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RESEARCH ARTICLE

DIFFERENT COMPRESSION TECHNIQUES ON ULTRASOUND IMAGING.

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Abstract

Medical Imaging is an important keystone of modern healthcare and will continue to play a role of ever increasing importance at all levels of the healthcare system due to advances in imaging technology (US,CT, MR and Molecular Imaging). Since the medical image data is increasing day by day, compression is needed to achieve efficient transmission and storage. Different compression techniques are compared and applied to diverse ultrasound images. Clinicians who are using ultrasound transducer or probe for diagnosis needs a better quality image for better observation so that they can analyze the disorder of structure and steer medication. From the results it is observed that Wavelet based compression offers better image appearance with Gamma and Log compression techniques.

Introduction:-

Over the past decade, medical imaging data has experienced exponential growth, creating a huge demand for data storage. Medical image archives are increasing by 30-50 % annually. Images are usually being archived longer by health providers than regulatory requirements. Digital medical images like X-Ray, Magnetic Resonance Imaging (MRI), Ultrasound (US), Computed Tomography (CT) are extensively used in diagnosis.

The ease of storing and transmission of digital medical images is a boon to patients and medical professionals. So for that numerous and diverse image compression methods have been proposed to compress medical images [see 1-2]. Image storage is required most commonly for educational, business documents and medical images [3]. Image data compression techniques are concerned with reduction of the number of bits required to store or transmit images without any appreciable loss of information.

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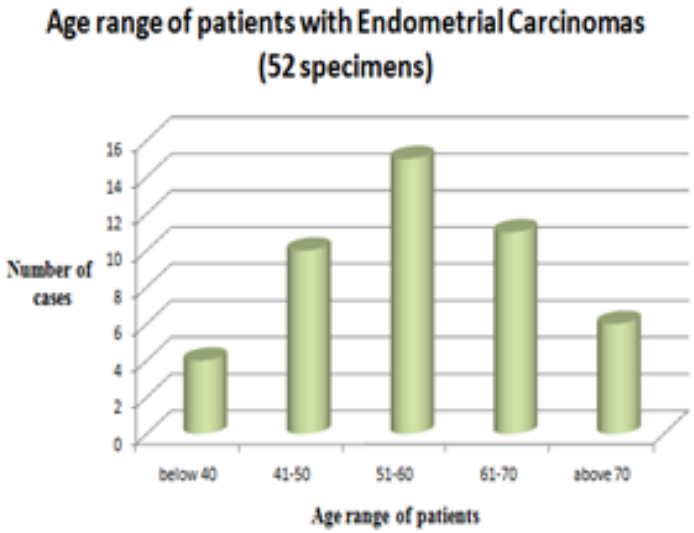

Fig.1:- Study carried out on 52 specimens of endometrial tumors received in Fatima Memorial Hospital, Lahore, Pakistan, during three years (2010–2012).(Adapted from Imran et al. [4]).

Image compression can be classified as lossy and lossless. Lossless compression techniques compress with no data loss but have low compression rate LOCO-I [5], CALIC [6], JPEG-LS [7],and JPEG 2K (5/3) [8] and lossy compression techniques can compress at high compression ratio but with a slight loss of data such as JPEG [9], JPEG2K(9/7) [see 10-11].

Developing countries like India facing the risk of endometrial cancer over many years. Every year in India, around 122,844 women are diagnosed with cervical cancer and 67,477 die from this disease.Most case of endometrial cancer occur between the ages of 50 and 60 years, but a few cases may occur before age 40 (Fig.1) .So early detection ofthis type of cancer can play an important role in reducing theassociated morbidity and mortality rates[12].

The remaining part of the paper is organized as follows: Section II various local and global compression methods on ultrasound modeling are studied. Section III presents the results based on visual quality assessment indices and section IV concludes the paper.

Ultrasonography and Compression Methods:-

For the proper identification and detection of abnormalities in the internal body structures of human body, certain ultrasonic tissue characterization methods are used. Ultrasound images or sonograms are formed by transmitting ultrasound pulses to target tissues using a probe. Reflected degrees of sound waves will be different for different tissues. These reflected sound waves are recorded and displayed as an image which can be viewed and can be used for diagnosis. The reflected echo R_e (t) with varying values of N are given in [13]. It is expressed as,

$$R_e(t) = \sum_{n=1}^{N} \alpha_n \cos(w_0(t) + \varphi_n) \quad (1)$$

where w_0 is the mean frequency and N represents the number of scatterers occurring in the cell. The amplitude and phase of each scatterer is denoted by α_n and Φ_n.

Gamma Compression:-

Gamma correction is a non-linear operation used to correct the image brightness level called luminance of each pixel in an image. These functions will maps luminance levels to compensate the non linear luminance effect of display devices. According to power-law expression

$$Y=AX^{\gamma} \quad (2)$$

where the input value X is raised to the power gamma to get the output value Y. Gamma value $\gamma < 1$ is called gamma encoding or compression. This will make the dark regions brighter as shown in Fig.4 with gamma value 0.6. Gamma value $\gamma > 1$ is called Gamma decoding or Gamma expansion

Log Compression:-

Logarithmic transformation maps narrow range of low level gray scale intensity values to wider range of output values. The compression is done by replacing each of the input pixel value to its logarithmic value. It is given by the expression

$$Y=A \log (1+r) \quad (3)$$

Where A is constant and it is assumed that r>=0.

Wavelet Based Compression:-

DWT transforms a discrete time signal to a discrete wavelet representation which allows good localization in both time & frequency domain.

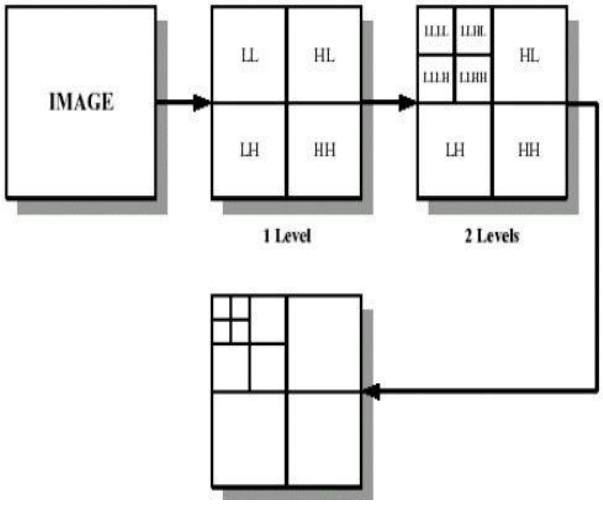

Fig 2:- 2D DWT for an image

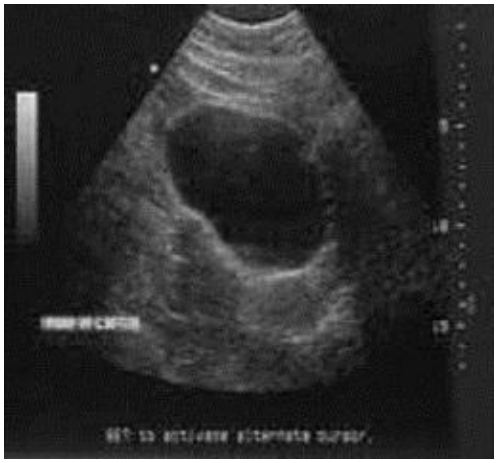

Fig 3:- Original Uncompressed Image

Fig 4:- Log Compressed Image

Fig 5:- Gamma Compressed

Fig 6:-DWT Compressed Image.

Results:-

Log-compressed, Gamma compressed and Wavelet based compressed images as shown in above figures respectively. Graphical representation of the above compression methods is shown in Fig 7. In that dwt gives leading performance in terms of psnr ratio. It also ensures better image retrieval for good resolution which aids in good diagnosis

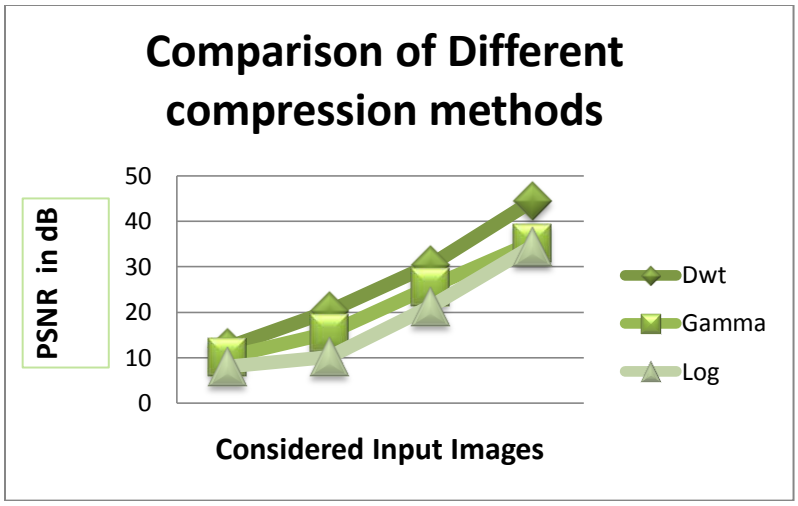

Fig 7:- Graphical representation of different compression methods.

Conclusion:-

A typical 12 bit medical image may be 2048 pixels by 2570 in dimension. This can be converted to a file size of 15,485,760 bytes. This has consequences of disk storage and image transmission time. This paper focuses on the performance evaluation of various compression techniques for ultrasound imaging system that can be used for patient diagnosis and treatment.

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