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A SURVEY ON VARIOUS MEDICAL IMAGE COMPRESSION TECHNIQUES

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ABSTRACT

The need for an efficient technique for compression of Images ever increasing because the transmission & storage. Telemedicine characterized by transmission of medical data and images between users is one of the emerging fields in medicine.Huge bandwidth is necessary for transmitting medical images over the internet. Resolution factor and number of images per diagnosis makes even the size of the images that belongs to a single patient to be very large in size. So there is an immense need for efficient compression techniques for use in compressing these medical images. Each ofthe regions that are considered to be more important than others in medical images is termed as a Region of Interest (ROI)e.g. tumor region of the brain MRI. Thus, the regions of interest can be coded with high spatial resolution than the background while transmitting the images. By this, ROI of high compression rate and high quality can be obtained. This paper reviews the application of ROI coding in the field of telemedicine. ROI coding with high spatial resolution than the background is accomplished using tiling method. High compression ratio is achieved by obtaining the ROI through user interaction and coding with the user given resolution. The experimental result shows that the application of ROI coding achieves high compression rate and quality ROI.This paper outlines the comparison of compression methods such as JPEG-LS and Interframe Coding, Optimized Volume of Interest Coding, Motion Compensation and Customized Entropy Coding, EZW Encoding with Huffman Encoder, Curvelet Transform, Visually lossless compression, Simple Selective Scan order with Bit Plane Slicing on the basis of compression ratio and compression quality.

Keywords:—Image compression, Telemedicine, Region of Interest (ROI), Huffman codes, Huffman encoding, Huffman decoding, symbol, source reduction ,JPEG-LS, Pipeline, FMRI, EZW, Curvelet Transform, Predictive Compression, Hybrid Compression

INTRODUCTION:

Two ways of classifying compression techniques are mentioned here:

(a) Lossless vs. Lossy compression: In lossless compression schemes, the reconstructed image, after compression, is numerically identical to the original image. However lossless compression can only a achieve a modest amount of compression. An image reconstructed following lossy compression contains degradation relative to the original. Often this is because the compression scheme completely discards redundant information. However, lossy schemes are capable of achieving much higher compression. Under normal viewing conditions, no visible loss is perceived (visually lossless).

(b) Predictive vs. Transform coding: In predictive coding, information already sent or available is used to predict future values, and the difference is coded. Since this is done in the image or spatial domain, it is relatively simple to implement and is readily adapted to local image characteristics. Differential Pulse Code Modulation (DPCM) is one particular example of predictive coding . Transform coding, on the other hand, first transforms the image from its spatial domain representation to a different type of representation using some well-known transform and then codes the transformed values (coefficients). This method provides greater data compression compared to predictive methods, although at the expense of greater computation.

NEED OF IMAGE COMPRESSION

Images transmitted over the internet are an excellent example of why data compression is important. Suppose we need to download a digitized color photograph over a computer's 33.6 kbps modem. If the image is not compressed (a TIFF file, for example), it will contain about 600 kilo bytes of data. If it has been compressed using a lossless technique (such as used in the GIF format), it will be about one-half this size, or 300 Kbytes. If lossy compression has been used (a JPEG file), it will be about 50 Kbytes. The download time for these three equivalent files are 142 seconds, 71 seconds, and 12 seconds, respectively which is a huge difference .JPEG is the best choice for digitized photographs, while GIF is used with drawn images, such as company logos that have large areas of a single color.

MEDICAL IMAGE & COMPRESSION

The compression of medical images has a great demand. The image for compression can be a single image or sequence of images. The medical community has been very reluctant to adopt lossy algorithms in clinical practice. However, the diagnostic data produced by hospitals has geometrically increased and a compression technique is needed that results with greater data reductions and hence transmission speed. In these cases, a lossy compression method that preserves the diagnostic information is needed. Medical image sequences called Volumetric Medical Image (VMI) or 3-D medical data needs efficient image compression solving storage and transmission problems and also preserving diagnostic information. In these cases, a lossy compression method that can preserve the diagnostic information is needed. Visually indistinguishable resultant images at high quality can be obtained using lossy compression techniques, for compression rates much greater than those obtained by lossless compression techniques. That is, human eye cannot detect a difference between the original image and the compressed then decompressed image with the lossy compression method. Compression is not just about the storage costs, it is also about transmission time, imaging apparatus utilization and convenience/comfort of the patient. Compression techniques can reduce file size and transmission time, thus improving overall care. Image compression techniques take advantage of redundancy that occurs. There are different types of redundancy. Each compression methodology will exploit one of these redundancies. The different types of redundancies are spatial, temporal and spectral. The research presented here will focus on the first of these three types of redundancies although the techniques can be used in the others also. It will make use of spatial redundancies since static spatial X-rays will be used.

IMAGE COMPRESSION TECHNIQUES:

In this section, a few newly proposed techniques for image compression, based on lossy, lossless and mixed of both methods for compression of medical images so that, image data are reduced while image information is totally preserved.

JPEG-Compliant Perceptual Coding for A Grayscale Image Printing Pipeline,1999

Rick A. Vander Kam [3] describe a procedure by which Joint Photographic Experts Group (JPEG) compression may be customized for gray-scale images that are to be compressed before they are scaled, half toned, and printed. Our technique maintains 100% compatibility with the JPEG standard, and is applicable with all scaling and half toning methods. experimental results suggesting that the customized JPEG encoder typically maintains "near visually lossless" image quality at rates below 0.5 b/pixel (with reference to the number of pixels in the original image) when it is used with bilinear interpolation and either error diffusion or ordered dithering. Based on these results, we believe that in terms of the achieved bit rate, the performance of our encoder is typically at least 20% better than that of a JPEG encoder.

Robust Image Transmission Using Re-synchronizing Variable-Length Codes and Error Concealment, 2000

Sheila S. Hemami [5] used Re-synchronizing variable-length codes for large alphabet sizes are designed by first creating re-synchronizing Huffman codes and then adding an extended synchronizing codeword, and the RVLC's are applied to both JPEG and wavelet-based image compression. The RVLC-JPEG images have negligible overhead at visually lossless bit rates, while the RVLC-wavelet overhead can be adjusted based on the desired tolerance to burst errors and typically ranges from 7 to 18%.

Perceptually Lossless Medical Image Coding, 2006

David Wu [7] Proposed a coder which Out performs the LOCO coder while preserving the visual fidelity of the image the heart of the proposed coder is the implementation of a visual pruning function combined with a vision model to identify and to remove visually insignificant information, achieving simplicity and modularity. The visual pruning function can be embedded into any Wavelet based coding framework while maintaining bit-stream compliance, superior compression ratio gains over that of its information lossless counterparts without any visible distortion.

Novel Lossless FMRI Image Compression Based on Motion Compensation and Customized Entropy Coding, 2009

Victor Sanchez [4] proposed a method for lossless compression of 4-D medical images based on the advanced video coding standard (H.264/AVC) a new context-based adaptive binary arithmetic coder designed for lossless compression of the residual and motion vector data. The proposed method effectively reduces data redundancies in the spatial and temporal dimensions by employing a 4-D search, VSBM, and bidirectional prediction for motion estimation. An average improvement on lossless compression ratio of 13% on real fMRI data when compared to 4D-JPEG2000 and H.264/AVC.

A Lossless Compression Method for Medical Image Sequences Using JPEG-LS and Interframe Coding, 2009

Shaou-Gang Miaou[1] have proposed a method that combines the JPEG-LS and an inter frame coding with motion vectors to enhance the compression performance of using JPEG-LS alone. Since the inter frame correlation between two adjacent images in a medical image sequence is usually not as high as that in a general video image sequence, the inter frame coding is activated only when the inter frame correlation is high enough. With six capsule endoscope image sequences under test, the proposed method achieves average compression gains of 13.3% and 26.3% over the methods of using JPEG-LS and JPEG2000 alone, respectively. Similarly, for an MRI image sequence, coding gains of 77.5% and 86.5% are correspondingly obtained.

3-D Scalable Medical Image Compression With Optimized Volume of Interest Coding, 2010

Rafeef Abugharbieh [2] presents a novel 3-D scalable compression method for medical images with optimized volume of interest (VOI) coding. The method is presented within the framework of interactive telemedicine applications, where different remote clients may access the compressed 3-D medical imaging data stored on a central server and request the transmission of different VOIs from an initial lossy to a final lossless representation. The proposed method achieves higher reconstruction qualities than those achieved by 3D-JPEG2000 with VOI coding at a variety of bit-rates. We also demonstrated that the proposed method attains lossless compression ratios comparable to those attained by 3D-JPEG2000 with VOI coding.

Still Image Compression by Combining EZW Encoding with Huffman Encoder, 2011

Janaki. R [6] proposed a technique for image compression which uses the Wavelet-based Image Coding in combination with Huffman encoder for further compression. It aims to determine the best threshold to compress the still image at a particular decomposition level by combining the EZW encoder with Huffman Encoder. Compression Ratio (CR) and Peak-Signal to-Noise (PSNR) is determined for different threshold values ranging from 6 to 60 for decomposition level 8.

Lossless Predictive Compression of Medical Images, 2011

Aleksej Avramovic[11] describes predictive lossless image compression process. Also, the most important predictors of the most important algorithms for lossless compression are described, which are accepted in standards or that are representative to their characteristics. Novel solution for the simple linear prediction is based on the detection of edges, called the GED and its comparison with the described predictors is made. GED algorithm is a mixture of distinguish features of most representative linear predictors, namely MED and GAP. Proposed predictor has shown satisfactory results on a chosen set of uncompressed medical images.

Efficient Image Compression based on Region of Interest, 2011

Balpreet Kaur [13] proposed the ROI is compressed with lossless and lossy techniques. Compression is used to compress the image so that it can be further transferred through the internet with in the low bandwidth. After the compression when both the images are compared with one another the root mean square error (RMSE) is very low which means the data lost during compression is negligible that can't be recognized with the human eyes. And also the PSNR is always between the ranges 20-40 which is considered as good.

A Survey on Lossless Compression for Medical Images , 2011

M.Ferni Ukrit [10] performed a survey on various lossless compressing techniques. For medical images various compression algorithm like Lossless JPEG, JPEG-LS, JPEG 2000, PNG and CALIC are used and

JPEG-LS is found to be the best algorithm based on compression speed and compression ratio.

A Survey on Various Compression Methods for Medical Images, 2012

Mrs.S.Sridevi M.E (Ph.D)[12] used various medical image compression techniques such as JPEG2000 image compression, JPEG2000 scaling based ROI coding, JPEG2000 MAXSHIFT ROI coding, Shape Adaptive wavelet transform and scaling based ROI, Discrete cosine transform, Discrete wavelet transform, Mesh based coding scheme, Subband block hierarchical partitioning are reviewed.

An Efficient Coloured Medical Image Compression Scheme using Curvelet Transform, 2012

A. Sivanantha Raja [8] describes a novel approach to Medical Image Compression using the Curvelet Transform. This transform has shown promising results over various transforms for 2-D medical images. It employs the Curvelet transform in combination with Lifting Wavelet Transform and Huffman Coding for medical image compression, which exhibits good approximation properties for smooth 2D medical images. This method gives higher
compression ratio compared other compression schemes proposed earlier. So the proposed method has efficient Medical image compression with perfect reconstruction capability.

A Novel Visually Lossless Spatial Domain Approach for Medical Image Compression, 2012

Marykutty Cyriac [9] proposed a method in which, the run length is stored in the pixel value itself for single run pixels thus reducing the size of the encoded vector. The technique is visually lossless and compresses images with high quality CT/MRI images are compressed using the proposed technique. Visually lossless compression with high PSNR value is obtained Further reduction can be achieved through entropy encoding This approach is appropriate for fast hardware implementation of the encoder and the decoder leading to real time applications.

Hybrid Image Compression Using DWT, DCT & Huffman Encoding Techniques, 2012

Harjeetpal Singh [15] presents a hybrid model which is the combination of several compression techniques. This paper presents DWT and DCT implementation because these are the lossy techniques and also introduce Huffman encoding technique which is lossless. PSNR and MSE will go better than the old algorithms and due to DWT and DCT we will get good level of compression. The results show that the proposed hybrid algorithm performs much better in term of peak-signal-to-noise ratio with a higher compression ratio compared to standalone DCT and DWT algorithms.

Hybrid Algorithm for Lossless Image Compression using Simple Selective Scan order with Bit Plane Slicing, 2012

Pasumpon Pandian [14] proposed a new hybrid image coding algorithm based on a sequencing that is simple to cast and encode the bit planes. The core idea is to sequence
the bits in the bit plane with selected scan order and then encode the bits by the combination of Run Length and modified Huffman coding scheme. Moreover, two
coding modes are proposed for efficient compression requirements particularly in the applications of medical and satellite image compression. The proposed HALIC lossless coding algorithm obtains the good results when compared to the JPEG-LS and CALIC standards achieved on specified image test set.

CONCLUTION:

This paper investigates mainly on the various types of medical image compression techniques that are existing, and putting it all together for a literature survey. Scope of this study focuses on the different available medical image compression techniques with their performance results. In this paper we performed a survey on various lossless compression techniques on medical images and Comparative analysis of compression methods is carried out. Comparative analysis is done on the basis of two parameters compression ratio and compression quality.

Survey results illustrate that the customized JPEG encoder typically maintains "near visually lossless" image quality at rates below 0.5 b/pixel and performance of encoder is typically at least 20% better than that of a JPEG encoder, RVLC's are applied to both JPEG and wavelet-based image compression. The RVLC-JPEG images have negligible overhead at visually lossless bit rates, Compensation and Customized Entropy Coding is used for FMRI compression and improvement on lossless compression ratio of 13% on real fMRI data when compared to 4D-JPEG2000 and H.264/AVC ,JPEG2000 with VOI coding used for image like MRI, Ultrasound ,CT scan. For medical images various compression algorithm like Lossless JPEG, JPEG-LS, JPEG 2000, PNG and CALIC are used and JPEG-LS is found to be the best algorithm based on compression speed and compression ratio. Curvelet Transform and Huffman Coding gives higher compression ratio compared other compression schemes proposed earlier, HALIC lossless coding algorithm obtains the good results when compared to the JPEG-LS and CALIC

Hence some existing medical image compression techniques has been discussed well with their performance results, image quality of the image after compression is the main criteria that all the compression techniques should hold .To conclude, all the compression techniques are useful for real-time medical image transmission or storage process. Each technique is different and gives appropriate results for the each technique. Everyday new compression technique is evolving hence selection of high PSNR value will lead to maintain the quality of the image and success in compression process.

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