A SURVEY ON MEDICAL IMAGE COMPRESSION USING HYBRID COMPRESSION TECHNIQUE (DWT, DCT AND HUFFMAN CODING)

Thaneshwar kumar*

Dr.Ramesh kumar**

Abstract-

Medical images are having a very significant role in health sciences medical images are produced by the mechanism of medical imaging which is the process of creating images of the human body or body parts using various techniques to reveal diagnose or treat a disease. Analysis of these images by the experts leads to detection of a certain and specific medical condition. Image compression plays a crucial role in medical imaging allowing efficient storage & transmissions. Discrete cosine Transform (DCT) and discrete wavelet transform (DWT) are the most commonly used transformation. DCT has high energy compaction property and requires less computational resources. On the other hand, DWT is multi resolution transformation whereas a Huffman coding is used to compress the image. Finally the Huffman compression is applied. This survey presented, proposes a method for the compression of medical images using hybrid compression Technique (DWT, DCT and Huffman coding).

Key words– Medical Image Compression**,** DWT, DCT, Huffman coding, SPIHT, JPEG2000, Lempel- Ziv Coding.

* M. Tech Scholar, BIT Durg

** Prof. CSE Dept. BIT Durg

1. INTRODUCTION

The objective of image compression is to reduce the redundancy of an image. Lossless Compression method applies when data are critical and loss of Information is not acceptable. Medical image compression is based on lossless compression method. Medical imaging is been used for diagnosis of disease and surgical planning, and they need long-term storage for profiling patient's data as well as efficient transmission for long distance diagnosis. It is essential to make the medical image compression lossless to avoid loss of critical medical information. In the last few years, there has been a considerable increase in the volume of medical images and video generated in hospitals. In a typical hospital, vast numbers of medical data are generated every year. The medical multimedia information is different from other multimedia data because of its particular properties. There are legal and strict regulations applied to medical multimedia information, since health of the patient depends on the correctness and accuracy of this information. Moreover, the integrity, confidentiality and security of medical data is crucial to protect in from accidental or malicious alteration during interchange and storage. Another critical property is that the information related to a patient must be available in a short period of time, whenever or wherever it is required, and especially so in the case of emergencies.

2. IMAGE COMPRESSION

The objective of image compression is to reduce irrelevance and redundancy of the image data in order to be able to store or transmit data in an efficient form .Compression is achieved by the removal of one or more of three basic data redundancies:

(a).Coding redundancy, which is present when less than optimal (i.e. the smallest length) code words are used.

(b) Interpixel redundancy, which results from correlations between the pixels of an image

(c) Psycho visual redundancy, which is due to data that is ignored by the human visual system (i.e. visually non-essential information).

Image data Compression exploits redundancy for more efficient coding:

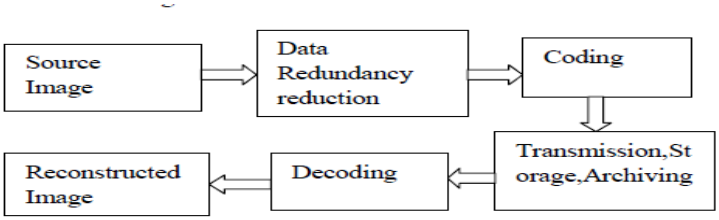

Fig 2.1 Block Diagram of Image Compression

3. BROAD SPECTRUM OF IMAGE COMPRESSION TECHNIQUES

Digital image compression can be divided mainly in two categories: lossless and lossy compression. When lossless data is decompressed; the resulting image is identical to the original. Lossy compression algorithms result in loss of data and the decompressed image is not exactly the same as the original.

(A) Lossless Image Compression Techniques:

Lossless compression is preferred for archival purposes and often for medical imaging, technical drawings, clip art etc.

Methods for lossless image compression are:

- Run-length encoding – used as default method in PCX and as one of possible in BMP, TGA, TIFF.
- DPCM and Predictive Coding.
- Entropy encoding.
- Adaptive dictionary algorithms such as LZW – used in GIF and TIFF.
- Deflation used in PNG, MNG, and TIFF.
- Chain codes.
- Huffman Encoding.

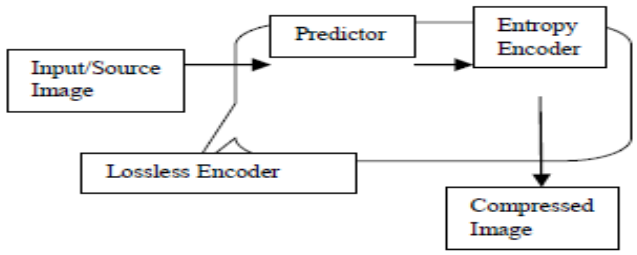

Fig3.1. Lossless Compression

(B) Lossy Image Compression Techniques:

Lossy methods are especially suitable for natural images such as photographs in applications where minor (sometimes imperceptible) loss of fidelity is acceptable to achieve a substantial reduction in bit rate.

- Transform Coding
- Discrete Cosine Transform (DCT)
- Discrete Wavelet Transform (DWT)
- Fractal Compression

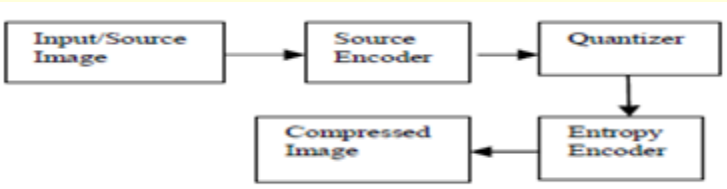

Fig.3.2 Lossy Compression

Discrete Cosine Transform (DCT)

DCT is a lossy Compression technique which is widely used in area of image and audio compression. Example: JPEG Images. DCTs are used to convert data into the summation of series of cosine waves oscillating at different frequencies. These are very similar to Fourier Transforms, but DCT involves use of Cosine functions and real coefficients, Fourier Transforms use both sine and cosine functions and complex numbers. For compression, Cosine functions are much more efficient as fewer functions are needed to approximate a signal. Both Fourier and DCT convert data from a spatial domain into a frequency domain and their respective functions converting thing back.

Discrete Wavelet Transform (DWT)

The DWT represents an image as a sum of wavelet functions, known as wavelets, with different location and scale. The discrete wavelet transform usually is implemented by using a hierarchical filter structure. It is applied to image blocks generated by the pre-processor. Two-dimension DWT leads to a decomposition of approximation coefficients at level j in four components: the approximation at level j+1, and the details in three orientations

(Horizontal, vertical, and diagonal).

Huffman coding

Proposed by Dr. David A. Huffman in 1952. "A method for the construction for minimum redundancy code." Huffman code is technique for compressing data. Huffman made significant contributions in several areas. Mostly Information theory and coding signal design for radar and communication & design procedures for asynchronous Logical circuits. Huffman coding is a form of statistical coding which attempt to reduce the amounts of bits required representing the string of symbols to vary in length. Shorter codes are assigned to the most frequently used symbols & longer codes to the symbol which appear less frequently in the string. Coe word length is no longer fixed like ASCII.

4.HYBRID IMAGE COMPRESSION TECHNIQUE USING DCT,DWT AND HUFFMAN CODING

H.B. Kekre et al. in the year 2014, proposed the comparison of performance of Hartley transform with Hartley wavelet and hybrid Hartley wavelet transform which are used for image data compression. It was concluded through that the Hartley wavelet was generated using two different component transform. Deepak kumar jain et al. in the year 2014, proposed an idea of image compression using discrete cosine transform and adaptive Huffman coding. It was concluded that the DCT is used for transforming an image into JPEG. Moreover standard DCT performs efficiency at Medium bit rate. Reny Catherin L et al. in the year 2013, proposed A survey on hybrid image compression technique for video transmission, it was concluded that the DCT-DWT and SPIHT provides higher compression ratio and good quality output images. Pallavi M. Sune et al. in the year 2013, proposed image compression techniques based on wavelet and Huffman coding, it was concluded that the best technique Huffman coding in lossless compression, in that the image uncompressed need have some specific knowledge of the symbol of probabilities in the compressed files and this can need more bit to encode the file also Huffman coding required two passes if the information is unavailable compressing the file: find frequency of each symbol and construct tree Huffman to compress the file. Sandhya Sharma et al. in the year 2013, proposed image compression using hybrid of DWT,DCT and Huffman coding technique, it was concluded that this technique tested against different medical images using different values of Huffman quantization factor. Prabhjot kaur et al. in the year 2012, proposed Hybrid Huffman coding technique for medical image application, it was concluded that

it gives better quality images and high CR than a Hybrid DWT-DCT technique and JPEG2000.Harjeet Singh et al. in the year 2012, proposed the hybrid image compression using DWT, DCT& Huffman encoding technique, it was concluded that it helps in many areas like telemedicine, wireless capsule endoscopies where the degree of compression is important. S.M. Ramesh et al. in the year 2010, proposed the medical image compression using wavelet decomposition for prediction method, it was concluded that A new method, i.e. coefficient graphic method is used to avoid ulticollinearity problem which is the main contribution of this method. Comparing with the SPHIT, JPEG2000 and proposed achieves the highest compression rate. S. Bhavani et al. in the year 2010, proposed A survey on coding algorithms in medical image compression, it was concluded that each of these schemes finds use in different applications showing to their unique characteristics. Though there a no. of coding schemes available, the need for improved performance and wide commercial usage, demand newer and better technique to be developed.

5. MEDICAL IMAGE COMPRESSION TECHNIQUE USING DIFFERENT METHODS

M.Tamilarasi et al. in the year 2009, proposed the contourlet Based Medical image Compression Using Improved EZW, it was concluded that the superior performance of contourlet against wavelet transform At higher compression ratio. However at lower compression ratios wavelet transform proves a suitable approach. Jayanta kumar Debnath et al. in the year 2008, proposed A modified vector quantization based Image compression technique using wavelet transform, it was concluded that it reduces the compression ratio A little bit, but increases the PSNR of the image drastically, which ultimately assures the purpose of the method For those area of image compression which requires high quality image. V Naga Prudhvi Raj et al. in the year 2007, proposed A Novel approach to Medical image compression using sequential 3D- DCT, it was concluded that the sequential 3D-DCT image coder uses fixed-size data cubes. It does not group all pixel blocks that are similar to each other. If we use the variable-size data cubes to group pixel blocks that are similar to each other, the performance of the coder may be improved better than the sequential 3D-DCT image coder. Robina Asraf et al. in the year 2006, proposed the diagnostically lossless compression-2 of medical images, it was concluded that the proposed schemes surpass the known lossless compression algorithms in four main aspects: High

Compression ratios, simplicity and flexibility, ability to tackle a broad set of data, Feasibility for implementation. Diagnostic centres and radiology departments of hospitals can use these schemes for their Image management/storage. Robina Ashraf et al. in the year 2005, proposed absolutely lossless compression of medical images, it was concluded that the results can be improved if number of test vector presented to MNVQ, and number of epochs to train MNVQ are increased. Lempel- Ziv coding may be another choice for lossless compression .work can also be done on the generalization of technique for a variety of medical image modalities. Xiaoli Li et al. in the year 2004, proposed A novel way of lossless compression of digital mammograms using grammar codes, it was concluded that the result based on our simulation presents that it is promising to get higher compression ratio for large images than Huffman, Lempel-Ziv, Arithmetic algorithms. Zuo-Dian Chen et al. in year 1999, proposed Adaptive predictive multiplicative autoregressive model for medical image compression, it was concluded that APMAR is more suitable for reversibly compressing different medical images than the other lossless compression methods. Although in individual cases MAR or AJPEG

May accomplish a slighty lower entropy than APMAR, the overall conclusion is that APMAR generally outperforms the other reversible compression techniques significantly. Liang Shen et al. in the year 1997, proposed a segmentation-based lossless image coding method for high-resolution medical image compression. It was concluded that the performance of SLIC is under way, by developing more efficient coding methods for the error image and discontinuity index data parts, and by modifying the region growing procedure. A detailed Test of SLIC will be conducted with a larger database of mammograms from the Algebra screen test program and other images. Extension to compression of 3-D medical images is also under investigation.Tenkasi V. Ramabadran et al. in the year 1992, proposed The use of contextual information in the reversible compression of medical images, it was concluded that the enhanced methods have been found to achieve significant performance improvements over the original methods. The EDPCM method has been found to perform the best for MR and UT images. The EWHT method has been found to perform the best for X-ray images.

PROBLEM IDENTIFIED:

I went through above these papers and identified various problems, which are as follows:

(i) The complexity of a high performance Novel image compression technique increases when we use Huffman coding with edge detection.

(ii) It is observed that when we are using 3-D medical image compression using Huffman encoding technique, then JPEG compression becomes low and the bit rate increases.

(iii) When we are using the image compression techniques based on wavelet and Huffman coding the uncompressed image needs to have some specific knowledge of the symbol of probabilities in the compressed file.

CONCLUSION

The problems identified above can be reduced by the technique of "Medical image compression using DWT, DCT& Huffman coding Hybrid model" and is developed through MATLAB mathematical platform.

This decreases the error ratio probability & ultimately increases the efficiency.

REFERENCES

[1]. Tenkasi V. Ramabadranand Keshi Chen, "The Use of Contextual Information in the reversible Compression of Medical Images", IEEE transaction on medical imaging,Vol.11,No.2,june1992,pp.185-195.

[2]. Liang Shen andRangaraj M. Rangayyan," A Segmentation-Based Lossless Image Coding Method for High-Resolution Medical Image Compression", IEEE transaction on medical imaging, Vol.16,No.3, June 1997,pp. 301-307.

[3]. Zuo-Dian Chen,Ruey-Feng Chang and Wen-JiaKuo,"Adaptive Predictive Multiplicative Autoregressive Model for Medical Image Compression",IEEE transaction on medical imaging,Vol.18,No.2,feb.1999,pp.181-184.

[4]. Xiaoli Li, Sridhar Krishnan and Ngok-WahMa,"A Novel Way of Lossless Compression of Digital Mammograms Using Grammar Codes", IEEE transaction, May 2004, pp.2085-2088.

[5]. Robina Ashraf and Muhammad Akbar," Absolutely Lossless Compression of Medical Images",Proceedings of the 2005 IEEE Egg. In medical and biology 27th annual confrenceshanghai,china, Sep.1-4,2005,pp.4006-4009.

[6]. Robina Asraf and Muhammad Akbar ," Diagnostically Lossless Compression-2 of Medical Images",Proceedings of the 2006 IEEE, International conference on mechatronics and automation,jun,2006,pp.28-32.

[7]. V Naga Prudhvi Raj and Dr. T. Venkateswarlu," A Novel Approach To Medical Image Compression Using Sequential 3D DCT", International conference on computational intelligence and multimedia applications, 2007,pp.146-149.

[8]. Jayanta Kumar Debnath, Newaz Muhammad Syfur Rahim and Wai-Keung Fung," A Modified Vector Quantization Based Image Compression Technique Using Wavelet Transform", IJCNN 2008,pp.171-176.

[9]. M. Tamilarasi and Dr. V. Palanisamy," Contourlet Based Medical Image Compression Using Improved EZW", 2009 International conference on Advanced in Recent Technologies in communication and Computing,pp.800-804.

[10]. S. Bhavani and Dr.k. Thanushkodi,"A survey On Coding Algorithms In Medical Image Compression", IJCSE,Vol.2,No.5,2010,pp.1429-1434.

[11] S.M. Ramesh and Dr. A. Shanmugam," Medical Image Compression Using Wavelet Decomposition for Prediction Method", IJCSIS, Vol.7, No.1, 2010, pp.262-265.

[12]. Li Wenna, GaoYang,YiYufeng and GaoLiqun," Medical Image Coding Based on Wavelet Transform and distributed arithmetic coding", CCDC 2011,pp.4159-4162.

[13]. Alessandro Polpetta and Paolo Banelli," Design and Performance of Huffman Sequences in Medical Ultrasound Coded Excitation", IEEE transaction,on ultrasonics,ferroelecctrics, and frequency control,Vol.59, No.4, apr.2012,pp.630-647.

[14].Harjeetpal Singh and Sakhi Sharma," Hybrid Image Compression Using DWT,DCT& Huffman Encoding Technique", IJETAE,Vol.2,No.10,oct.2012,pp.300-306.

[15].Prabhjot Kaur and Sarabdeep Singh, "Hybrid Huffman Technique for Medical image Application", IJARECE,Vol.1,Issue4,oct.2012,pp.1-5.

[16].Sandhya Sharma and Sarabjeet Kaur," Image Compression Using Hybrid of DWT,DCT and Huffman Coding", IJSETT,ISSN No.2277-8136,jan.2013pp.19-23.

[17].Jayavrinda Vrindavanam, Saravanan Chandran, Gautam K Mahanti and Vijyalakshmi K, " Huffman Coding and Position Based Coding Scheme for Image Compression: An Experimental Analysis", IJAIS, ISSN:2249-0868,(ICWAC 2013).

[18].Reny Catherin L, Thirupurasunthari P,Sherley Arcksily Sylvia A, Sravani Kumari G, Joany R.M. and N.M. Nandhitha, " A Survey on Hybrid Image Compression Techniques for Video Transmission", IJECE,Vol.6,No.,2013,pp.217-224.

[19].Ms. Pallavi M. Sune and Vijaya K. Shandilya, " Image Compression Techniques Based on Wavelet and Huffman Coding", IJARCSSE, Vol.3, Issue4, Apr.2013,pp.524-528.

[20]. S. Anandanarayanan and Dr. S.K. Srivatsa," A High Performance Novel Image Compression Technique using Huffman Coding with Edge Detection", IJCET,Vol.4,Issue2,2013,pp.17-22.

[21]. Manisha Singh and Devanand Bhonsle, " Image Compression with Hybrid Method: An Overview" IJEETC, Vol.2,No.3,july 2013.

[22]. Deepak Kumar jain, Devansh Gaur, Kavya Gaur and Neha jain," Image Compression Using Discrete Cosine Transform and Adaptive Huffman Coding", IJETTCS,Vol.3,Issue1, Jan.-Feb.2014,pp.90-94.

[23]. H.B. Kekre, Tanuja Sarode and prachi Natu, " performance Comparison of Hartley Transform with Hartley Wavelet and Hybrid Wavelet Transform for Image Data Compression", IJCT,Vol.12,No.6, pp.3634-3641.

[24]. Kitty Arora and Manshi Shukla, " A Comprehensive Review of Image Compression Technique",IJCSIT, Vol.5(2), 2014,pp.1169-1172.