FAST AND EFFICIENT IMAGE COMPRESSION USING WAVELET TRANSFORM

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***Abstract*: Compressions based on wavelet transform are the state-of-the-art lossless compression technique used in image compression. For medical images it is critical to produce high compression performance while minimizing the amount of image data, so the data can be stored economically. The wavelet-based compression scheme contains transformation, quantization and lossless entropy coding. For the Transformation stage, discrete wavelet transform is introduced.**

The paper is concluded by discussing the applications of the wavelet-based image compression on medical images and radiologic practice.

***Keywords*:-Image Compression, Lossless Compression, DICOM (Digital Imaging and Communications in Medicine), Wavelet transform using Matlab.**

1. INTRODUCTION

As we are living in the digital world, people are facing with many diseases.So in order to diagnosis their disease they have to visit doctor, the doctor diagnosis the disease and stored the report file in the DICOM format.DICOM stands for Digital Imaging and Communications in Medicine.DICOM is an application layer network protocol for the transmission of medical images ,waveforms and accompanying information.DICOM is used for storing and transmitting medical images enabling the integration of medical imaging devices such as scanners ,servers,workstations ,printers,network hardware and pictures archiving and communication system from multiple manufactures.DICOM files can be exchanged between 2 entities that are capable of receving image and patient data and DICOM format.

Our aim is to design an application for to provide lossless compression of DICOM images by applying Daubechies wavelet.This helps in better bandwidth utillization of the networks.

2. LITERATURE REVIEW

The study on the relevant papers related to the topic would not have been possible if the researchers did not routinely place their code and papers on the Internet for public access. Through various sources like books and papers available on Internet, library, digital library relevant papers were surveyed. Some of them are listed below.

Neha Sikka [1]:

This paper reveals about a lossless technique of Image processing is proposed by considering Haar wavelet and Vector transform techniques. 96% compression percentage is achieved with the help to proposed method and when the results are compared with other techniques like Integer-to-Integer transform and Band-let image compression, low SNR (Signal to Noise Ratio) values and high RMSE values are achieved for the proposed system which shows its accurate behaviour. Lossless compression process always produces the replica of the original image after decompression stage. Lossless techniques are required in the case of sensitive data applications such as legal documents, executable documents, medical images etc. During image compression process a digital image is considered as a matrix containing intensity values of different image pixels as the data stored inside the matrix. The intensity values in case of Gray scale images are in the range of 0-255. This algorithm is the combination of Haar wavelet technique and Vector transform technique.

Ajala Funmilola A, Fenwa Olusayo D [2]:

This paper works on comparsion between Discrete Cosine Transform (DCT) compression technique and Wavelet Transform (WT) compression techniques for medical images.The result showed compression ratio of 10:1 and 7:1 for DCT and DWT respectively. The mean difference of 77.84 with standard deviation of 83.17 and mean difference of 77.77 with standard deviation of 83.23 from the original image were recorded for DCT and DWT compression technique. There are two forms in which medical image compression can be done which are namely; Lossless compression (compression done involving no loss of data) and Lossy compression (compression done involving loss of data). Lossless compression will be applied in the clinically relevant areas and lossy compression will be applied in the other areas.

3. EXISTING SYSTEMS

Keynotes on HAAR wavelet transform:

The HWT is a wonderful tool for understanding how a discrete wavelet transformation works. It is not desirable in practice because the filters are too short **-** since each filter is length two, the HWT decouples the data to create values of the transform. In particular, each value of the transform is created from a 2 x 2 block from the original input. If there is a large change from 2 x 2 block, the HWT will not detect it. The HWT also send integers to irrational numbers and for lossless image compression, it is crucial that the transform send integers to integers. For these reasons, researchers developed more sophisticated filters. Be sure to check out the other subsections to learn more other types of wavelet filters.

4. PROPOSED METHOD

Usually Medical images require large space for storing, so in order to reduce the memory space we use discrete wavelet transformation technique. We use Daubechies' wavelets and analysis techniques to get high compression ratio, low bit rate, high PSNR value and low MSE detect the high frequency variation in the diagonal direction that is indicative of text. Excellent results have been obtained in experiments using a large set of real world medical images many with superimposed text.

5. TRANSMISSION OF MEDICAL IMAGES

The DICOM Standard is an evolving standard and it is maintained in accordance with the Procedures of the DICOM Standards Committee. Proposals for enhancements are forthcoming from the DICOM Committee member organizations based on input from users of the Standard. These proposals are considered for inclusion in future editions of the Standard. A requirement in updating the Standard is to maintain effective compatibility with previous editions.

6. LOSSLESS COMPRESSION FOR MEDICAL IMAGES

Medical images are compressed due to their large size and repeated usage for diagnosing purposes. Certified radiologists and doctors assess the degree of image degradation resulting from various types and amounts of compression associated with several different digital image file formats. A qualitative, rather than a quantitative approach is normally chosen because radiologists typically evaluate images qualitatively in their day-to-day practice and, also, because common metrics used for comparing images pre- and post compression, e.g., mean pixel error, root mean square error, maximum error, etc., may not correlate well with visual assessment of image quality.BMP (bitmapped picture) is Microsoft Windows device-independent bitmap standard for loss-less format. Users of this format can depend on images being displayed on any Windows device.

7. PERFORMANCE EVALUATION PARAMETERS

The effectiveness of lossless compression schemes can be described using the following parameters

Compression Ratio: It is defined as the ratio of orginal file size to that of compressed file size.

Bit Rate:The Bit Rate is the average number of bits (fractional) required to encoded a pixel and is computed from the total number of bits encoded divided by the number of pixels.

Mean Square Error: The cumulative squared error between the original and the compressed image is shown by MSE.

$$\text{MSE}=\frac{1}{MN}\sum_{y=1}^{N}\sum_{x=1}^{M}[I(x,y)-I'(x,y)]2$$

Peak Signal to Noise Ratio: The peak error between the original and the compressed image is shown by PSNR.

$$\text{PSNR}=10log10\left(\frac{MAX\,I^2}{MSE}\right)=20log10\left(\frac{MAX_I}{\sqrt{MSE}}\right)$$

8. SYSTEM IMPLEMENTATION

Matlab Software 2017a consists of Various Modules:

1. The Input Module to retrieve the Medical Image as input.

2. Provide Security Feature by changing the DICOM unique identifier (UID).

3. Wavelet Decomposition module to provide wavelet compression using Daubechies wavelet of order 2.

9. COMPRESSION ALGORITHM

General flow of the Various Modules of Matlab Software is shown by the Algorithm below. Source code of this program is given below.

- Read an image from a DICOM file into the MATLAB workspace.
- Read the metadata from the same DICOM file.
- Apply Wavelet decomposition to provide Lossless compression of Image.

10. SIMULATION RESUIT

Simulation: The Images used in this project are shown in the Figure below.The Images for transformation are scanned directly from MATLAB R2017a.These Images are in DICOM format and are then converted to .dcm (dotcom).

Result:

Step1: Read an image from a DICOM file into the MATLAB workspace.

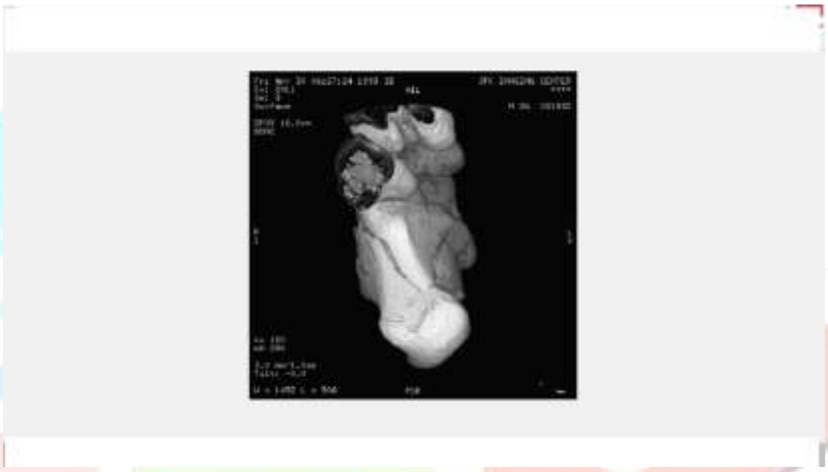

Figure1:Original image

Step2:Apply wavelet transform for the image

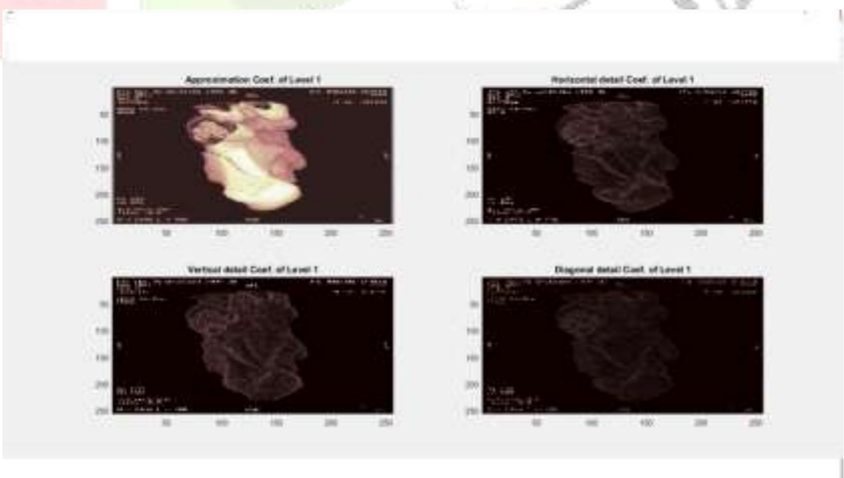

Figure 2: First level

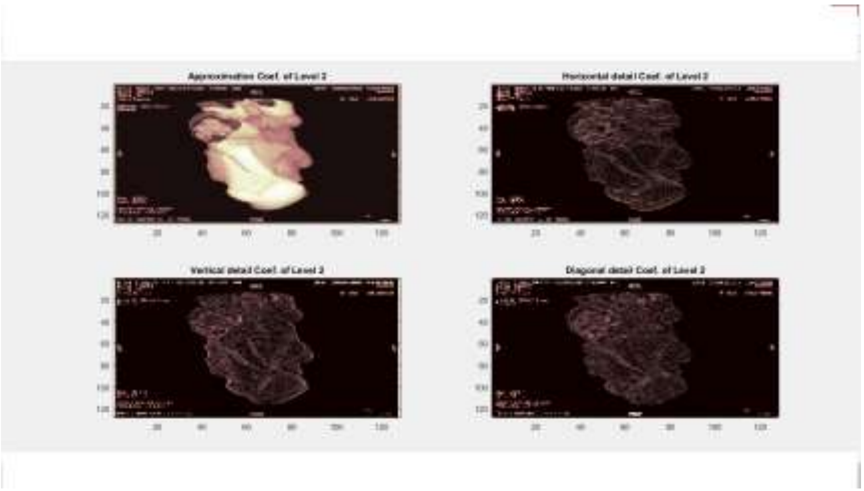

*Figure 3: **S**econd level*

Table 1: Calculation of Bit Rate, Compression Ratio, Mean Square Error, Peak Signal to Noise Ratio for level – 1

Type of wavelet	Bit Rate	Compression Ratio	Mean Square Error	Peak Signal to Noise Ratio
Db1	1.31	99.24%	0.25	54.151
Db2	1.50	99.336%	0.248	54.186
Db3	1.51	99.339%	0.246	54.221
Db4	1.53	99.349%	0.244	54.256
Db5	1.56	99.36%	0.242	54.292
Db6	1.62	99.38%	0.240	54.328

Table 2: Calculation of Bit Rate, Compression Ratio, Mean Square Error, Peak Signal to Noise Ratio for level – 2

Type of wavelet	Bit Rate	Compression Ratio	Mean Square Error	Peak Signal to Noise Ratio
Db1	0.63	96%	0.5625	50.629
Db2	0.73	96.07%	0.5566	50.675
Db3	0.76	96.1%	0.5537	50.698
Db4	0.79	96.16%	0.5479	50.743
Db5	0.79	96.2%	0.5450	50.766
Db6	0.82	96.21%	0.5398	50.812

11. CONCLUSION

In this paper we have developed a technique for wavelet transforms. It is found that the proposed method gives high reduction in Mean square error with a better quality of the reconstructed medical image judged on the basis of the human visual system (HVS).

So finally we can conclude that as compared to existing system .The proposed wavelet based method is very suitable for low Bit Rate Compression, high compression ratios, can perform lossless coding ,high PSNR,low MSE's as well as good visual quality of the image at low bit rates.It can also maintain the high diagnostic quality of the compressed image and hence can reduce heavily the transmission and the storage costs of the huge medical data generated everyday.

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