A REVIEW OF IMAGE COMPRESSION IN MEDICAL IMAGES USING ROI WITH DISCRETE COSINE TRANSFORM

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Abstract— **Image compression addresses the problem of reducing the amount of data required to represent a digital image. There are some areas of medicine where it is sufficient to maintain high image quality only for diagnostically significant regions, for example, tumor section of the brain MRI. This paper represents a compression method based on ROI and its performance analysis focusing on Discrete Cosine Transform technique. It is used for reducing the redundancy that is nothing but avoiding the replica data. The DCT is a mathematical function that transforms digital image data from the spatial domain to the frequency domain.**

Index Terms— **DICOM images, lossy compression, Medical image compression, Region of Interest, Discrete Cosine Transform.**

I. INTRODUCTION

An image is essentially a 2-D signal processed by the human visual system. The signal representing the image usually is a analog form. Medical imaging has a great impact on the diagnosis of diseases and surgical planning. Image compression is an function of data compression that encodes the original image with few bits. The objective of image compression is to diminish irrelevance and redundancy of the image data in order to be able to store or transmit data in an proficient form. Image compression means the reduction of the size of the image data, while retraining necessary information.

A. Image Compression

Image compression addresses the difficulty of reducing the quantity of data required to characterize a digital image. Through image compression the image is represented in small storage space, in this manner the storage/transmission requirements of the image are also reduced [1]. Image compression is achieved by the removal of one or more of the three basic data redundancies and these redundancies are:

- Coding Redundancy
- Interpixel redundancy
- Psychovisual redundancy

Coding redundancy is present when less than optimal code words are used. It consists in using variable length code words selected as to match the statistics of the original source.

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This type of coding is always reversible and usually implemented using lookup tables [1].An inter-

pixel redundancy is from correlations between the pixels of an image because in image neighboring pixels are not statistically independent. This is due to the relationship between the adjacent pixels of an image. This kind of redundancy is called Inter-pixel redundancy or spatial redundancy. Psychovisual redundancy is due to data that is ignored by the human visual system (i.e. visually non essential information). Most of the times, the psycho physical aspects of human vision have confirmed that the human eye does not respond with equal sensitivity to all incoming visual information. A few piece of information are more necessary than others.

B. Image compression techniques

The image compression techniques are generally classified into two categories depending whether or not an exact replica of the original image could be reconstructed using the compressed image.

These techniques are:-

- Lossless technique
- Lossy technique

These both techniques are explained as follows:

Lossless compression technique In lossless compression techniques, the original image can be completely recovered from the compressed (encoded) image [8]. These are also called noiseless since they do not add noise to the signal (image). It is known as entropy coding since it uses statistics/decomposition techniques to eliminate/minimize redundancy. Lossless compession is used only for a few applications with strict necessities such as medical imaging. Following techniques are incorporated in lossless compression:

- Run length encoding
- Huffman encoding
- LZW coding
- Area coding

Lossy compression technique Lossy schemes provide much higher compression ratios than lossless schemes [8]. By this scheme, the decompressed image is not identical to the original image, but reasonably close to it and is used in many applications. In lossy methods, a little information is lost as the high compression ratio is the main objective [3]. Lossy compression techniques includes following schemes:

- Transformation coding
- Vector quantization
- Fractal coding
- Block Truncation Coding
- Sub band coding

II. MEDICAL IMAGING

Digital Image Processing is one of the most popular research areas from last four decades, in the whole world. Reason for this popularity is huge variety of implementations of Digital Images in almost each era of technology. Medical Imaging is one of the major application areas of Digital Image Processing. Various medical diagnosing techniques are using digital images of human body as the deciding factors for next medical treatment [6]. Imaging in Medicine is being used to image the human body since 1960. Imaging helps a lot to represent the internal problem of body in visual manner. Medical Sonography is an ultrasound-based diagnostic medical imaging procedure used to visualize muscles, tendons, and lots of internal organs, their volume, structure and any pathological lesions with valid time tomographic images.

Imaging techniques extensively used in medicine include X-Ray, Magnetic Resonance Imaging (MRI), Ultrasound and Computed Tomography (CT). This technique is being used on large scale in field of neurology, cardiology, gynecology, urology and other medical diagnostic systems [7]. 3D MRI contains multiple slices containing parts of body, requires all information of that part. The compression methods for 3D medical image includes the properties like: high lossless compression ratios, resolution scalability, quality scalability etc [11]. Current compression schemes produce high compression rates if loss of quality is inexpensive. However, in most cases physicians may not afford any insufficiency in diagnostically important regions of images; called ROIs. An approach that brings a high compression rate with good quality in the ROI is thus necessary.

III. DICOM IMAGES

The Digital Imaging and Communications in Medicine (DICOM) standard was created by the National Electrical Manufacturers Association (NEMA) facilitate the distribution and viewing of medical images, such as MRIS, CT scans and ultrasound. The DICOM file has a special file format that contains both a header (which stores information about the patient's name, the type of scan, image dimensions, MRI, CT, Audio recording etc), as well as all of the image data (which contains all the information about the image). The DICOM header can be extracted and presented separately. Furthermore, it can be parsed into the XML format providing in this way interoperability with other medical file standards [9]. DICOM is a standard that is adopted by hospitals across the globe to handle, store, print and transmit information in medical imaging. It is mainly developed to ensure interoperability of the electronic health record systems where the digital image information is an integral part of the patient record. The DICOM image furthermore contains the patient id so that the patient information not at all gets separated by mistake [5].

IV. REGION OF INTEREST IN MEDICAL IMAGING

The ROI is important in medical applications where certain parts of the image are of higher diagnostic significance than others. All regions of medical image do not have equal importance as only some portions are diagnostically important. In such cases, these regions require to be encoded at a higher superiority than the background, lesser important regions [4]. In medical imaging data loss in the diagnostically important regions (ROI) is not affordable. The ROI can be determined from a DICOM image and the rest of image can be considered as Non-ROI of an image. The general theme is to preserve quality in diagnostically critical regions, while allowing lossy compression of the other regions. During the image transmission for telemedicine purposes, ROIs are required to be transmitted first or at the high priority [11]. In the ECG (Heartbeat) signals, ROI mask is used to separate the signal region from the non-signal region in the image that is to be transformed [10].

V. PROPOSED METHOD

The Discrete Cosine Transform (DCT) is a mathematical transformation technique that is used to change a spatial representation of data into a frequency symbol. A data in the frequency domain contains the identical information as to in the spatial domain [2]. The arrangement of values obtained by applying the DCT is coincidentally from lowest to highest frequency. This characteristic and the psychological observation that the human eye and ear are less sensitive to recognizing the higher-order frequencies leads to the option of compressing a spatial signal by transforming it to the frequency domain and dropping high order values and keeping low-order ones. When reconstructing the data and transforming it back to the spatial domain, the results are remarkably parallel to the original signal. The DCT method can be used to compress both color and gray scale images. DCT is a method most frequently used in several areas including WWW, industries, science and engineering etc [2].

The Haar Wavelet Transformations can be applied only on the NON-ROI parts of the image, where it is used to generate the floating point coefficients. It is a sequence of square-shaped functions but the DCT techniques can also be used for arbitrary shaped functions and zig-zag functions. When DCT technique is used with the JPEG images and the image is reduced to higher compression ratios, the difficulties will raised. So DCT technique with ROI part is used for DICOM images to reduce these difficulties.

The proposed method will work as follows:

- Read the image from database and get dimensions.
- Select ROI from the image.
- Separate out ROI and Non-ROI from the image.
- Apply Discrete Cosine Transform compression to ROI
- Merge both ROI and NON-ROI images.
- Compare the quality and size reduction of original image with newly reconstructed image by various measures.

In the method, the medical image is selected from the database. Then the image will be segmented into parts and the ROI and NON-ROI part of the image is classified. We will select the ROI part of the image and apply the Discrete Cosine Transform on the image. After applying the selected method both the images are merged together. The quality and size of the original image and newly constructed images are compared [5]. The flow chart of the proposed method is shown below in fig.1

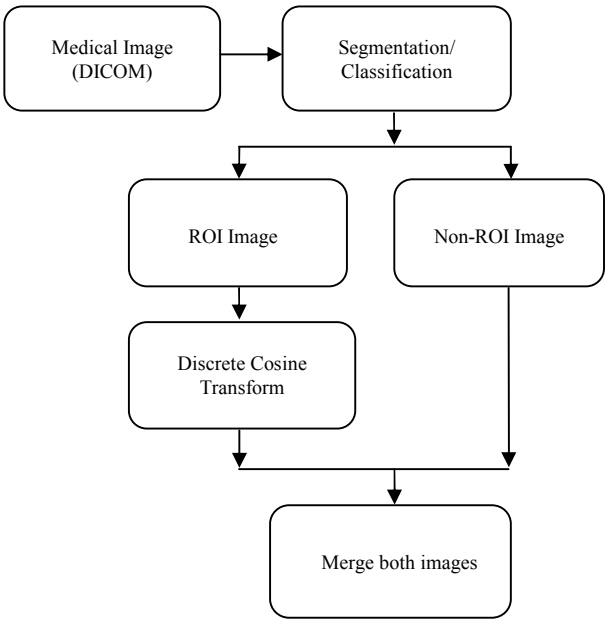

Fig.1 Flow chart of proposed method

CONCLUSION

The paper discusses about the ROI-based Medical image compression technique. DCT method is used with the ROI part of the image to reduce the blocking effect in the image for the better understanding. Region of Interest based compression techniques helps to reduce size of image without degrading the quality of the important data. The area of improvement can be a system which itself identifies the area of interest within the medical image and then applies various compression techniques on region of interest as well to reduce size of the image.

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