RESEARCH ARTICLE OPEN ACCESS

MRI Image Compression and Image De-noising using Encoding and Decoding Technique

Mrs. Aparna Singh Kushwah , Devendra Gour
Assistant Professor Electronics And Communications Department UIT-RGPV, Bhopal
Student Electronics And Communications Department UIT-RGPV, Bhopal
Corresponding auther : Mrs. Aparna Singh Kushwah

ABSTRACT:With ever increasing use of medical Magnetic resonance imaging (MRI), a challenge exists to deal with storage and transmission of these images while still maintaining high diagnostic quality. Considering this challenges, two part of image compression techniques are developed to improve the compression performance. In the first part of the research, an encoding and decoding approach is proposed to compress the image using selection of discrete wavelet transform (DWT) technique. In the second part of the research to noise attack and remove the noise with the help of filter. The performance efficiency of medical image compression methods are examined in terms of in terms of peak signal to noise ratio (PSNR), Normalize absolute error (NAE) and computtion time.

Keywords: - Image Compression, Image De-noising, DWT, PSNR, NAE, Computation Time

---

Date of Submission: 07-06-2018 Date of acceptance:22-06-2018

I. INTRODUCTION

Magnetic resonance imaging (MRI) is exceptionally prominent in the restorative industry since they have low reactions in patients and in addition requiring cheap and generally little hardware as contrasted and different innovations. Consistently, an enormous number of MRI pictures are created by doctor's facilities and therapeutic consideration focuses; which numerous should be put away for later references or transmitted among medicinal professionals. For instance, in restorative data and correspondence frameworks, for example, PACS (Picture Archival and Communication System), HIS (Hospital Information System) and RIS (Radiology Information System), utilizing proficient high rate picture compression routines is unavoidable. These frameworks need different assets to transform the created data, so they have expanding requirement for capacity and transmission. This examination addresses these difficulties and the requirements for methods with as high compression proportion as could reasonably be expected while keeping up acceptable indicative quality. There are many attempts to overcome the storage cost and transmission time challenges for MRI images including techniques based on the region of interest (ROI) coding. ROI based methods are able to compress the selected spatial regions of an image, instead of the entire image, to obtain higher output image quality as well as high compression ratio [1]. In medical domain, certain medical images such as MRI and CT necessitate lossless compression as even a negligible loss can lead to unfavorable effects. Moreover, attainment of high compression prediction is one of the methods so as to estimate current data from previously identified data. For example, in medical image compression applications, diagnosis is valuable only when compression techniques preserve the entire pertinent and significant image data required. In the past two decades, the frequently employed image compression technique for medical images is JPEG which integrates DCT transform with Huffman coding. During the last decade, on account of the necessity for enhancing the visual quality in compressed medical images, the wavelets (DWT) has continuously come out with flying colors in regard to image compression [2]. The vital qualities of wavelet transforms like Multi-resolution representation, energy compaction, blocking artifacts and de-correlation, have enabled the discrete wavelet transform (DWT) emerge as one of the most imperative techniques for image compression during the period [3]. Triggered by the immense success of wavelet in medical image compression, the familiar and the sophisticated image compression techniques for medical images are enlarged in accordance with integer wavelet transform with Embedded Block Coding with Optimized Truncation [4]. For the superior conservation of imperative image features and attainment of high compression ratios, simple DWT transform and fuzzy c-means clustering are proficiently integrated. Of late, the hybrid model of image compression has become the cynosure of the researchers [5].

II. DIFFERENT TYPES OF NOISE

Noise is added inside the picture at the time of photograph acquisition or transmission. Different factors may be accountable for introduction of noise inside the photo. The wide variety of pixels corrupted in the picture will decide the quantification of the noise. The fundamental assets of noise within the virtual image are:

a) The imaging sensor may be stricken by environmental conditions at some stage in picture acquisition.

b) Inadequate mild degrees and sensor temperature may additionally introduce the noise in the picture.

c) Interference in the transmission channel may also corrupt the photo.

d) If dirt debris is gift at the scanner display screen, they also can introduce noise inside the photograph.

Noise is the undesirable results produced within the picture. For the duration of photo acquisition or transmission, numerous elements are chargeable for introducing noise in the photo. Depending at the sort of disturbance, the noise can have an effect on the picture to special volume. Commonly our cognizance is to cast off sure kind of noise.

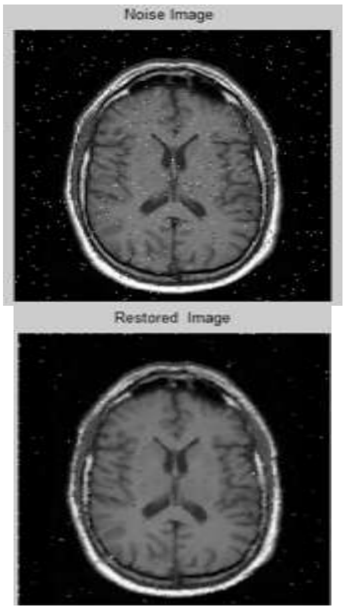

Figure 1: Salt and Pepper noise and original image

So we become aware of sure type of commotion and apply one of a kind calculation to get rid of the clamor. Picture commotion can be sorted as Impulse clamor (Salt-and-pepper clamor).

Gaussian Noise

Gaussian distribution which is also known as normal distribution whose Probability Density Function is equal to statistical noise known as Gaussian Noise. This noise is removed from the digital images by smoothening of the image pixels which helps in reducing the intensity of the noise present in the image which is caused due to acquisition but the result maybe sometime undesirable and also which can result in blurring edges of the high-quality images [2].

Speckle Noise

The Speckle Noise is defined as a noise which is present in the images and which degrades the quality of an image. Speckle Noise is a phenomenon that convoys all coherent imaging modal quality in which images are produced by interfering echoes of a transmitted waveform that originate from diversity of the studied objects [5].These are the granular noises that are fundamentally present in the image and reduce the quality of the active radar and Synthetic Aperture Radar (SAR) images or Magnetic Resonance [6]. Imaging (MRI) images is referred to as Speckle Noise. If Speckle Noise is present in the conventional radar results from random variations in the return signal from an object which is no longer image process signal increases the mean grey level in an image. A Speckle Noise is the coherent imaging of objects in the image. In fact, it is caused due to errors in data transmission. This kind of noise affects the ultrasound images and MRI images.

III. ELEMENTS OF LOSSY IMAGE COMPRESSION SYSTEM

In transform based image compression, the image is subjected to transformation and then the transformed data are encoded to produce the compressed bit stream. The general structure of a transform-based image compression system is shown in Figure 1. There are two versions of transform coding. One is frame based and the other is the block based. The block based approach requires fewer computations and allows adaptive quantization of coefficients.

In Figure 2, X represents the original image pixel values; Yi denotes the transformed values of the original image. All the transformed coefficients are then quantized and entropy coded which are represented by Ci. These compressed bit streams are either transmitted or stored. Reconstructed image can be obtained by decompressing the coded signal. The goal is to design a system so that the coded signal Ci can be represented with fewer bits than the original image X [8].

In the 1980’s, almost all transform based compression approaches were using the DCT. Later, the trend moved to compression schemes based on the DWT. DWT overcomes the effect of blocking artifacts associated with DCT. Perhaps the most significant improvement in conventional coding is achieved by the use of arithmetic coders instead of simple Huffman coders, which increases the compression ratio by 5-8%. However, the multimedia content in daily life is growing exponentially;

therefore, a performance gain of about 10% in ten years does not satisfy the demand. Therefore, researchers have been looking for new solutions that could solve the problem of the stagnating image compression performance.

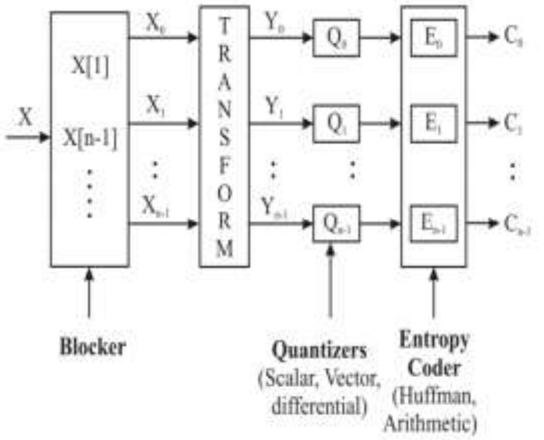

Figure 2: Transform-based image compression system

Finally, the quantized coefficients are coded to produce the compressed bit stream. The coding process typically exploits a statistical model in order to code symbols with fewer bits for symbols that has higher probability of occurrence. In doing so, the size of the compressed bit stream is reduced. Assuming that the transform employed is truly invertible, the only potential cause for information loss is in the coefficient quantization, as the quantized coefficients are coded in a lossless manner [9]. The decompression process simply mirrors the process used for compression. The compressed bit stream is decoded to obtain the quantized transform coefficients. Then, the inverse of the transform used during compression is employed to obtain the reconstructed image.

IV. PROPOSED METHODOLOGY

In DWT, image pixels are transformed into coefficient that is real values. The image is segregated into four regions, where the upper left of this region is the low resolution sub-band in which the energy of the image is concentrated. Then, it is combined with the other sub-bands to obtain the original reconstructed image. The wavelets transform decomposes the signal into group of basic function. These functions are known as wavelet as follows,

$$\Psi_{x,y}(z \quad \frac{1}{\sqrt{x}}\Psi\left(\frac{z-b}{x}\right)$$

(1)

Here, x denotes the scaling parameter, b represents the shifting parameter, Ψ is the wavelet coefficient and z is 1, 2… n size of the image. This work depends on transformation of HSI into DWT. The core tensor is decomposed in the coefficient resulted from the transform, and then perform inverse transform in order to obtain the original image. The major benefit of wavelet is that they allow both spatial and spectral resolution.

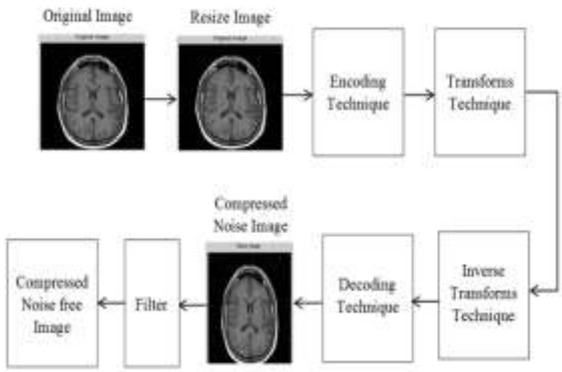

Figure 2: Block Diagram of Proposed Methodology

V. SIMULATION RESULT

The proposed calculations are tried utilizing 256x256 8bit/pixel image. In the reproduction, pictures are tainted by Salt and Pepper commotion. The commotion level shifts from 10% to 90% with augmentation of 10% and the execution is quantitatively measured by Mean square Error (MSE) and Peak Signal to Noise Ratio (PSNR).

Mean Square Error (MSE)

$$= \frac{1}{N_1 N_2}\sum_{j=1}^{N_2}\sum_{i=1}^{N_1}(f(i,j)-g(i,j))^2$$

(1)

Peak Signal to Noise Ratio (PSNR) in dB

$$= 10 \times \log_{10}(\frac{255^2}{MSE})$$

(2)

Where MSE remains for Mean Square Error, PSNR remains for Peak Signal to Noise Ratio. From the reproduction result appeared in Table I to II, it is watched that the execution of proposed calculation is enhanced PSNR than the current calculations at medium and high noise level.

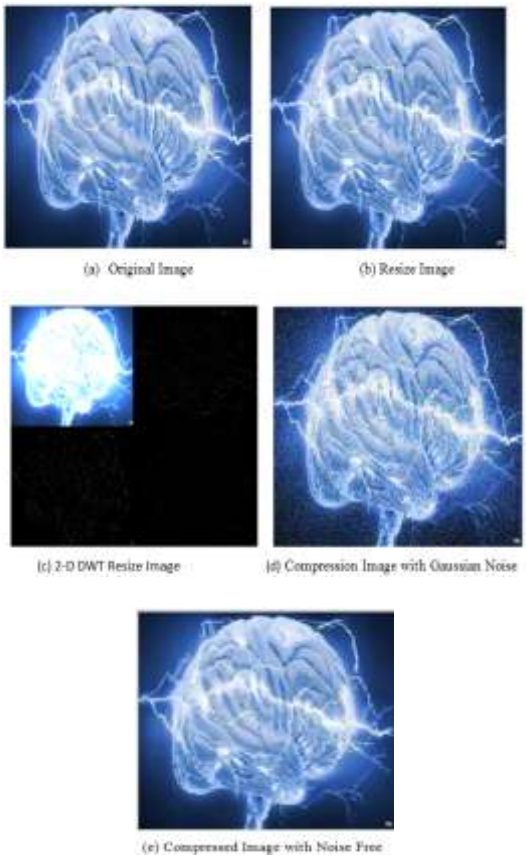

Figure 3: Hybrid Algorithm applied on MRI Image for Gaussian Noise

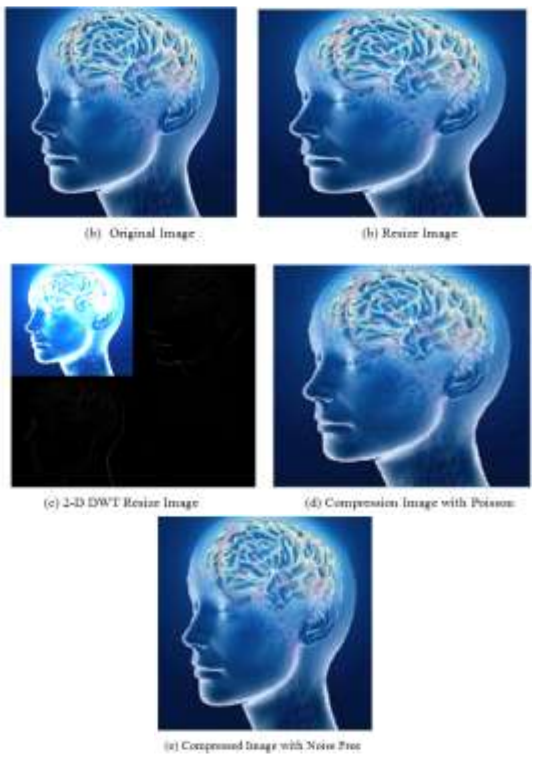

Figure 4: Hybrid Algorithm applied on MRI Image for Poisson Noise

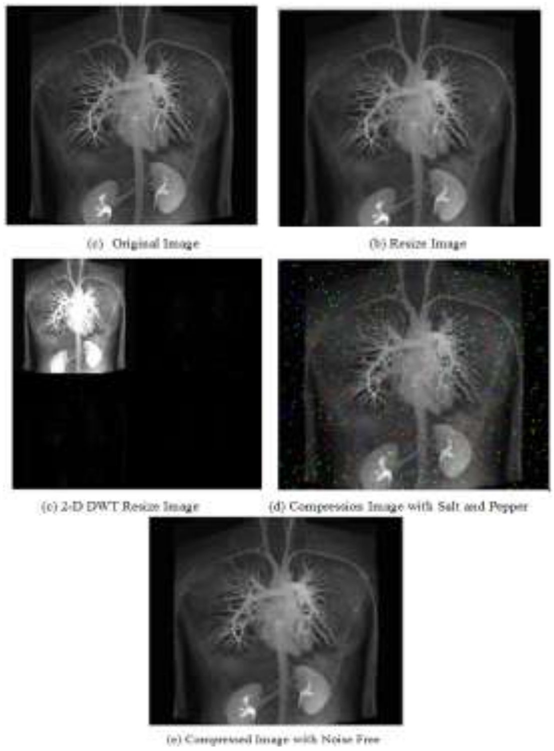

Figure 5: Hybrid Algorithm applied on MRI Image for Salt and Pepper Noise

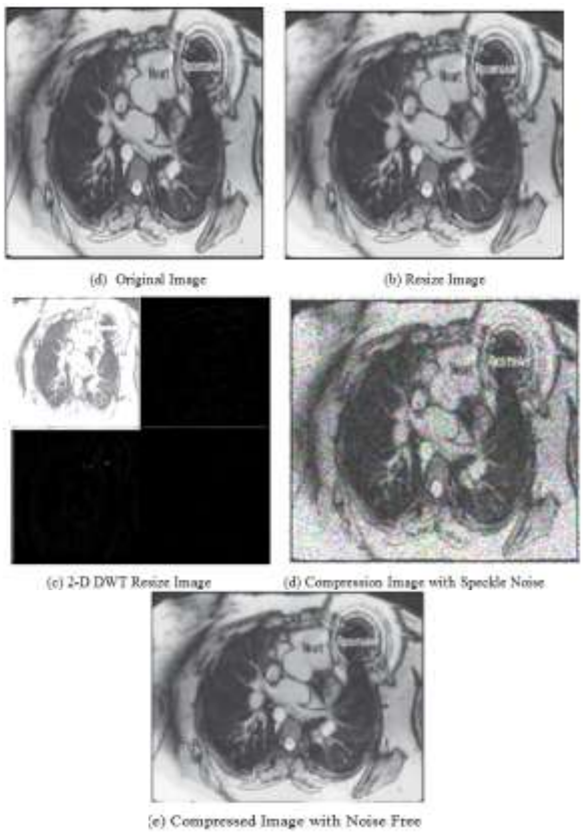

Figure 5: Hybrid Algorithm applied on MRI Image for Speckle Noise

Table 1: Experimental Results of Hybrid algorithm for Different Parameter

Image	Noise	NAE	PSNR (dB)	Computation Time
MRI-I	Gaussian Noise	2.278	40.318	0.9016
MRI-II	Poisson Noise	2.1374	40.773	1.2164
MRI-III	Salt and Pepper Noise	2.054	43.456	1.351
MRI-IV	Speckle Noise	2.453	42.406	1.532

Table 2: Comparison Result

Image	Peak Signal to Noise Ratio (dB)	
	Previous Algorithm	Proposed Algorithm
MRI-I	30.8	40.318
MRI-II	36.9	40.773
MRI-III	42.8	43.456

VI. CONCLUSION

In this paper, our compression method is based on two-dimensional discrete wavelet transform to approximate the image. The results show that the method performs better than previous method. At the same time, we make the proposed denoising method an experiment contrast with the traditional denoising method (such as median filtering method) as well as the classic of compressed sensing method .We can see that based on adaptive compression perception of generalized principal component analysis method has good performance in removing image noise, the method can remove noise while protecting the texture information of the original image.

REFERENCE

[1]. Dinu A J, Ganesan R, Abraham Alem Kebede, Balaji Veerasamy, “Performance Analysis and Comparison of Medical Image Compression Techniques”, International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT), 2016.

[2]. Sanjith S, Ganesan R, "Evaluating the Quality of Compression in Very High Resolution Satellite Images Using Different Compression Methods", International Journal of Engineering Research in Africa, Vol. 19, pp. 91-102,Mar. 2016.

[3]. Sanjith Sathya Joseph, Ganesan Ramu, "Performance Evaluation of Basic Compression Methods for Different Satellite Imagery", Indian Journal of Science and Technology, Vol. 8 Issue 19, Aug. 2015.

[4]. Sanjith S, Ganesan R, Rimal Isaac R. S. "Experimental Analysis of Compacted Satellite Image Quality Using Different Compression Methods", Adv Sci Eng Med Vol. 7, pp. 17, Mar 2015.

[5]. Sanjith S, Ganesan R, Fusion of DWT-DCT Algorithm for Satellite Image Compression", International Journal of Applied Engineering Research, ISSN 0973-4562, Vol. 10,pp. 130-137, Jul 2015.

[6]. Sanjith S, Ganesan R. "A Review on Hyperspectral Image Compression", Control, instrumentation, communication and computational technologies (ICCICCT). International Conference, Kanyakumari, India. , pp. 10-11, Jul 2014.

[7]. Ansari M.A., R.S. Anand "Comparative Analysis of Medical Image Compression Techniques and their Performance Evaluation for Telemedicine", Proceedings of the International Conference on Cognition and Recognition, pp. 670-677, 2014.

[8]. Smitha Joyce Pinto, Prof. Jayanand P. Gawande "Performance analysis of medical image compression techniques”, Proceedings of the Institute of Electrical and Electronics Engineers IEEE, 2012.

[9]. M.A. Ansari , R.S. Anand "Performance Analysis of Medical Image Compression Techniques with respect to the quality of compression” IET-UK International Conference on Information and Communication Technology in Electrical Sciences (ICTES 2007) Chennai Tamil, India , pp. 743-750. Dec. 2007.

Mrs. Aparna Singh Kushwah "MRI Image Compression and Image De-noising using Encoding and Decoding Technique "International Journal of Engineering Research and Applications (IJERA) , vol. 8, no.6, 2018, pp.27-31