Texture Based Biomedical Image Compression

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Abstract

In Telemedicine, huge amount of information is stored in digital form. As the imaging techniques produce prohibitive amount of data, compression is necessary for storage and communication purpose. Image compression is used to reduce the redundancies and irrelevant information in image and represents it in shorter manner to achieve efficient archiving and transmission of images. Many current compression schemes provide a very high compression rate but with loss of quality of Image. The approach presented in this paper offers great potential in complete lossless compression of the biomedical image with the reconstructed image being mathematically identical to the original image. Here edges and textures are considered as the basic parameters in this compression algorithm. Edges are the boundaries of surface markings as well as curves that corresponds to the discontinuities in surface orientation. Texture can be defined as the property of all surfaces that describes visual patterns and contains important information about the structural arrangement of the surfaces. This paper also compares texture based biomedical image compression technique with other compression techniques.

Keywords*—DICOM, Medical image compression, Texture, Run length encoding, Discrete wavelet Transform.*

I. Introduction

Every day, an enormous amount of information isstored, processed and transmitted daily digitally. Method of compressing the data prior to storage and /or transmission is of significant practical and commercial interest. Image compression helps in reducing the amount of data required to represent a digital image. The fields of e-medicine and Tele-medicine are booming and needs the fast and error free communication of medical images to their destination to perform e-consultancy between various specialists to agree upon the correct diagnosis for the patient. Thus, the relevance of image compression remains to maintain the accuracy and visual quality of image while compressing it to reduce redundancies and fast transmission across the internet.
Here two parameters are used: 1) Edges 2) Textures
Edges are the boundaries of objects, the boundaries of surface markings as well as curves that correspond to discontinuities in surface orientation. Texture is the innate property of all surfaces that describes visual patterns, each having properties of homogeneity. It contains important information about the structural arrangement of the surfaces

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II. LITERATURE SURVEY

TABLE I. COMPARISON OF REFERENCE PAPERS

Sr no	Reference	Purpose	Merits	Demerits
1	Texture based DICOM Image Compression (Ashok. M.Sapkal,Vinayak. K. Bairagi, Ms A Tapaswi)	A compression approach towards visual quality rather than pixel-wise fidelity has been pursued. To fully utilize the edges, edge-based impainting is designed and texture synthesis is used to restore the removed blocks.	As exemplar blocks are used, it provides more compression ratio.	The noise removal technique used in this method do not give efficient results.
2	Texture-Based Identification and Characterization of Interstitial Pneumonia Patterns in Lung Multidetector CT (Amit SatpathyXudong Jiang and How-Lung Eng)	This paper proposes two sets of novel edge-texture features, Discriminative Robust Local Binary Pattern (DRL BP) and Ternary Pattern (DRL TP), for object recognition.	The advantages of the proposed method are that the algorithm complexity is much reduced.	The process captures only the texture information, the contour is not effectively represented
3	Texture Classification with a Dictionary of Basic Image Features (Michael Crosier Lewis D Griffin)	Here, we explore a quantization of filter responses into a dictionary of discrete features which is based on geometrical, rather than statistical considerations, resulting in a simple texture description based on a dictionary of visual wordswhich is independent of the images to be described.	It describes the advantages of rotationally invariant local description.	In this particular case, scale invariance may have been a disadvantage.
4	Absolutely lossless compression of medical images (Robina Ashraf, Muhammad Akbar)	A method is proposed which provides high compression ratios for radiographic images with no loss of diagnostic quality.	Original image can be recovered therefore there cannot be subsequent claim that important information was lost as a result of the compression process, which could be crucial.	It has moderate compression ratio of final compressed image.
5	Run-length encoding for volumetric texture. (Dong-Hui Xu, Arati S. Kurani, Jacob D. Furst, Daniela S. Raicu)	This paper presented a new approach for volumetric texture analysis using run length encoding matrix and its texture descriptors.	Evaluation of volumetric texture is done by segmentation process which improves compression ratio.	In worst case RLE generates output data which is 2 times more than size of input data.
6	Medical Images Texture Analysis: A Review (Shahabaz,Ashwani Kumar Yadav,Devendra	In this paper, the problems of texture analysis such as segmentation, and classification were discussed.	Compares different classification algorithm along with its accuracy.	100% accuracy cannot be obtained by any of the

	Kumar, SomwanshiRatnadeep)			mentioned techniques.
7	Implementation of Data Compression U sing Huffman Coding (K. Ashok Babu and V. Satish Kumar)	Implementation of high-speed Huffman decoding system.	Proposed system enhances speed of operation.	Complex architecture.
8	JPEG2000: A Review and its Performance Comparison with JPEG (Reena Singh, V. K. Srivastava)	Paper provides a comparison of performance of JPEG AND JPEG2000	JPEG2000 improves compression performance of JPEG especially at low bit rate	PCRD algorithm in JPEG2020 is not sufficiently efficient in terms of high computational complexity
9	Performance analysis of medical image compression techniques (Smitha Joyce Pinto, Prof. Jayanand P. Gawande)	comparative analysis of compression method is carried out	results are very satisfactory in terms of compression ratio and compression image quality	Applicable only for images and not for videos signals.
10	Medical Image Compression based on Region of Interest using Better Portable Graphics (BPG) (David Yee,SaraSoltaninejad,DeborsiHazarika,GaylordMbuyi, Rishi Barnwal, Anup Basu)	In this paper, a state-of-the-art image compression format known as Better Portable Graphics (BPG), which is based on the High Efficiency Video Coding (HEVC), is used for medical image compression.	High compression ratio with similar quality compared to JPEG.	It does have some drawbacks, such as lack of native support, that extends it'sdecompile time. In general, the larger your file, then the slower the decompiling time will be.

III. PROPOSED SYSTEM

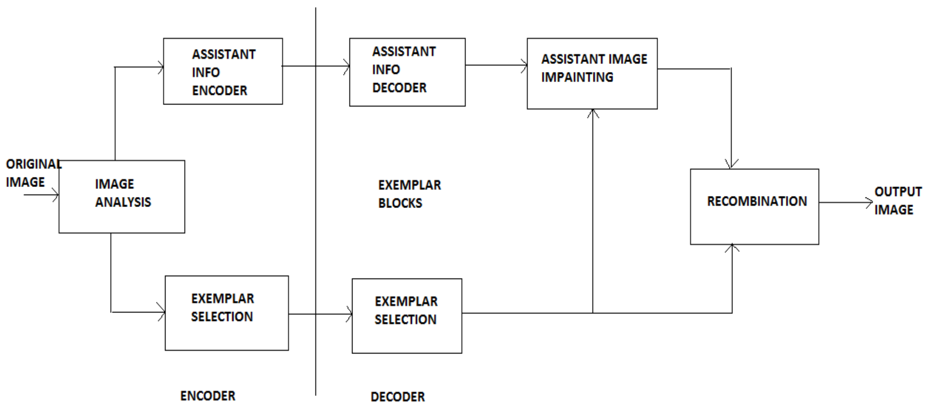

Fig.1.Overall methodology of the proposed compression system

An uncompressed DICOM image is taken and processing is done on the given image. The first step is to read an image in MATLAB. Further the image has to be pre-processed and then encoding is carried out. The basic idea of the reduction process is to remove the redundant data. From a mathematical viewpoint, this amounts to transform a 2-D pixel array into a statistically uncorrelated data set. This transformation is applied prior to storage or transmission of the image. At the receiving end, the compressed image is decompressed to reconstruct the original image or an approximation of it.

IV. ENCODER

IMAGE ANALYSIS-.

The first step is to read the input image in MATLAB.
The input image given is in DICOM format which is converted into JPEG format. After this conversion if the input image is in RGB form it is converted to grayscale image for further operations.
Image preprocessing includes image slicing and noise removal. Noise reduction is done by adaptive median filtering is applied to the sputum image to remove any impulse noise present in the image. The regions that are profoundly affected by noise and lightly affected by noise should be treated accordingly to enhance the resultant image. Intensity modification gray-scale conversion is performed upon the original image for further processing.

EXEMPLARSELECTION-

A wavelet representation provides, access to a set of data at various levels of detail. However, wavelet analysis differs from Fourier analysis such that the different signal frequencies are described by individual wavelet basis functions are localized rather than global. Advantages of wavelet analysis include the following: very good image approximation with just a few coefficients,it can be used to extract and encode edge information, which provide important visual cues in differentiating images. Moreover, the coefficients of a wavelet decomposition provide information that is independent of the original image resolution. Images of different resolutions can also be compared easily using this wavelet transform. Finally, wavelet decompositions are easy and fast to compute, requiring linear time in the size of the image. Wavelet transform does not reduce the amount of data present in the image. It is simply a different form of representation of the image.
Vector quantization on the other hand can reduce the amount of data in the image. This gives superior results which are in general applicable to any images. This wavelet decomposition and quantization is applicable to those area of digital images where high precision reconstructed image is required like criminal investigations, medical imaging, etc

ASSISTANT INFO ENCODING-

Run length encoding is used for this purpose.Run-length encoding (RLE) is a form of lossless data compression in which runs of data (sequences in which the same data value occurs in many consecutive data elements) are stored as a single data value and count, rather than as the original run. This is most useful on data that contains many such runs.

V. DECODER

ASSISTANT INFO DECODER-

Compressed image is decoded using RLE decoder.

EXEMPLAR BLOCK-

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Inverse quantization
Wavelet decomposition

ASSISTANT IMAGE IMPAINTING-
The pixels near the edges are restored at this stage. After complete process the performance parameters are calculated.

$$PSNR(dB) = 20*\log_{10}(\text{Maximum pixel value}) / (\sqrt{MSE}) \text{------ Eq. 1}$$

Where, PSNR represents Peak Signal to Noise Ratio,
MSE represents the mean squared error of the image defined as,

$$MSE = 1/N * \Sigma_i \Sigma_j (f(i,j) - F(i,j))^2 \text{------ Eq. 2}$$

Where, N is the total number of pixels, F (i, j) denotes the pixel value in the reconstructed image and f (i, j) is the pixel value in the original image.

$$BR(bpp) = (\text{Size of the compressed image in bits}) / (\text{Total no of pixels}) \text{ ----- Eq. 3}$$

If the bit rate increases, it results in improvement in quality of the reconstructed image.

VI. RESULTS & OBSERVATIONS

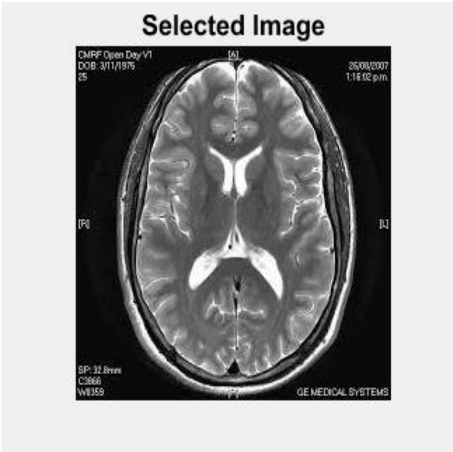

Figure 2. Input image

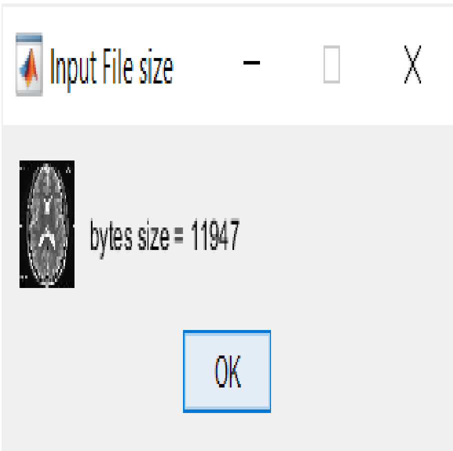

Figure 3. Input File Size

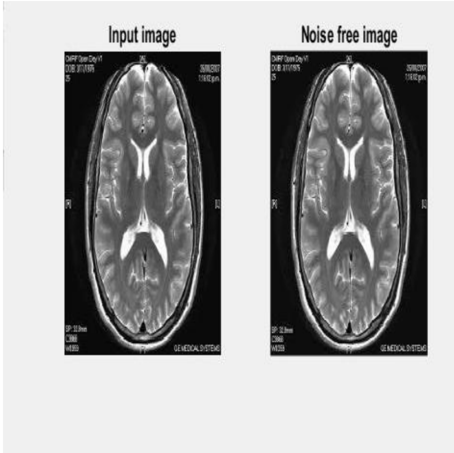

Figure 4. Noise free image

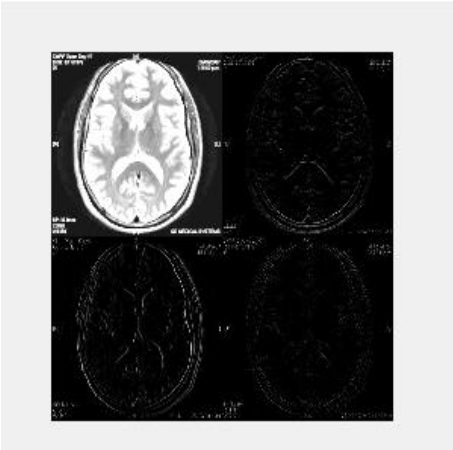

Figure 5. Output of DWT

VII. CONCLUSION

Texture Based medical image compression algorithm is proposed to improve compression efficiency by maintaining visual quality.The compression performance metrics used are compression ratio while the quality metrics used are Peak Signal to Noise Ratio (PSNR), Mean Square Error (MSE).

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