Comparison of compression technique for medical application for Dicom CT images

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Abstract- Medical image compression is essential for medical diagnosis. For the medical images, only a small portion of the image might be diagnostically useful, but the cost of a wrong interpretation is high. Hence, Region Based Coding (RBC) technique is significant for medical image compression and transmission. Lossless compression in these 'regions' and lossy compression for rest of image can helps to achieve high efficiency and performance in medical applications. Wavelet transforms (DWT), discrete cosine transforms (DCT), Run Length Encoding Lossless compression technique presently are the most usefully and wider accepted approach for the purpose of compression. Comparison of these compression techniques is required for different Dicom CT image compression functions. As compression in Dicom CT images needs negligible data loss while compression process so in this Research, we will compare these compression techniques on different Dicom recommended CT images. The redundancy reduction for techniques will be done through Huffman encoding.

Keywords – Image Processing, Noise Removal, Huffman Encoding, PSNR

I. INTRODUCTION

A large amount of image data is produced in the field of medical imaging, in the form of computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET) and ultrasound images, which can be stored in picture archiving and communication system (PACS) or hospital information system (HIS) [8].

With maturity of communication technology, digital image becomes an important carrier of information transmission. However, when we enjoy convenient and quick services, our information exchange still exists many hidden dangers. On one hand, mass data storage and transmission face huge pressure; on the other hand, in the process of transmission, image information is susceptible to be attacked or defaced. Therefore, image compression and image encryption technology research have important theoretical significance. To the traditional encryption scheme, it is difficult to realize the alternative and diffusion of the whole image [2]-[6].

Some of the most desirable properties of any compression method for medical images include: (i) high lossless compression ratios, (ii) resolution scalability, which refers to the ability to decode the compressed image data at various resolutions and (iii) quality scalability, which refers to the ability to decode the compressed image at various qualities or signal-to-noise ratios (SNR) up to lossless reconstruction [5].

II. IMAGE COMPRESSION

Image compression addresses the problem of reducing the amount of data required to represent a digital image. It is a process intended to yield a compact representation of an image, thereby reducing the image storage/transmission requirements. Compression is achieved by the removal of one or more of the three basic data redundancies:

1. Coding Redundancy
2. Inter pixel Redundancy
3. Psycho visual Redundancy

Coding redundancy is present when less than optimal code words are used. Inter pixel redundancy results from correlations between the pixels of an image. Psycho visual redundancy is due to data that is ignored by the human visual system (i.e. visually non essential information). Image compression techniques reduce the number of bits required to represent an image by taking advantage of these redundancies. An inverse process called decompression (decoding) is applied to the compressed data to get the reconstructed image. The objective of compression is to reduce the number of bits as much as possible, while keeping the resolution and the visual quality of the reconstructed image as close to the original image as possible.

III. TECHNIQUES FOR COMPRESSION

Huffman Encoding: This is a general technique for coding symbols based on their statistical occurrence frequencies (probabilities). The pixels in the image are treated as symbols. The symbols that occur more frequently are assigned a smaller number of bits, while the symbols that occur less frequently are assigned a relatively larger number of bits. Huffman code is a prefix code. This means that the (binary) code of any symbol is not the prefix of the code of any other symbol. Most image coding standards use lossy techniques in the earlier stages of compression and use Huffman coding as the final step.

Run Length Encoding: This is a very simple compression method used for sequential data. It is very useful in case of repetitive data. This technique replaces sequences of identical symbols (pixels), called runs by shorter symbols. The run length code for a gray scale image is represented by a sequence { Vi , Ri } where Vi is the intensity of pixel and Ri refers to the number of consecutive pixels with the intensity Vi as shown in the figure. If both Vi and Ri are represented by one byte, this span of 12 pixels is coded using eight bytes yielding a compression ratio of 1: 5

Discrete Wavelet Transform: The Fourier transform is a useful tool to analyze the frequency components of the signal. However, if we take the Fourier transform over the whole time axis, we cannot tell at what instant a particular frequency rises. Short-time Fourier transform (STFT) uses a sliding window to find spectrogram, which gives the information of both time and frequency. [3] But still another problem exists: The length of window limits the resolution in frequency. Wavelet Transform seems to be a solution to the problem above. Wavelet transforms are based on small wavelets with limited duration.

Wavelet compression firstly reads image file, and then use wavedec2 function to conduct wavelet compression and appcoef2 function to extract approximate component, horizontal component, vertical component and diagonal component from the decomposition coefficients, finally, it uses extracted low frequency coefficients to restore compressing image [2].

Discrete Cosine Transform: Transform coding constitutes an integral component of contemporary image/video processing applications. Transform coding relies on the premise that pixels in an image exhibit a certain level of correlation with their neighboring pixels. Similarly in a video transmission system, adjacent pixels in consecutive frames2 show very high correlation. Consequently, these correlations can be exploited to predict the value of a pixel from its respective neighbors.

IV. PROBLEM DEFINITION

Image compression is the useful process to save a lot of space and resources while sending images from one place to another. Compression is a way to eliminate the redundant part, and functions which can be regenerated at the time of decompress. Moreover when we considering images from medical area then compression have good advantages but due to little data lose while compressing and decompressing, it is very much necessary to find a compression technique which will be best suitable for image compression for medical area. There is compression techniques which can be suitable for Dicom Ct images also. This particular category of image is carrying negligible fault tolerance so it needs strong compression technique with negligible loss. We will compare well know Compression techniques which are suitable for Dicom CT images. Techniques such as Discrete Cosine Transform, Discrete Wavelet Transform, Huffman encoding and Run Length encoding. We will experiment the compression process with CT images and try to fetch best fit technique for processing image compression.

IV. OBJECTIVES OF THE STUDY

- ✓ To find optimal compression technique for compressing Dicom CT images.
- ✓ To compare a four compression techniques and highlight the advantages.

V. RESEARCH METHODOLOGY

Our research will start with study of Compression techniques. Our research will start with study of compression techniques and to start our work we will proceed with 6 images with 512 $\times$ 512 gray scale images (some of them will be choose from live database of Medical College). For basic compression process, we will find the low level coefficients by implementing the discrete wavelet transform. This low coefficient value will be encoded with Run Length encoding which will eliminate the similar symbols available in the image. After this process we will implement the discrete cosine transform process which will compress the image by low coefficient value and will be encoded through Huffman encoding for eliminating the redundancy of data and functions. The described process will be carried on image size of 256 × 256 and will find the difference in sound to noise ratio.

Finally after all above process, we will proceed with comparing the above techniques to find the best result for compression.

VI. Experimental Results

Our initial work starts with selecting images from database and converting it to the gray scale.

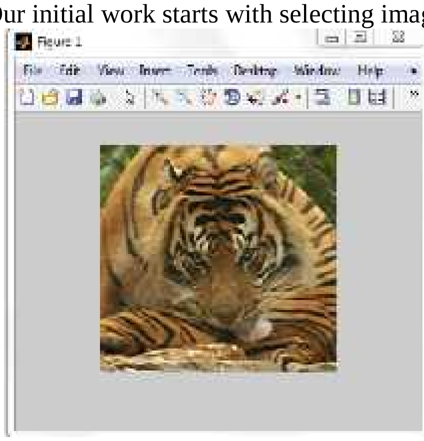

Fig 1: Basic Image without any operation

Fig 2: Image after basic grayscale operation

Our initial experimentation is based on converting Red Green Blue in Gray Scale. Function rgb2gray is used for initial process.

Further in Fig 3, we have done some image induction process which will be helpful in noise removal process in further experimentation.

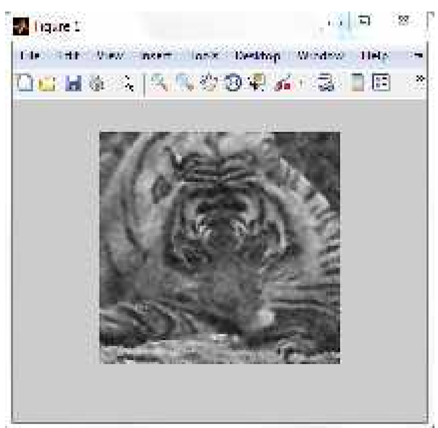

Fig 3: Induction process for image

VII. CONCLUSION

In our continuous research we are working on image compression with experimentation of performance of various techniques. We have done some initial experimentation and we are working on further process of finding density and will proceed with defined work.

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