Review of Image Compression Techniques

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Abstract-- In this paper we will study the concept of image compression and study about the various technologies applied on the image compression. Also highlight the benefits of the image compression. In this paper two technologies of image compression are highlighted they are lossless compression, lossy compression and various technology included in them. Image compression is a process of compress the data on digital image. In this technique we can compress image using wavelet function without degrading the quality of that image

Keywords- MRI, CTSCAN, ULTRASOUND, X-RAYS

I. INTRODUCTION

Image compression is very useful in medical science. Medical science grows now a day and develop new technology. Hospital needs to store high volume of data and medical images about of the patients. To overcome these problem images can be compressed so that more and more amount of data and images can be store in the hard disk. It help to reduce the consumption of expensive resource like hard disk.

There are different type of medical image that are used for diagnosed. So we need to store all the diagnostic images regard compression on biomedical images by using different type of wavelet function and suggested the most appropriate wavelet function that can be perform optimum compression for a given type of biomedical image. To analyse the performance of the wavelet function with the biomedical images. We fixed the loss amount of data in the compressed image and calculate their respective compression percentage. The wavelet function that given the maximum compression for a specific type of biomedical images will be the most appropriate wavelet for that type of biomedical images.

II. COMPRESSION TECHNIQUE

In this paper we study different type of image compression techniques. The image compression techniques are broadly classified into two categories.

A. Lossless compression technique

B. Lossy compression technique

A. Lossless Compression Technique:- In lossless compression we can perfectly recover the original image from the compress image. It can also know as noiseless. Since they do not add noise signal to the image. It uses statistics/decompression technique to eliminate/minimize redundancy. Lossless compression is preferred for artificial images such as drawing, comics etc.

There are the following technique are included in lossless compression.

A.1. Run length encoding

A.2. Huffman coding

A..3. LZW coding

A..4. Area coding

A.1 Run length encoding:- The run length compression technique is useful in case of repetitive data. In this technique the sequence identical symbol or pixel is replace and it is known as run by shorter symbol. The run length code gray scale image is represented by a sequence (Vi,Ri).where Vi is the intensity of pixel and Ri is the no of consecutive pixel with intensity as shown in fig.

Fig:-A.1. Run length encoding

A.2. Huffman coding:- Huffman coding is based on the probabilities or statistical occurrence frequencies. In the Huffman encoding each pixel are treated as a symbol. The symbols which have frequency are assigned a smaller number of bits while the symbol which has less frequency is assigned a relative large number of bits. While the symbol which has less frequencies are assigned a relative large no of bits.

A.3. Lempel-Ziv-Welch (LZW):- It is a very useful coding. It is used in computer industries, and in implemented as a computer on UNIX. It is dictionary base coding. LZW is basically of two type, Static and dynamic. In static dictionary coding, when the code is assigned (encoding) and in decoding process. Dictionary is not change. Dictionary is fixed in both processes. But in thedynamic dictionary coding updated on fly.

A.4. Area Coding:- Area coding is enhanced foam of run length coding of lossless compression. The significant of lossless method is that this technique over the other, if reflecting two dimension character of images. This coding uses an array of sequence building up a two dimension object. The algorithms for this coding try to find rectangular region with the same characteristics and these regions are coding in a descriptive form as an element with two points and a certain structure. The problem with this coding is that, it cannot be implemented in hardware because of non-liner method.

B. Lossy Compression Technique:- Lossy compression technique is especially suitable for natural images such as photos in application where minor loss of fidelity is acceptable. Lossy scheme is widely used must application. Because the reconstruct image is sufficient for

Fig:-B. lossy compression technique

Fig shows the outline of lossy compression technique. Transformation is applied to the original image. The discrete wavelet transform cut the images into block of 64 pixels (8×8) and process each block independently, shifting and simplifying the colours so that there is less information to encode. Then the quantization process result in loss of information. In the quantization the value in each block are divided by a quantization coefficient. This is the compression step where information loss occurs. Pixels are changed only in relation to the other pixel with their entropy coding is applied after quantization. The reduced coefficients are then encoded usually with entropy coding.

The decoding is a reverse process. In the decoding process firstly entropy encoding is applied to compress data to get the quantized data after that dequantized is applied to it and finally the inverse transformation is applied to get the reconstructed image by this scheme the decompress image is not identical to the original image but reasonable close to it. This scheme provides much higher compression ratio than lossless scheme.

There are the following major performance consideration of lossy scheme include

1. Compression ratio
2. Signal to noise ratio
3. Speed of encoding and decoding

Lossy compression technique include following scheme

- B.1. Transformation coding
- B.2. Vector quantization
- B.3. Fractal coding
- B.4. Block truncation coding
- B.5. Sub band coding

B.1 Transformation coding:- transformation coding is a lossy compression technique resulting in a lower quality copy of original signal. This scheme is used for 'natural' data like audio signal or biomedical image.

In transformation coding less bandwidth is required. In this coding scheme transform such as DFT (discrete Fourier transform) and DCT (discrete coding transform) are used to change the pixel in the original image into frequency domain coefficients. These coefficients have several desirable properties; one is the energy compression property that results in most of the energy of the original data being concentrated in only a few of the significant transform coefficient. This is the basic of achieving the compression only few significant coefficients are selected and remaining are discarded. The selected coefficient are further quantization and entropy encoding. DCT coding has been the most common approach to transform coding and also adopted in the JPEG image compression standard

B.2 Vector Quantization:- In vector quantization a dictionary of fixed-size vectors, is to be develop, called code vectors. A vector is usually a block of pixel values. So image is then partitioned into non-overlapping blocks (vectors) called image vectors. Then for each in the dictionary is determined and its index in the dictionary is used as the encoding of the original image vector. Thus, each image is represented by a sequence of indices that can be further entropy coded.

B.3 Fractal Coding:- In Fractal Coding decompose the image into segments by using standard image processing techniques such as edge detection, color separation, and spectrum and texture analysis. Then each segment is looked up in a library of fractals. The library actually contains codes called iterated function system (IFS) codes, which are compact sets of numbers. Using a systematic procedure, a set of codes for agiven image are determined, such that when the IFS codes are applied to a suitable set of image blocks yield an image that is a very close approximation of the original. This scheme is highly effective for compressing images that have good regularity and self-similarity.

B.4 Block truncation coding:- In this scheme, the image is divided into non overlapping blocks of pixels. For each block, threshold and reconstruction values are determined. The threshold is usually the mean of the pixel values in the block. Then a bitmap of the block is derived by replacing all pixels whose values are greater than or equal (less than) to the threshold by a 1 (0). Then for each segment (group of 1s and 0s) in the bitmap, the reconstruction value is determined. This is the average of the values of the corresponding pixels in the original block.

B.5 Sub band coding:- In this scheme, the image is analyzed to produce the components containing frequencies in well-defined bands, the Sub bands. Subsequently, quantization and coding is applied to each of the bands. The advantage of this scheme is that the Quantization and coding well suited for each of the sub bands can be designed separately.

III. WAVELET

Wavelet mean a “small wave”. the smallness implies to a window function of finite length. wavelet are function that satisfy certain mathematical requirement and are used in representing data or other function. wavelet compression involves a way analyzing an uncompressed image in a recursive fashion, resulting in series of higher resolution images. The primary steps of wavelet compression are performing a discrete wavelet transformation (DWT), quantization of the wavelet space image sub-band, and then encoding these sub-band that do the image compression. Image decompression, or reconstruction is achieved by carrying out the above steps in reverse and inverse order that is decode, dequantize and inverse discrete wavelet transformation

Mathematical description:-

Wavelet are generated from mother wavelet. Mother wavelet is a prototype for generating the other window function

The mother wavelet is scaled by a factor of ‘a’ and translated by a factor of ‘b’ to give

$$\Psi_{ab}(t) = 1/\sqrt{|a|} \times \Psi(t-b/a)$$

Where ‘a’ and ‘b’ are two arbitrary real number ‘a’ and ‘b’ represent the dilation and translation parameter respectively in the time axis. when $a < 1$ expands and $a > 1$ stretches. Mathematically when “t” is replaced in equation by (t - b) it causes a translation or shift in the time axis resulting in the wavelet function.

There are many members in wavelet family, a few of them are generally found to be more useful. The various types of wavelet i.e.

3.1 HAAR WAVELET

Haar wavelet is discontinuous and resembles a step function.

3.2 DAUBECHIES

Daubechies are compactly supported orthonormal wavelet and found application in DWT

3.3 COIFLETS

The wavelet functional has 2N moments equal to 0 and scaling function 2N-1 moments equal to 0. The two functions have support of length 6N-1

3.4 BIOORTHOGONAL

This family of wavelet exhibits the property of linear phase, which is needed for signal and image reconstruction. By using two wavelet, one for decomposition (on the left side) instead of the same single one.

The Wavelet are chosen based on their shape and their ability to analyze the signal in particular application.

IV. RESULT AND ALGORITHM

In order to decide the most appropriate wavelet function for a particular type of biomedical image for compression. We use the following steps:-

1. First input is taken for compression by using imread (‘image’) command.
2. In the next step calculate the different filter with the wavelet function, wfilter(‘wname’)
3. The output of the last step is used to make the compression using wavelet packet ‘wpdencmp’
4. In the step multi-level 2-D wavelet reconstruction of ‘n’ level of decomposition taken place out, waverec2
5. Finally the ‘n’ level reconstructed image will be displayed.

V. CONCLUSION AND FUTURE WORK

This paper represents the concept of image compression and various technologies used in the image compression comparing the performance of compression techniques. Identical data sets and performance measures are used. Some wavelet functions perform well for certain classes of data or images and poorly for others. It leads to less storage of memory and reduction of calculation. Some other wavelet functions can also be used to compress the medical images to reduce the memory space.

Below table is the output of each type of image compression with different types of wavelet function.

medical images	Ultrasound	MRI	x-RAY	CT-SCAN
HAAR WAVELET	67.3340	45.8618	70.7581	83.4061
Daubechies	70.3121	59.5647	78.3265	86.4813
coiflets	68.5786	57.3456	75.5543	87.8277
Biorthogonal	69.8913	61.6623	76.3945	87.5465
Best suitable	Daubechies	Biorthogonal	daubechies	coiflets

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