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Medical Image Compression Using ISPIHT & Modified JPEG2000 Hybrid

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Abstract: ***Compression means reducing the number of bits required to represent the data. Compression plays a crucial role in the field of image processing. The images produced using various digital techniques are required to be compressed in accordance with the area of application. Digital imaging is an integral part of the field of medicine. A large amount of medical images are produced every day and the number is on the rise. Medical images also need to be compressed so that they do not consume up large amount of valuable resources like storage drives and network bandwidth as well. This paper presents a hybrid compression method developed by improving and combining two existing compression techniques viz. SPIHT and JPEG2000. The compressed images are evaluated on the basis of various quality matrices which are PSNR, MSE and entropy.***

Keywords: Image compression, lossless compression, medical images, ISPIHT, JPEG2000, PSNR, MSE, Entropy

1. Introduction

Image compression is the procedure of encoding data utilizing less bits (or other data bearing units) than an encoded representation would use through utilization of particular encoding plans. Compression is valuable on the grounds that it lessens the utilization of valuable assets, for example, hard disk space or transmission transfer speed. On the drawback, compacted information must be decompressed, and this additional preparing may be unfavourable to a few applications. For instance, a compression plan for picture may require costly equipment for the picture to be decompressed quick enough to be seen as its being decompressed (the choice of decompressing the picture in full before viewing it might be badly designed, and obliges storage room for the decompressed picture). The outline of information clamping plans hence includes exchange offs among different elements, including the level of compression, the measure of compression presented (if utilizing a lossy compression plan), and the computational assets needed to pack and un-compress the information. Image compression is an application of information layering on advanced images. Image compression is minimizing the size in bytes of a design document without degrading the nature of the image to an inadmissible level. The diminishment in document size permits more pictures to be put away in a given measure of circle or memory space. It additionally decreases the time needed for pictures to be sent over the Internet or downloaded from Web pages. There are a few diverse courses in which picture documents can be packed. For Internet utilize, the two most regular layered realistic picture organizations are the JPEG and SPIHT algorithms.

2. Lossless Image Compression

Lossless or reversible compression refers to compression techniques in which the reconstructed data exactly matches the original [2].Lossless compression indicates compression strategies, which give quantitative limits on the way of the misfortune that is presented. Such compression systems give they ensure that no pixel contrast between the first and the layered picture is over a given quality. It discovers potential applications in remote sensing, medicinal and space imaging, and multispectral picture chronicling. In these applications the volume of the information would call for lossy compression for functional stockpiling or transmission. Then again, the need to save the legitimacy and exactness of information for resulting observation, finding operations, scientific dissection, and logical or clinical estimations, frequently forces strict stipulations on the remaking mistake. In such circumstances lossless compression turns into a reasonable arrangement, as, from one perspective, it gives fundamentally higher compression picks up opposite lossless calculations, and then again it gives ensured limits on the way of errors presented by compression.

2.1. Joint Photographic Experts Group (JPEG)

JPEG stands for Joint Photographic Experts Group, the first name of the Committee that composed the standard. JPEG is intended for compacting full-shade or grey scale pictures of common, demonstrable scenes. It works well on photos, naturalistic craftsmanship, and comparable material; not all that well on lettering, basic comics, or line drawings. JPEG handles just still pictures, however there is a related standard called MPEG for movies. The JPEG2000 is a coding scheme that was presented in the year 2000; it provides both lossy and lossless compression schemes.

2.2 Set Partitioning in Hierarchical Trees (SPIHT)

SPIHT is the wavelet based image compression system. It gives the Maximum Image Quality, progressive picture transmission, completely installed coded record, Simple quantization calculation, quick coding/translating, totally versatile, Lossless compression, exact bit rate coding and Error protection [6]. SPIHT makes utilization of three rundowns – the List of Significant Pixels (LSP), List of Insignificant Pixels (LIP) and List of Insignificant Sets (LIS). These are coefficient area records that hold their directions. After the instatement, the calculation takes two

stages for each one level of edge – the sorting pass (in which records are sorted out) and the refinement pass (which does the genuine dynamic coding transmission). The result is as a bit stream. It is equipped for improving the image consummately (each and every bit of it) by coding all bits of the convert. Then again, the wavelet convert yields perfect recreation just on the off chance that its numbers are put away as boundless imprecision numbers. Top sign to-commotion proportion (PSNR) is one of the quantitative measures for picture quality assessment which is focused around the mean square slip (MSE) of the re-created picture. The MSE for N x M size picture is give:

$$MSE = \frac{1}{MN}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}\|I(i,j) - K(i,j)\|^2$$

Where *f (i,j)* is the original image data and *f ' (i,j)* is the compressed image value. The formula for PSNR is given by:

$$PSNR = 10 \log ((255)^2 / MSE)$$

The SPIHT method has been improved by changing the wavelet transformation method from HAAR to MFHWT. The MFHWT is an improved fast version of HAAR wavelet transformation method which gives out results faster as compared to HAAR technique.

3. Proposed Method

The proposed method is a combination of two lossless compression techniques; ISPIHT and modified JPEG2000. The JPEG2000 has been modified by addition of block matching before the quantization process. By additional block matching, better compression SPIHT and JPEG2000 provide good compression results and hence their combination is used to create a new compression scheme based on both of them.

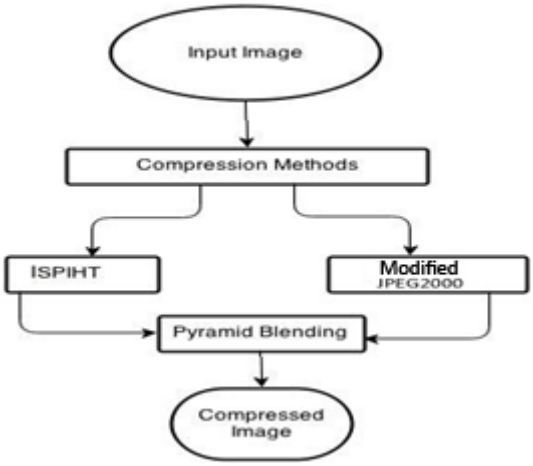


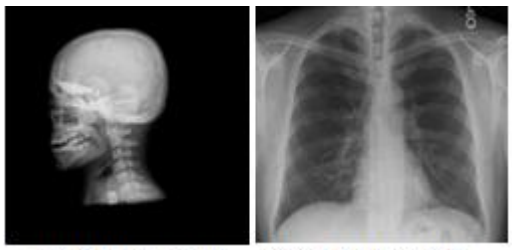
Figure 2: Flow Chart of the proposed method

4. Results and Discussion

The two compression techniques are combined using MATLAB. The results show that combining two different compression schemes can provide even better results. This has been shown by the results of the proposed method. This method has been implemented on a set of different gray-scale medical images. The different steps in the proposed algorithm are:

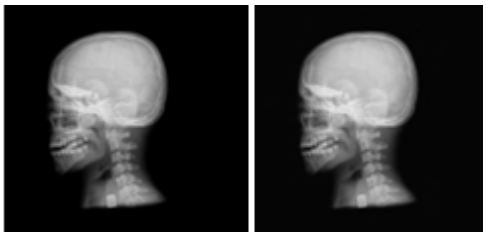
1) Consider the input image (gray-scale)
2) Compress the image using ISPIHT and JPEG200 differently and calculate PSNR, MSE and entropy
3) Combine the compressed images using pyramid blending and calculate PSNR, MSE and entropy of the final image.

The gray-scale medical images that used during the implementations are shown below:

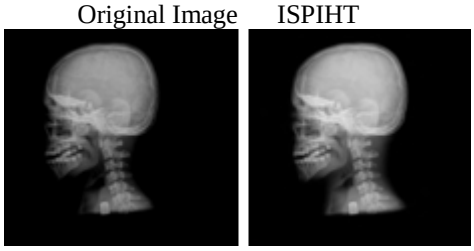


Skull Radiograph Chest Radiograph

After compressing the above images, the resulting compressed images are shown in the figures below:

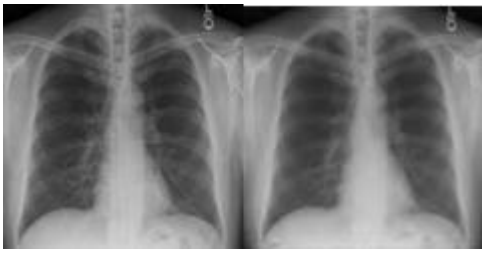


Original Image ISPIHT

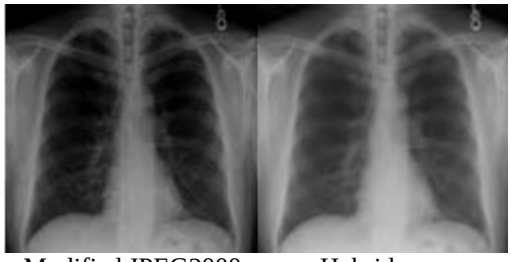


Modified JPEG2000 Hybrid

Figure 3: Skull Images



Original Image ISPIHT



Modified JPEG2000 Hybrid

Figure 4: Chest Images

The values for PSNR, MSE and Entropy for the skull and chest image are as shown in the following table:

Image	*Compression Method*	*PSNR*	*MSE*	*Entropy*
Skull	ISPIHT	53.744	134.6697	3.42
Skull	Modified JPEG2000	20.7754	5993.932	3.1939
Skull	Hybrid	85.1003	3.643	3.4054
Chest	ISPIHT	53.5141	138.285	7.4256
Chest	Modified JPEG2000	12.8369	14949.7408	7.4332
Chest	Hybrid	71.4766	17.4843	7.3958

Fig. 5 Values of different compression quality parameters

Graph showing variations for quality parameters for skull radiograph after applying different compression methods.

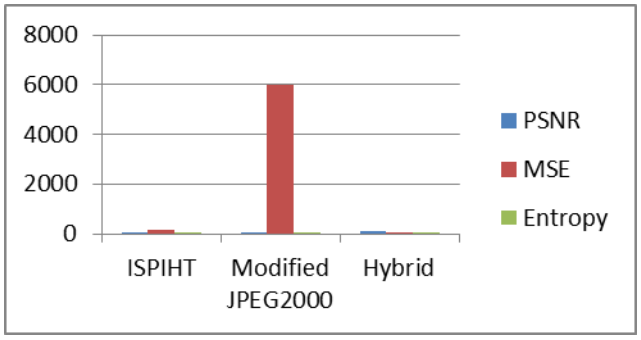


Figure 5: Comparison of Quality Parameters

Graph showing variations for quality parameters for chest radiograph after applying different compression methods.

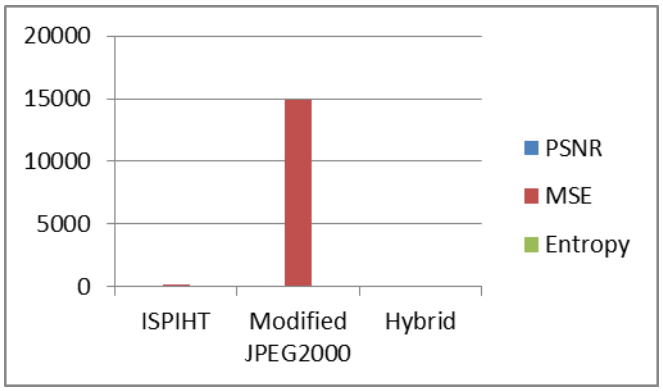


Figure 6: Comparison of Quality Parameters

It is clear from above findings that the value of PSNR comes to be highest in the proposed method. The amount of information that must be coded by the compression algorithm is specified by the value of entropy. The results show that the loss of such information is minimized in the proposed method side by side giving a higher quality output image.

5. Conclusion

In this paper the performance of the hybrid compression method composed of ISPIHT and modified JPEG2000 is shown by the values of PSNR, MSE and entropy. In my previous findings I combined ISPIHT and JPEG2000 and showed its results compared to both the techniques. In this research I have tried to improve the results by adding block matching to JPEG2000 and improving its performance. The results show the hybrid compression to be better than both SPIHT and JPEG2000 schemes applied alone.

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