Fusion of MRI and CT Brain Images Using Histogram Equalization

P.Natarajan[1], Krishnan N[2], N.Soniya[3]
[1]Erode Sengunthar Engineering College, Thudupathi, Perundurai, Erode, Tamil Nadu, India.
[2]Center for Information Technology and Engineering, M S University, Thirunelveli, Tamil Nadu, India
[3]M.Tech Student, School of Computing Science and Engg, VIT University, Vellore, Tamil Nadu, India
pnatarajan@vit.ac.in, krishnancite@ieee.org, soniya.nagashanthi@gmail.com

***Abstract* - Image fusion is the process of combining relevant information from two or more images into a single image. The resulting image will be more informative than any of the input images to retaining the important features of each image. The resulting image contains more information as compared to individual images. Multiple image fusion is an important technique used in aerial and satellite imaging, medical imaging, robot vision, digital camera application and battle field monitoring. The histogram equalization method is useful in images with backgrounds and foregrounds that are both bright or both dark. In particular, the method can lead to better views of functional and structural parts in MRI and CT images. Based on this, the removal of noise in the image by using adaptive filtering, the system is evaluated and the accurate output will be produced. The fusion algorithm of foreground images and background images is studied. Here, the foreground image is MRI and background image is CT image.**

***Keywords* - Image Fusion, Functional Images, Anatomical Images, Histogram Equalization.**

I. INTRODUCTION

The Image fusion is to combine the original two input images to get a different form of multiple images pixels as an output in a fused form [1]. There are different medical imaging technique in the image fusion and it has become a common term used within medical diagnostics and as well as for treatment. The term is used when multiple patient images are registered and overlaid or merged to provide additional information. Foreground is a functional image displaying the non-anatomical information [3] whereas the background provides the anatomical information without functional activity. The foreground image and the background image are based on the analysis of the image pixels. Hence both the images are fused to obtain a unique image with functional and anatomical information [3] and with the best resolution. Histogram Equalizer (HE) is one of the methodologies, which is used to detect the specified diagnosis of that particular image. Especially, removing noise by adaptive filtering gives the clear and accurate diagnosis to remove the noise of the output image.

Initially, foreground image and background image are taken as an input and with these input, histogram equalization has to be done. The histogram of foreground image and as well as the background image [3] before equalization has to be analysed and plotted. Now, the histogram of these foreground and background image has to be displayed in the equalized form of images and finally, the histogram of foreground and background image after equalization has also been plotted[6]. The work of the edge detection also plays a major role in deciding the result of the final processed image. Conventionally, edge is detected according to algorithms like sobel algorithm, prewitt algorithm, canny algorithm, roberts algorithm and laplacian of gaussian algorithm [5]. In real world applications, this edge detection is very much useful for the medical images that contain objects for the diagnosis of the diseases.

II METHODOLOGY.

HISTOGRAM EQUALIZATION

Histogram equalization is a technique that allows us to improve the contrast of images with such narrow histograms and it has been found to be a powerful technique in image enhancement [7]. This technique does not change the values contained in the matrix x (m, n) that represents the image. Instead, it modifies the color mapping associated with the values of the matrix x (m, n), so that this tends is uses to evenly every color in the full dynamic range [black to white].

The histogram of an image represents the relative frequency of occurrence of the various gray levels in the image [8]. In Fig. 2 you can see the histograms of two black and white images. Foreground and background images i.e MRI and CT images and it is considered as a functional and anatomical images, For black and white images have 256 gray levels, from 0 to 255, and the vertical lines in the histogram[6] indicate, how many pixels in an image assume a particular gray level [11]. In this experiment it is deal only with black and white images.

978-1-4673-1344-5/12/$31.00 ©2012 IEEE

FOREGROUND AND BACKGROUND FUSION

Different imaging techniques may provide with complementary and occasionally conflicting information. The combination of images can often lead to additional information not apparent in separate images [3]. The goal of image fusion is to impose a structural anatomical framework in functional images [1]. Often in a functional image there is not enough anatomical detail.

Generally functional images have low spatial resolution and anatomical images have high spatial resolution [3]. So, with anatomical images, a lesion can be detected with an accuracy of milli-meters. With the functional images this is not possible, but they have ability to detect lesions, before the anatomy is damaged [2]. The functional image is considered as an MRI brain image [4] and the anatomical image is considered as a CT brain image.

The resolution of foreground image and background image are different. The size validation and alpha factor is used to fuse both the images. The Foreground should be image co-registered with respected, so that both images represent the same region [2]. Select and merge both Foreground and background i.e MRI and CT images [4].

ADAPTIVE FILTERING

In the adaptive filtering method is used to remove the noise from the images. Wiener filter that is a type of linear filter is used as adaptive filter is applied as a filter to an image adaptively tailoring itself to the local image variance. Where the variance is large in wiener and performs little smoothing. Where the variance is small, wiener performs more smoothing.

This approach often produces better results than linear filtering. The adaptive filter is more selective than a comparable linear filter, preserving edges and other high-frequency parts of an image [9]. In addition, there are no design tasks; the wiener procedure handles all preliminary computations and implements the filter to an input image. However, does it require more computation time than linear filtering.

The adaptive filter functions works best when the noise is constant-power ("white") additive noise, such as Gaussian noise.

CANNY EDGE DETECTION ALGORITHM

In edge detection algorithm, it contains various methods of algorithms to detect the edges [10]. The alorithm's like sobel algorithm, prewitt algorithm, canny algorithm, roberts algorithm and laplacian of gaussian algorithm. These are the algorithm's which is used for the edge detection**.**

The Canny method is one of the method in detection of edges and it is used to finds edges by looking for local maxima of the gradient of an image. The gradient is calculated using the derivative of a Gaussian filter [12]. The method uses two thresholds, to detect strong and weak edges, and includes the weak edges in the output only if they are connected to strong edges [7]. This method is therefore less likely than the others to be fooled by noise, and more likely to detect true weak edges.

Canny edge detection is used to perform thresh specifies sensitivity thresholds for the canny method [5]. Thresh is a two-element vector in which the first element is the low threshold, and the second element is the high threshold. If you specify a scalar for thresh, this scalar value is used for the high threshold and 0.4*thresh is used for the low threshold. The value for thresh is relative to the highest value of the gradient magnitude of the image.

In canny algorithm thresh and sigma is used to detect the edges using sigma as the standard deviation of the Gaussian filter. The default sigma is sqrt(2), the size of the filter is chosen automatically, based on sigma.

III. ARCHITECTURE

In this flow chart, it is fully described about the entire architecture of this paper. And it is very clear about the overall process, which are first starts with foreground and background images. Now, histogram equalization of foreground & background image is plotted. After these plotting the equalized form of foreground and background image are produced. And again the histogram equalization of foreground and background image is plotted. Now, it is clearly shown the differences between before histogram equalization and as well as after histogram equalization. If suppose the array size is not equal then it display message as array size is not equal or else it display the fused form of fused image as an output. After this process to remove the noise of fused image the adaptive filtering is used. Finally, the edge detection algorithm is applied for that fused image and the accurate form of edge detected image are displayed as a finalized output.

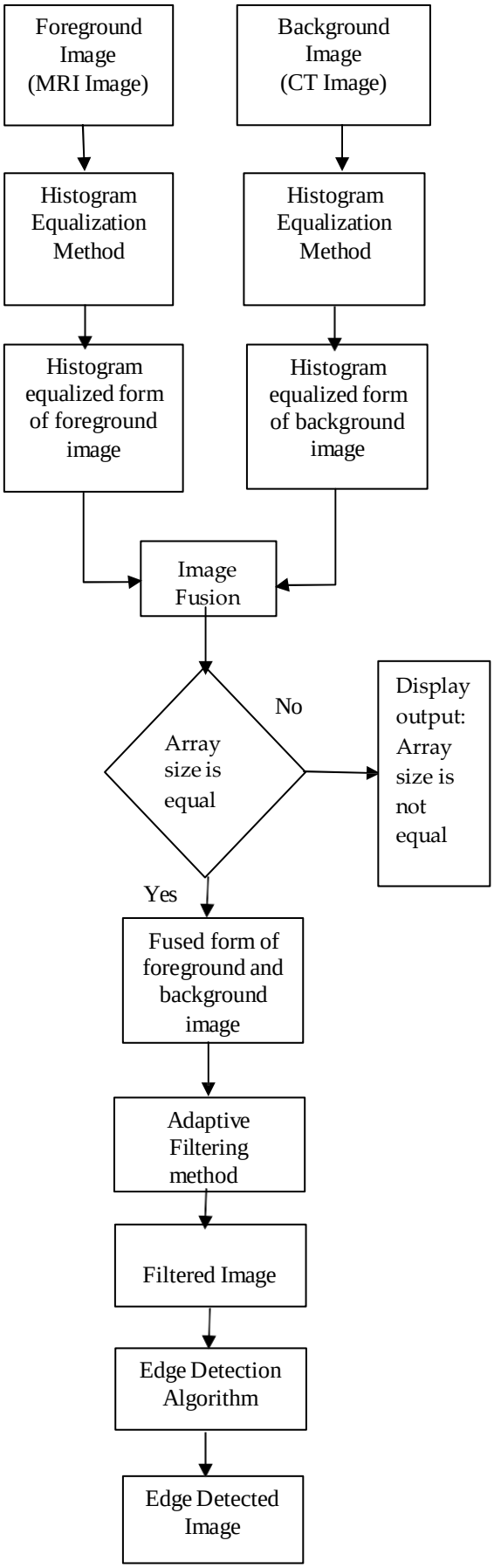


Fig. 1. Architecture of the system

IV. RESULTS AND DISCUSSION

The foreground & background image as MRI & CT images as an input. The histogram equalization is applied to these input images.

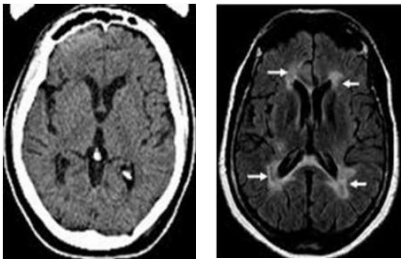


Fig. 1. Foreground & Background image

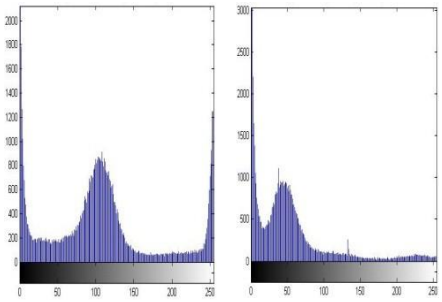


Fig. 2. Histogram of foreground & background image before equalization

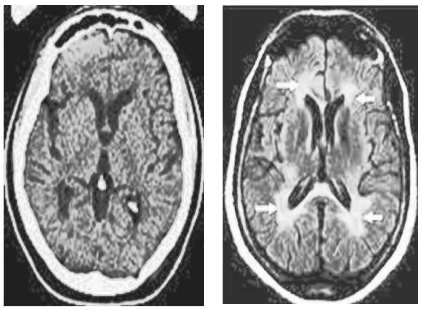


Fig. 3. Equalized foreground & background image

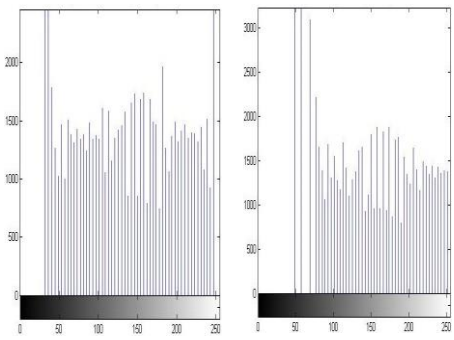


Fig. 4. Histogram of foreground & background images after Equalization

Now, the fusion has been take place, the enhanced form of MRI & CT image as displayed

with help of histogram equalization. Finally, the resulted image gives more information compare to the original two images.

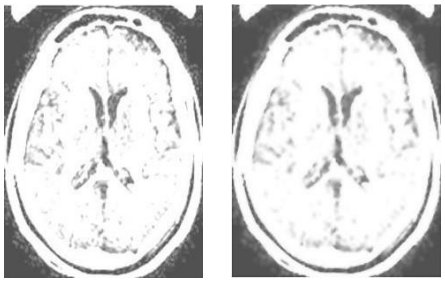
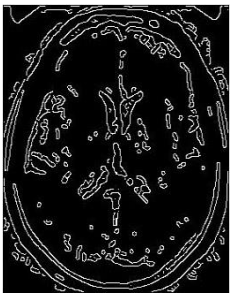


Fig. 6. Fused & filtered image

Now, it is very clearly shows that canny edge algorithm produces a very accurate and clear form of edge detected image.



Fig, 7. Canny Edge detected fused image

V CONCLUSION

In this paper, the fore ground image as MRI image i.e functional image and the background image as CT images i.e anatomical image are taken as an input. The Histogram equalization method is applied to the MRI & CT input image. Now, it is plotted the histogram of both images before equalization. And again it is plotted the histogram of foreground & background image after equalization. Hence the fusion of MRI and CT image is getting improved. Now, the fusion has been take place, the fused form of MRI image and CT image as displayed. Here, the adaptive filtering method is applied to get filtered form of fused image. Finally, the resulted image gives more information compare to the original two images. The canny edge detection algorithm produces a very accurate and clear form of edge detected image.

REFERENCES

[1] M.MaliniDeepika, Dr.V.Vaithyanathan, “An Efficient method to improve the spatial property of medical images”, Journal of Theoretical and Applied Information Technology, Vol. 35 No.2, pp. 141-148

[2] Jing Yuan, Brandon Miles, Juan Shi, Greg Garvin, Xue-Cheng Tai, and Aaron Fenster,”Efficient Convex Optimization Approaches to Variational Image Fusion”, Medical Imaging Lab, Robarts Research Institute, University of Western Ontario London, Ontario, Canada N6A 5B7.

[3] Habib Zaidi, PhD, PD Marie-Louise Montandon, PhD, Abass Alavi, MD, PhD (Hon), DSc (Hon)b, ”The Clinical Role of Fusion Imaging Using PET, CT, and MR Imaging”, Magn Reson Imaging Clin N Am, 18, 2010.

[4] Roger Lundqvist, ”Atlas-Based Fusion of Medical Brain Images”, Acta Universitatis Upsaliensis, Comprehensive Summaries of Uppsala Dissertations from the Faculty of Science and Technology 673, 62pp. Uppsala, ISBN 91-554-5180-2.

[5] Prof. J.Mehena, ”Medical Images Edge Detection Based on Mathematical Morphology”, International Journal of Computer & Communication Technology, (IJCCT), Volume-2, Issue-VI, 2011.

[6] Volker Schatz, ”Low-latency histogram equalization for infrared image sequences - a hardware implementation”, Journal of Real-Time Image Processing, June, 2011.

[7] Johnson J L, Padgett M L. “PCNN models and applications”. IEEE Transactions on Neural Networks, Vol. 10, No. 3, pp 480-498, May 1999.

[8] Natarajan P, “Newfangled MRI Brain Edge Detection Using Enhanced Canny Algorithm”, 2011 IEEE International Conference on Computational Intelligence and Computing Research, PP 84 - 87, Dec 2011.

[9] Natarajan P, Krishnan N, “MRI Brain Image Edge Detection with Windowing and Morphological Erosion”, 2011 IEEE International Conference on Computational Intelligence and Computing Research, PP 94 - 97, Dec 2011.

[10] Natarajan P, N.Krishnan, Sugavanesh C, “Neoteric Approach for Edge Detection in Brain MRI Images”, 2011 IEEE International Conference on Computational Intelligence and Computing Research, PP 80 - 83, Dec 2011.

[11] Natarajan P, N.Krishnan, Sugavanesh C, “Brain MRI Image Edge Detection Using Top-Hat Mathematical Morphology”, 2011 IEEE International Conference on Computational Intelligence and Computing Research, PP 120 - 123, Dec 2011.

[12] Natarajan P, N.Krishnan, Rajesh N, “Brain MRI Image Edge Detection Using Gradient Method”, 2011 IEEE International Conference on Computational Intelligence and Computing Research, PP 124 - 126, Dec 2011.