An Effective Image Matrix Compression Technique for Medical Pitch

A. Ramachandran, E. K. Subramanian, J. Jegan

Abstract - An image volume is one of the most significant properties. The million and billions of medical image storage is very challenging in digital fashion. The ultimate goal of technique for compression is to minimize the volume of medical image by identifying as well as removing the redundant pixel values. The numerous transform technique has been used in digital image compression standards. The basic image transform techniques are Cosine and Wavelet Transform types. The existing techniques still needs improvement in compression ratio. So, a new image matrix technique is proposed for effective image compression in the medical pitch. The newly proposed medical image compression is an Effective Hybrid Technique (EHT). EHT compute the Image Quality (IQ) and Compression Ratio (CR) of medical pictures. The image quality is calculated by EHT using signal noise performance and error values. The different image formats have been used for proposed image compression experiments and achieved good CR compare to existing techniques.

Keywords: Compression Ratio, Image Matrix, Digital Image, Redundant Pixel, Hybrid Transform, Image Quality.

1. INTRODUCTION

The two dimensional image pixel values are represented by f(x, y), which is an image intensity or gray level point value of image. The image compression is a method of identifying and removing of interpixel redundancy. The widespread redundancy techniques are interpixel redundancy, coding, temporal and psycho visual redundancy [1] [2].

The lossy and lossless are the two image compression standards. The lossy technique is not reconstructing the original images exactly due to loss of information. But lossless compression able to reconstruct image without loss of information. Hence it reduces the storage with the fast transmission [3] [4].

An image compression process reduces the number of bits needed for representing information. It removes data which are irrelevant and redundant, thus achieved image compression. The compression is most essential in the medical pitch for effective archiving and storage. An efficient method for digitization of medical images involves two stages such as quantization and transformation [3].

2. PRINCIPLES OF COMPRESSION AND DECOMPRESSION FOR IMAGE

An image compression is different than binary data compression. The images have statistical properties and can be exploited [4]. Lossless image compression has involved an image compression and decompression on the same copy of the original image. The executable documents are compressed and exactly reproduced when decompressed [5]. But images not reproduced exactly in lossy techniques. An approximation is sufficient as long as error is tolerable [6]. Usually the images will hold redundant information due to correlations with neighboring pixels. The main task of compression is identifying less correlation to reduce redundant and irrelevant values.

The image repeated values are used to identifying and removing of duplicate data. The signals that are not noticed by human eyes or removed by irrelevancy reduction. The first method to remove redundancy is spatial, second one is spectral and last one is temporal. The decompression process is used to get the reconstructed image. The image resolution and quality depend on the pixels. The basic blocks for image compression are the encoder and decoder [7].

3. TRANSFORMS TECHNIQUES

The transform technique is depending on error which is tolerable and resources needed for computation. To achieve the image compression quantization process is performed. The aim of transformation is to extract correlation and redundancy. The discrete transform techniques such as cosine and wavelet are the most useful methods.

3.1 Discrete Cosine Transform (DCT)

The discrete cosine transform is a compression method that is used broadly. The DCT image is divided into N x M blocks. The DCT changes the spatial image by representing average value in low order term, converts the spatial image representation. The average value and strength in the image blocks are represented by the low-order term, high order term is used to represent width or height of the block [8]. An array size of 8 X 8 is pre-computed and given as input to the basic functions to implement computational process in DCT.

3.2 Discrete Wavelet Transforms (DWT)

The set of digital filters are used to calculate wavelet transform for discontinuous values of the image. There are two types of filter namely like low and high frequency pass filter. These filters are used to extract information say crude part by low pass filter and detailed part by high pass filter from the decomposed image by wavelet transform. The image after filtering results in like LL, LH, HL and HH are four frequency sub-bands [3].

Revised Manuscript Received on April 05, 2019.

A. Ramachandran, Assistant Professor, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Science. (msg2chandran@gmail.com)

E. K. Subramanian, Assistant Professor, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Science. (eksdeal@gmail.com)

J. Jegan, Associate Professor, Sreenivasa Institute of Technology and Management Studies, Chittoor. (jegan.deepa@gmail.com)

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

4. PROPOSED METHODOLOGY

4.1 Analysis of Medical Image

The quality perception is influenced by content of the image. The X-ray images have been identified medical modalities of this system. An original and reconstructed image are identical both numerically and visually in lossless techniques.

4.2 Compression Ratio (CR)

The compression ratio represents volume level of image. The compression ratio is often computed by dividing the volume of the uncompressed image in bits over the volume of the compressed image.

$$CR = \frac{\text{Original Image Volume}}{\text{Compressed image volume}} \qquad (1)$$

The compression ratio is 2:1 to 3:1 for lossless techniques [4].

4. 3 Objective of Performance Metrics

If there is a loss of information compressed and decompressed images may not be identical. The fidelity measures the quality of the image reconstructed. The Mean Absolute Error (MAE) shown in the (2) measures the distortion.

$$MAE = \frac{1}{N}\sum_{I=1}^{N} | y_i - x_i | \qquad (2)$$

where x, y are the paired observations. N is the of scatter plot, where x_i, y_i are the coordinates.

The most common objective measures of image fidelity that are based on pixel differences are Peak Signal to Noise Ratio (PSNR), Mean Square Error (MSE) and Root Mean Square Error (RMSE). The distortion represented by mean square error and defined as

$$MSE = \frac{1}{M\ X\ N}\sum_i \sum_j \left(x(i,j) - x_R(i,j)\right)^2 \qquad (3)$$

PSNR is measured in decibels and is defined as wherein (4). 255 the maximum possible intensity for 8-bit grey scale of images [11].

$$PSNR = \frac{20\ log_{10} Max|P|}{RMSE}\ db \qquad (4)$$

where, P is the peak intensity level of the given image, for instance P=255 for a gray scale image. The peak signal to noise ratio of high indicates high quality that means more similarity. The acceptable values of PSNR ranges between 30 dB to 50 dB [11].

4.4 Effective Hybrid Technique

An effective hybrid technique proposed depends on the single level discrete wavelet. The image is represented by 8 x 8 pixels such as M x N and divided into non-overlapping of 8 x 8 pixels. The above pixels are transformed by image matrix and it contains the frequency sub-bands. Then coded by the image matrix algorithm while matrix value transformed again by effective hybrid method. Proposed method to decode the matrix values Fig. 1 given below. The sub-bands are recomposed through inverse process of effective hybrid method. Every pixel determines the quality of the compression.

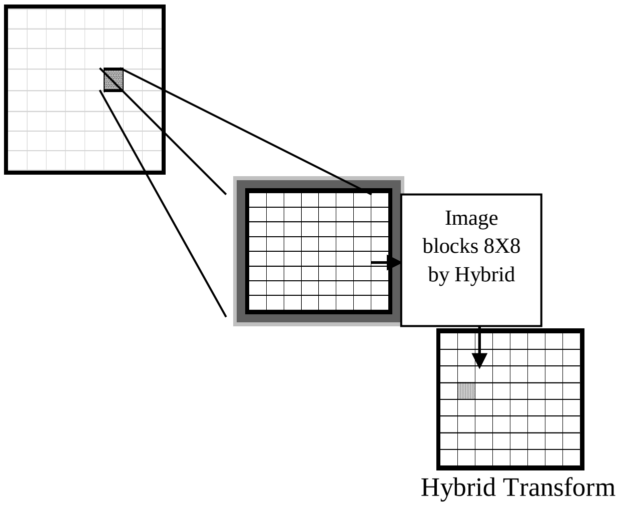

Fig. 1. Effective Hybrid Technique

The splitting process is used in compression technique and merging process applied in decompression. The quantization is used to compressed the blocks of image and stored in an array to reduce the space.

4.4.1 Compression Algorithm

The newly designed hybrid compression procedure as an image matrix algorithm show in Fig. 2. The proposed algorithm reduces the image matrix and sub-bands. The coefficient value and random weights are used to calculate and store the image values in new array. The algorithm for image matrix calculates probable data for each frequency matrix.

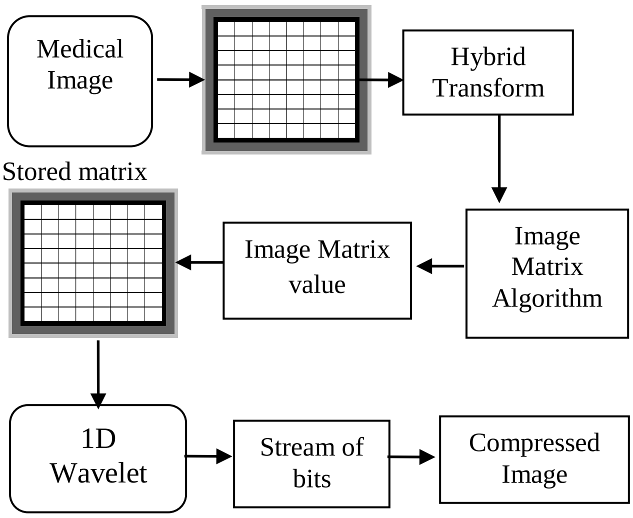

Fig. 2. Effective Hybrid image Compression Method

It takes the stream of bits and converts into floating-point values which are dimensional and these values range from 0 to 1. The original stream of bits reproduced exactly in decoding process.

Algorithm: Compression Method
1. Input: Medical Image MI
MI=Read_Medical Image (image)
2. from MI value into M X N by decomposition of image
3. MI cropped for image construction
4. CMI=MI (100:(size of image cropping [0]–1)+100))
5. image value for (0 to 1)
6. CMI construction PXQ pixels PXQ=8X8
7.convert volume of Medical Image
MI=CONEVOLU (floating (CMI))
8. construction of MI is cropping CMI
CMI=MI (100:(size of image cropping [0]-1)+100)
9. image value for (0 to 1 +100)
10. construction of CMI image block of pixel= M X N
{M X N represented image pixel value}
11. HMI=Wavelet Transform Image(image,10)
12.Size of Pixel=Absolute Value(HMI) power of2
13. Size of Pixel Image Size=A
Logarithm of 10(Size of Pixel)
14. Output: CI= Compressed Image

4.4.2 Reconstruction Algorithm

The new reconstruction procedure is reverse way of hybrid image compression. The decoding process can be calculated by an image array value using arithmetic decoding. The pointer values are calculating by incrementing three values.

Algorithm: Reconstruction Procedure
1. Input: CI =Compressed Image
CI=Input_Image()
2. Reconstruction by Cropping Medical Image CMI
3. from MI value into M X N by decomposition of image
4. construction of CMI image block of pixel= M X N {M X N represented pixel value of image}
5. The image pixel component PXQreconstructed
6. The value composed by M X N in an image MI
7. ConvGridImage (-1>Fixed Image Value (FIV/40) < 1, display Size of Image [SI]
8. Output: DQI = Decompressed Quality Image

The reconstruction algorithm performs addition of two values and decoded to original image. The sub-bands values are decoded using image array values and it can identify image stream values.

5. SAMPLE OUTPUT

The radiologic procedure sample used is medical image as an input (X-rays) image. An X-rays image can be used to diagnose patient medical conditions and frequently used in medical imaging. X-rays are primarily used for diagnostic radiography and crystallography. The sample outputs are displayed for an image compression with medical image as in Fig.5. The input of medical image as an original image has been applied hybrid coefficient technique and converted to standardized quantization image. The compressed size has been minimized without quality loss. Also, the new image decompression able to produce original quality image.

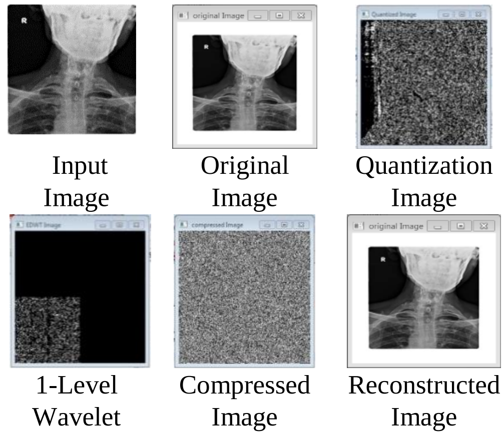

Fig. 5. Image Compression

6. EXPERIMENTAL RESULT

The experiment of proposed method has been done using medical images. Here the medical image has been tested using hybrid image compression. The metrics of the image such as quality and volume has been done by evaluation procedure. The evaluation can be calculated among original image and reduced image. The Table 1 shows type of image, original image, existing compression, proposed method and decompressed image.

Table 1. Image Compression Comparison

Type of Image	Size of Bytes in Original Image	Existing Compression Image Size in Byte		Size of Bytes in Hybrid	Size of Bytes in Decom pression Image
		DWT	DCT		
.jpg	131072	75536	75530	65536	131070
.bmp	92160	56080	56000	46080	92158
.tif	100962	60481	60400	50481	100960

The evaluation for different X-rays medical images compression shown in Fig. 6. Table 1 reveals that the new system performs efficiently better than compare to existing techniques in reducing the volume of the medical images. The proposed method gives greater benefits in saving storage space and effective reconstruction of the medical images. It is important to preserve the good quality of the medical image. Table 2 reveals that the mean value of mean square error of five sample X-rays. The real time X-ray image dataset has been tested and found better performance of PSNR values which are displayed. The PSNR average value of proposed hybrid method is better than the existing methods like DCT and DWT.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

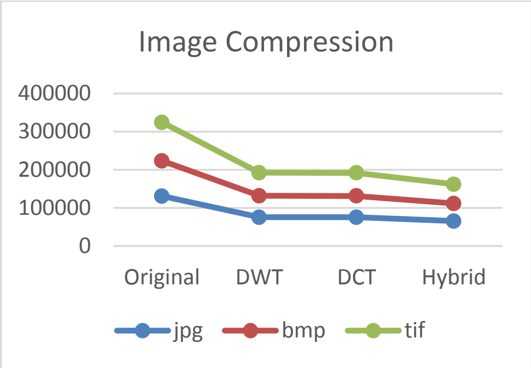

Fig. 6. Compression of jpg Image

The performance evaluation for different X-ray medical images compression shown in Fig.7. The pictorial representation of PSNR value shown in Fig. 8 and it presents the comparison of subjective measures in MSE and PSNR for X-ray images obtained with existing and proposed method. It represents the MSE value of existing method and proposed method from 0 to 3. Similarly, PSNR value ranges from 41(dB) up to 48(dB).

Table 2: MSE and PSNR Value of X-ray Image

	MSE			PSNR		
X-rays Images	DCT	DWT	Hybrid	DCT	DWT	Hybrid
Img 1	0.88	0.92	0.73	45.62	44.12	45.72
Img 2	2.51	2.15	2.00	44.01	43.12	45.01
Img 3	1.83	1.58	1.41	44.23	44.45	44.79
Img 4	3.12	2.98	2.48	42.13	43.12	43.99
Img 5	4.19	3.99	3.01	41.19	41.99	43.01

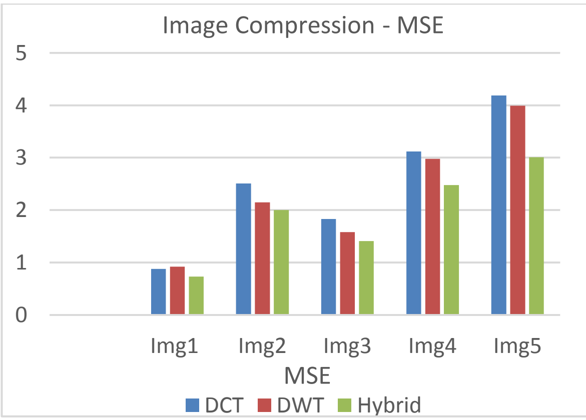

Fig.7. X-rays Image MSE Value

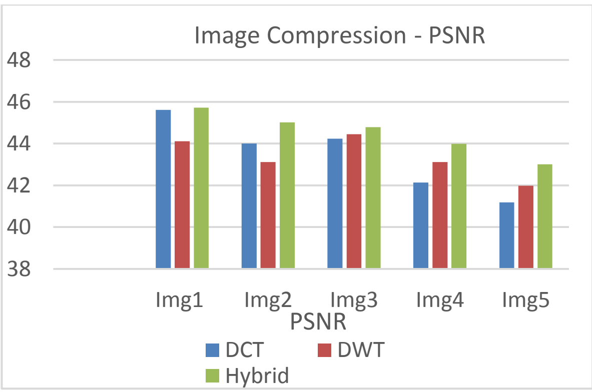

Fig.8. X-rays Image PSNR Value

Table 3 shows the average CR values of five sample X-rays. The X-rays image dataset in real time has been tested and found better performance of CR values. The PSNR average value of proposed hybrid method is better than the existing methods like DCT and DWT.

Table.3. Compression Ratio of X-ray Image

X-rays Images	DCT CR	DWT CR	Hybrid CR
Img 1	8.9	8.7	10.2
Img 2	7.8	7.4	9.8
Img 3	8.1	8.6	9.6
Img 4	6.8	7.1	8.9
Img 5	5.9	6.4	9.1

The pictographic represents the performance evaluation for different medical image compression as shown in Fig.9 and it presents the comparison of subjective measures in CR for medical images obtained with existing and proposed method. Comparison of CR has been calculated the average values of five sample images taken for consideration. Results shows that higher CR is obtained compared to existing techniques.

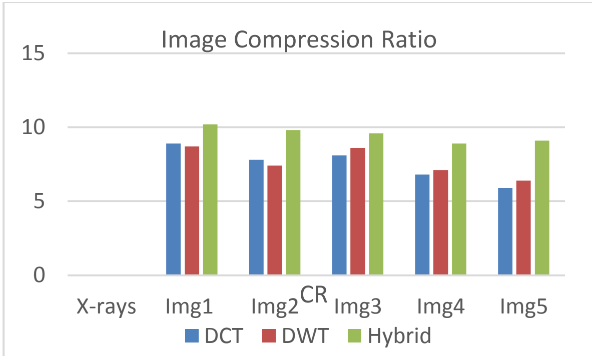

Fig.9. Compression Ratio of X-rays Image

7. CONCLUSION

The proposed mechanism reduces the size of medical image as well conserves the quality. Experiments were performed on multiple medical images and achieved good quality of reconstruction. Image compression techniques minimizes the bits needed for image representation and provides output without loss. The image compressed using hybrid technique minimize the fifty percentage in volume which is a significant improvement over the existing techniques. The hybrid method has been achieved around 70% of improvement in compressing and reconstruction of the image.

REFERENCES

1. Vidya, K., "Medical image compression using Adaptive Threshold", *Journal of Electrical Engineering Technology*, Vol. 11, Issue No.1, pp709-718, Jan.2016.
2. Roopashree. S, Sachin Saini, Rohan Ranjan Singh, "Enhancement and Preprocessing of Images Using Filtering", *International Journal of Engineering and Advanced Technology* Vol.1, Issue.No.5, Jun'2012.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

3. A Survey on Lossless Compression for Medical Images M.Ferni Ukrit, A.Umamageswari Dr.G.R.Suresh *International Journal of Computer Applications (0975 – 8887) Volume 31– No.8, October 2011.*
4. Vidhya, K., and Shenbagadevi, S., "A Novel Threshold approach for Medical Image Compression", *Advanced Science Letters*, Vol. 4, Issue No.4, pp.313-321, Apr.2012.
5. Mohammad Al-Rababah Abdusamad Al-Marghirani. "Implementation of Novel Medical Image Compression Using Artificial Intelligence", *International Journal of Advanced Computer Science and Applications, Vol. 7, No. 5, 2016.*
6. Gonzalez, R.C. and Woods, R.E.2001. Digital Image Processing. Boston MA: Addison Wesley Publishing company.
7. Sadashivappa, G. and Anandha Babu, K.V.S. 2002. Performance analysis of image coding using wavelets, International Journal of Computer Science and Network Security, 8(10), pp: 144-151.
8. A New Lossless Medical Image Compression Technique using Hybrid Prediction Model Amira Mofreh, Tamer M. Barakat & Amr M. Refaat Signal Processing: An International Journal (SPIJ), Volume (10) : Issue (3) : 2016.
9. Dictionary based Image Compression via Sparse Representation, Arabinda Sahoo1, Pranati Das2 International Journal of Electrical and Computer Engineering (IJECE) Vol. 7, No. 4, August 2017, pp. 1964-1972 ISSN: 2088-8708, 2017.
10. Grgic, S., Grgic, M. L. & Zovko-Cihlar, B. Performance Analysis of Image Compression Using Wavelets. *IEEE Trans, on industrial Electronics*, 48(3), 682–695, 2001.
11. Mastriani, M., "Union is strength in lossy image compression", *International Journal Information Communication Engineering*., Vol. 5, Issue No.2, pp. 102-119, Feb.2009.
12. Zaid, A.O., and Fradj, B.B., "Coronary Angiogram Angiogram video compression for remote browsing and archiving applications", *Computerized medical imaging and graphics*, Vol.34, Issue No.12, pp.632-641, Dec.2010.
13. Wang. L., "Three -dimensional medical image compression based on low complexity RKTL", *IEEE Electronics Letters*, Vol.46, Issue No.9, pp.395-397, Sep.2010.
14. Vasanthi Kumari, P., and Thunushkodi, K., "A Secured and Efficient Medical Image Compression Using Quasi Group Encryption", *International Journal of Advances in Engineering and Emerging Technology*, Vol. 3, Issue No. 1, pp. 315-328, Jan.2013.
15. Thepade., Sudeep, D., and Erandole., Shwetali., "Effect of tiling in image compression using wavelet transform & hybrid wavelet transform for cosine and transforms", *Emerging Trends in Computing, Communication and Nanotechnology (ICE-CCN), International Conference*, pp. 753-758, May.2013.
16. Talu, M.F. and Turkoglu, I., "Hybrid Lossless Compression Method for Binary Images", *IU-Journal of Electrical & Electronics Engineering*, Vol. 11, Issue No. 2, pp. 1399-1405, Feb.2011.
17. Suzuki, T., and Ikehara, M., "Integer DCT Based on Direct- Lifting of DCT-IDCT for Lossless-to-Lossy Image Coding", *IEEE Transactions Image Processing*, Vol.19, Issue No.7, pp.2958-2965, Jul.2010.
18. Sudha, V.K., and Sudhakar, R., "Two-Dimensional Medical Image Compression Techniques-A Survey", *International Journal on Graphics Vision and Image Processing*, Vol.11, Issue No.11, pp.9-20, Nov.2011.
19. Sridhar.S., "Digital Image Processing",*Oxford University Press*, 2012.
20. Shubhangi., Shubham Singh., and Shubham Bisht., "Image Edge Detection Using Modified Ant Colony Optimization Technique", *International Research Journal of Engineering and Technology (IRJET)*, Vol. 4, Issue No. 4, pp.78-82, Apr.2017.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication