International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 09 , September 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

A Method of Medical Image Enhancement using wavelet Based Fusion and Analysis

Stuti Gohiya [1], Paresh Rawat [2]

Sagar Institute science and Technology Bhopal, (India)

ABSTRACT

Medical image processing is a exigent field of research since the encapsulating images suffers from the low and deficient contrast. The efficiency of the medical image processing depends on the quality of the encapsulate medical images. Major factors for the low contrast medical images are age of encapsulating equipments, inferior illumination conditions and in-experience of medical staff. Thus, contrast enhancement methods are used for ameliorating the contrast of medical images before being used. In this paper an amalgam of the contrast limited adaptive histogram equalization (CLAHE) method and the wavelet based Fusion techniques are used for designing the efficient medical image enhancement method. Method is capable of adapting the Fusion rules adaptively for best enhanced results. First CLAHE image enhanced is used for ameliorating the contrast of the medical images. Then in second stage 2D discrete wavelet transformation based adaptive image fusion is used for fusing the original and CLAHE output images. For testing the execution of SNR and entropy are calculated and used as parameters. It is found that based on adaptive Fusion the visual content of the medical images are efficiently enhanced under all kind of encapsulating environments.

Keywords: Medical Image enhanced, RGB color spaces, Contrast limited Adaptive Histogram Equalization, Wavelet Fusion, Entropy.

I. INTRODUCTION

The medical images are accrued from different types of the sophisticated imaging camera systems and optical technologies Viz. MRI, CT scan, Somography and X-rays. Due to these techniques encapsulate medical images suffers from low and deficient contrast issues. Therefore, contrast enhanced dexterity [14, 15, and 17] are widely used to ameliorating quality of the medical images and their processing in the low illumination conditions. Contrast enhanced is the most ordinary method of enhancing the image quality [14]. These methods basically ameliorate the perceived difference between the image intensities in close proximity. Efficiency of the diseases identification through medical images depends on the efficiency of contrast enhanced. Therefore this paper focuses the problem of medical image enhanced using ameliorated contrast execution of existing methods using wavelet based fusion. Wavelet fusion is widely used tool for image quality amelioration [1, 3 and 4]. But since there are many wavelet based methods therefore it is very laborious to choose the particular fusing rules for specific medical image environment. Thus this paper proposes to design an adaptive medical image fusion method which can work efficiently for all images.

Image enhancements are broadly of two types Viz. spatial domain methods and transformation domain techniques. A spatial domain methods directly works on the image brightness thus are simpler. While most

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

commonly used transform domain methods uses DWT [4] and DCT [1] for image enhancement Contrast Limited Adaptive Histogram Equalization (CLAHE) is widely used maximal entropy based spatial domain enhancement method [14] method is the most popular spatial domain enhancement method.

This paper takes benefit of both spatial domain and transforms domain techniques for ameliorating the quality of the medical images. Paper proposes to enhances the input medical image suing spatial domain CLAHE method in RGB cooler space and then gray converted enhances image and the original images are fused using wavelet based fusion in transform DWT domain.

Reaming part of paper is organized as follows: Section II have discussed the various existing enhancement methods and reviewed there works in section III describes the spatial domain CLAHE enhancement techniques in RGB space is described. In section IV Wavelet based fusion implementation in DWT domain is described in detail. Section V details result of proposed method for MRI application are presented and performance is companied. Section VI gives conclusion and future work.

II LITERATURE REVIEW

Various methods are proposed in literature for enhancing the images such as methods using the image histogram, local region based enhancement, and transform domain methods. In this section paper reviews some of the relevant methods of enhancing the true color images..

A. Review of Contrast enhancement methods

A most popular method is Contrast Limited Adaptive Histogram Equalization (CLAHE) given by K. Zuiderveld [14] and has proposed to ameliorate image contrast for medical imaging applications to overcome the amplification of low problem and to ameliorate the contrast. Etaa D. Pisano *et al* [15] have used contrast limited adaptive histogram equalization (CLAHE) method to ameliorate the image quality. In last two decades various researchers used CLAHE as method for pre processing the different images..Hitam *et al.* [17] have presented a mixture of the CHAHE in RGB and HSV color spaces for enhancing the underwater images. They have used image fusion technique to produce the enhance image by fusing images in RGB and HSV color spaces.

Vasile et al. [18] have proposed a histogram equalization of color image enhancement using the adaptive neighborhood approach method was inconsistent. Irene *et al* [19] have used CIE-Lab color space for the detection of the optical disc in retinal images. In this paper SNR and mean square error are used as parameter to compare three enhancement techniques. It is clear that the proposed method of image enhancement replaces Y-Cb-Cr with RGB color space and uses CLAHE and wavelet fusion.

III. CONTRAST LIMITED ADAPTIVE HISTOGRAM EQUALIZATION (CLAHE)

Another popular spatial domain method of contrast enhancement is CLAHE method [14, 17]. Method produces the optimal equalization in terms of maximum entropy and also limits the contrast of an image. The CLAHE method is very useful where the brightness requirement is high like as in geographical channels or underwater environments.

In this paper CLAHE method [14] is implemented for true color images. Equalization is implemented individually for all three RGB color spaces. These equalized RGB components are merged together to result the

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

color equalized image [17]. CLAHE was originally developed for successfully enhancing the low contrast medical images [14]. Method partitions the images into related regions and finds the equalization to each region. This flattens the distribution of grey levels and thus makes hidden features of the image more visible.

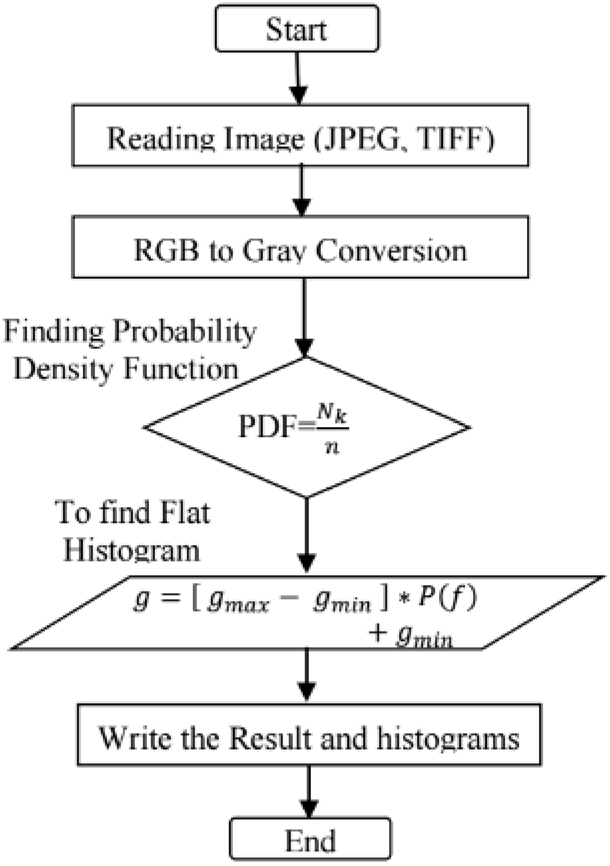
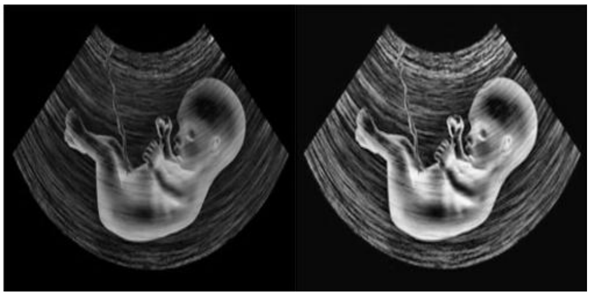


Figure 1 Algorithm for CLAHE enhancement

In this paper images are equalized in RGB color spaces individually. The basic algorithm for enhancing individual image regions by using the CLAHE technique is described In the Figure 1.

An example of the CLAHE enhanced image is shown in the Figure 3 for lg-image16 with non uniform brightness. It is clear that the CLAHE method ameliorate the information in the enhanced image by ameliorating the contrast.



a) Input sonography image b) CLAHE enhanced image

Figure 2 Basic CLAHE enhanced

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

IV WAVELET BASED IMAGE FUSION TECHNIQUES

Wavelet transform is first performed on source images. Then a fusion decision map is generated based on a set of fusion rules.

Then fused wavelet coefficient map can be constructed from the wavelet coefficients of the source images according to the fusion decision map. Finally the fused image is obtained by performing the inverse wavelet transform. The DWT based techniques became popular due to their multi-resolution properties. The main issue in wavelet fusion technique is the selection of decomposition level and the optimum wave filter

Pixel Based Fusion Rules

In this paper the pixel level maxima is opted as the fusion rule defined as;

Pixel Averaging (*Method1*)

All the four sub bands of the fused image F is simply acquired by averaging the wavelet coefficients of source images A & B.

$$F_{j,k} = (A_{j\,k} + B_{j,k})/2 \;\&\; FJ = (lAj + lBj)/2$$

Proposed adaptiveFusion techniques.

Wavelet decompositions are first performed on input medical images [8]. Then a fusion is implemented based on a set of fusion rules. Then fused coefficients are constructed from the wavelet coefficients of the source images using the fusion rule. Finally the fused image is obtained by performing the inverse wavelet transform. The Proposed Fusion block Diagram or method is given in the Figure 3 Below. Comparisons of wavelet decomposition for original and enhanced CLAHE images are shown in the Figure 4.

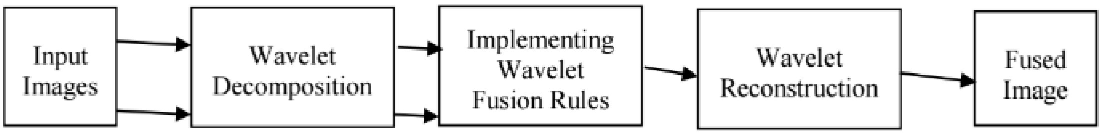
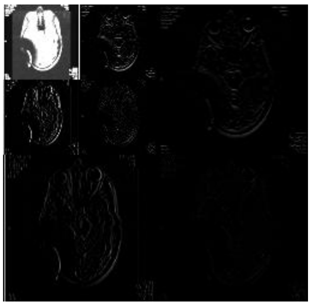


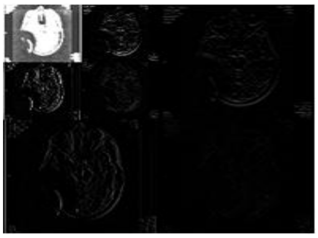
Figure 3 Proposed Fusion Method

The input medical image and enhanced image is fused using the three pixel level fusion rules Viz. Pixel level Maxima, Pixel Level Minima and Pixel Level Averaging



a) 2D wavelet decomposition of original; NRI image

International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 09 , September 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346



b) 2D wavelet decomposition of CLAHE enhance image

Figure 4 DWT decomposition second levels

V. WAVELET BASED FUSION

The process of the wavelet baseed fusion is explained in the Figure 5. As can be seen that two I, ages are fused on low resolution after beong dwcoposed by wavelet transform.

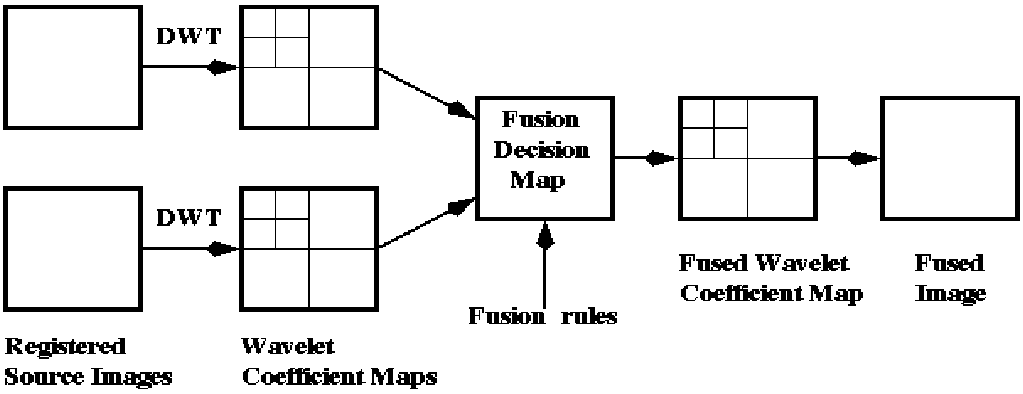
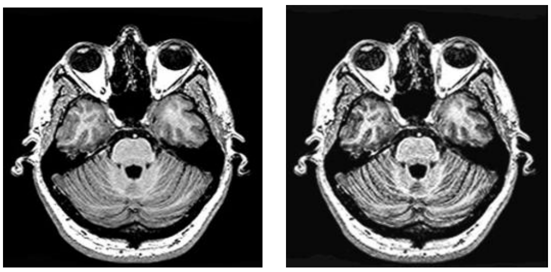


Figure 5 Wavelet based Image Fusion

VI. RESULTS AND DISCUSSION

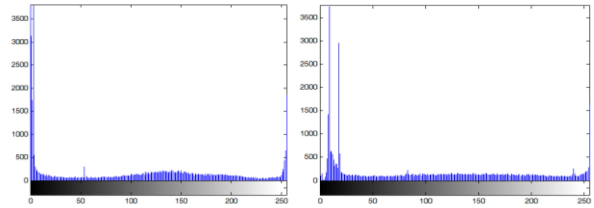
Section presents comparison of experimental results for various color image enhancement methods. The results of the Histogram equalization (HE) based contrast limited adaptive histogram equalization CLAHE and wavelet based fusion improves contrast better and results are shown for different images.

And also preserves the brightness and entropy because method maximizes entropy. This method not only gives flat histogram but also enhance image contrast.



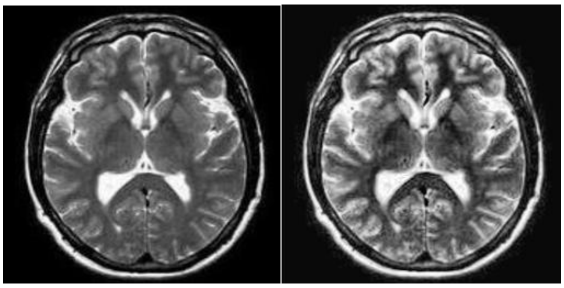
- **Original 2_CT_image b) CLAHE enhanced image**

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

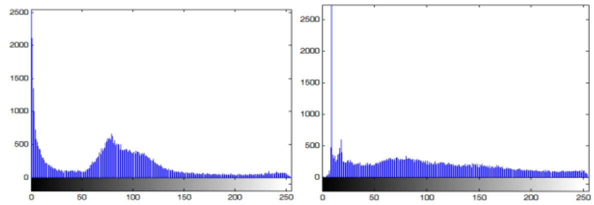


c) Original Histogram d) Equalized histogram with CLAHE

Figure 6 CLAHE enhancement for patient_2_CT_image



- **Original MRI image 2 b) CLAHE enhanced image**



c) Histogram original d) CLAHE Equalized histogram Figure 7 CLAHE enhancement for 2_MRI_image

It is clear from the Figure 6 that enhanced Sonography image with CLAHE enhancement provides flat histogram distribution and describe the baby features more clearly. Therefore using CLAHE enhancement is used to generate the multi-focused image set from single input image as shown in Figure 6 a) and b).

The fused results of various methods for Sonography image 1 is shown in the Figure 7.8. It can be observed that features in pixel level maxima fused image are more visible compared to others.

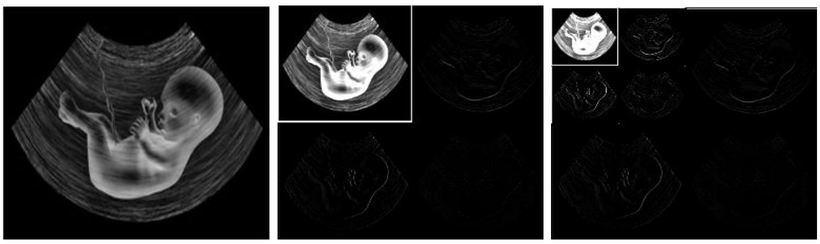


Figure 8 Result of Wavelet Decomposition a) Sonography image b) first level c) second level decomposition

VI . CONCLUSION

Paper presents the comparison of image fusion methods for medical images. It is proposed to design the adaptive fusion rule based on entropy analysis. The spatial domain methods CLAHE is used to generate the multi focused image set from single medical image. Execution of the three enhancement methods Viz. Pixel

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

level Minima, Maxima and Averaging are compared based on Entropy analysis. It is found that our adaptive method works efficiently for all medical images and is capable of adapting the optimum fusion rule. The information content in the fused image is maximum since the entropy of the fused image is more than the input image in most of the images. Results are evaluated for six uniquely different medical imaging environments and it is found that the proposed adaptive fusion based method is independent of imaging environments.

REFERENCES

[1] Jayanta M., and Sanjit K. Mitra, "Enhancement of Color Images by Scaling the DCT Coefficients", *IEEE Transactions on Image Processing,* Vol. 17, No. 10, pp. 1783-1794, 2008

[2] Prateek S. Sengar, Tarun K. Rawat, Harish Parthasarathy, "Color Image Enhancement by Scaling the Discrete Wavelet Transform Coefficients", *IEEE Interna*tional Conference on Microelectronics, Communication and Renewable Energy (ICMiCR), 2013

[3] Peng Geng, Xing Su, Tan Xu , Jianshu Liu " Multi-modal Medical Image Fusion Based on the Multiwavelet and Non sub sampled Direction Filter Bank" International Journal of Signal Processing, Image Processing and Pattern Recognition Vol.8, No.11 pp.75-84 2015,

[4] Nayera Nahvi, Deep Mittal, "Medical Image Fusion Using Discrete Wavelet Transform", International Journal of Engineering Research and Applications Vol. 4, Issue 9(Version 5), pp.165-170 September 2014

[5] K. Zuiderveld, "Contrast Limited Adaptive Histogram Equalization", Graphics Gems IV, pp. 474-485

[6] S. Senthilkumar, S. Muttan, "Effective Multiresolute Computation to Remote Sensed Data Fusion" IEEE International Conference on Computational Intelligence and Multimedia Applications, 2007

[7] K. Kannan, S. Arumuga Perumal, K. Arulmozhi, "Area level fusion of Multi-focused Images using Multi-Stationary Wavelet Packet Transform ",*International Journal of Computer Applications (0975 – 8887) Volume 2 – No.1, May 2010*

[8] Anjali Malviya, S. G. Bhirud, "Image Fusion of Digital Images", International Journal of Recent Trends in Engineering, Vol. 2, No. 3, November 2009

[9] Susmitha Vekkot, and Pancham Shukla, "A Novel Architecture for Wavelet based Image Fusion" *Journal of World Academy of Science, Engineering and Technology,* 57, pp. 32-3, 2009

[10] Jun Kong, Kaiyuan Zheng, Jingbo Zhang, Xue Feng, "Multi-focus Image Fusion Using Spatial Frequency and Genetic Algorithm",", IJCSNS International Journal of Computer Science and Network Security, Vol..8, No. 2, pp 220-224, February 2008

[11] J Gao, Z. Liu and T. Ren, "A new image fusion scheme based on wavelet transform Proc. ,3rd International Conference on Innovative computing, Information and Control, Dalian, China, Vol 2 ,June 2008

[12] Paresh rawat, Sapna Gangrade, Pankaj Vyas, "Implementation of Hybrid Image Fusion Technique Using Wavelet Based Fusion Rules", International Journal of Computer Technology and Electronics Engineering (IJCTEE) Volume 1, Issue 1 2011.

[11] Agung W. Setiawan, Tati R. Mengko, Oerip S. Santoso, Andriyan B. Suksmono, "Color retinal image enhancement using CLAHE", Proc. of 2013 International Conference on ICT for Smart Society (ICISS), pp. 1-3, 2013

[12] A.Saradha Devi, S. Suja Priyadharsini, S. Athinarayanan, "A Block based Scheme for Enhancing Low Luminated Images", *International journal of Multimedia & Its Applications* (IJMA) Vol. 2, No. 3, pp. 49-61, 2010.

[13] Narasimhan K, Sudarshan C R, N. Raju, "A Comparison of Contrast Enhancement Techniques in Poor Illuminated Gray Level and Color Images", *International Journal of Computer Application s0975 – 8887) Vol. 25, No .2, pp. 17-25, 2011* [14] K. Zuiderveld, "Contrast Limited Adaptive Histogram Equalization", Graphics Gems IV, pp. 474-485 1998.

[15] Etta D, Pisano, S. Zong, R. E Jhonston "Contrast limited adaptive histogram equalization image processing to improve the detection of simulated speculation in Dense Monograms", Journal of Digital Imaging, vol. 11, No. 4, pp 193-200, 1998

[16] Bhavana. Va , Krishnappa. H. Kb, "Multi-Modality Medical Image Fusion A survey" International Journal of Engineering Research & Technology (IJERT) Vol. 4 Issue 02, February-2015

[17] Muhammad Suzuri Hitam,. Wan Nural Jawahir Hj Wan Yussof, Ezmahamrul Afreen Awalludin,, Zainuddin Bachok, "Mixture Contrast Limited Adaptive Histogram Equalization for Underwater Image Enhancement", IEEE international conf. 2013.

[18] Vasile V. Buzuloin. Mihai Ciuc. Rangaraj M. Rangavvam. Loic Kjj. Coustantin Vertan, "Histogram equalization of colour images using the adaptive neighborhood approach", Proc. SPIE 3646, Nonlinear Image Processing X, 330, 1999.

[19] Irene Fondon, Mark J. J. P. van Grinsven, Clara I. Sanchez, Aurora Saez, "Perceptually Adapted Method for Optic Disc Detection on Retinal Fundus Images", Proc. of IEEE international conference pp. 279-284, CBMS 2011

Authors

Paresh Rawat: has completed B.E. in Electronics Engineering in the 2000, M Tech in Digital Communication

from MANIT Bhopal INDIA in 2007, and pursuing Ph. D* from MANIT INDIA, Currentlyworking as Assistant Professor in the department of electronic and communication engineering at TCST India. His main **research areas are**: Image and Video Processing

Stuti Gohiya: I am pursuing B.E in Electronics and Communication Engineering (Final Year) from Sagar Institute of Science & Technology, SISTEC-GN, Bhopal (M.P) INDIA

2