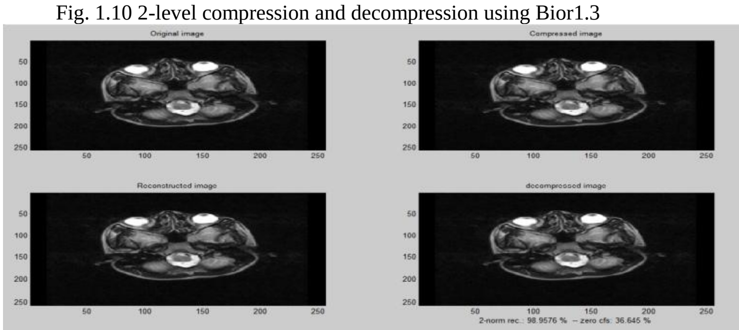


Fig. 1.11 3-level compression and decompression using Bior1.3

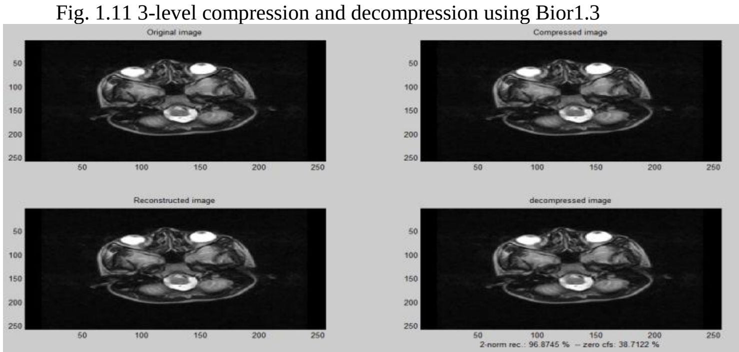


Fig 1.12. 4-level compression and decompression using Bior1.3

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