Review of Medical Image Enhancement using wavelet based Image Fusion

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Abstract – *paper reviews the various challenge in the field of medical image processing addressed by the researchers. The major challenge is that captured image suffers from the problem of low contrast and noise. Many enhancement methods have been proposed by researchers for enhancing the ccontrast of medical images before being further processed. The paper first reviews the enhancement methods used for medical imaging operations. Since wavelet Fusion methods are widely used for enhancing the medical images therefore paper gives broad classification of the medical image fusion methods. Paper concludes that medical image fusion efficiently improves the medical image quality but no fusion method works uniformly for different medical imaging accusation environments. Use of the an adaptive fusion methods with capability of selecting the optimum fission rule may improve the enhancement performance*

Key Words: *Medical Image enhancement, Contrast Enhancement, Image Fusion, Wavelet Fusion, Entropy*

I INTRODUCTION

Many researchers have worked in last decade for improving the information of medical images. Medical image processing is an essential part of many desires analysis. The processing efficiency of the medical images depends on the visual quality of the captured images. Most of the captured medical images suffer from low contrast.

Major factors for the low contrast medical images are age of the image acquisition systems, poor lightning conditions and in-experience of doctors and staff. Wavelet based image fusion is commonly used for improving the image quality [3 and 4]. The medical image acquisition using multiple cameras is shown in the Figure 1. It can be seen that for improving the visual quality the captured images are fused together.

In other words image fusion technique merges the multiple images of the same medical scene for providing enhanced image with improved information contents.

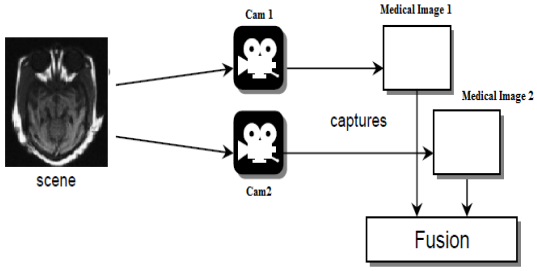

Figure 1 Medical image multi fusion requirement

II FUSION CLASSIFICATION

Image fusion can be implemented at different levels such as signal level, pixel level or feature and symbol levels. Therefore it is required to classify the fusion methods first. With the developing image processing algorithms, pixel level techniques have become popular in last few decades. Almost all image fusion algorithms developed nowadays fall into pixel level fusion. The image fusion methods are broadly classified as Direct Fusion and Multi Resolution Fusion as shown in the Figure 2.

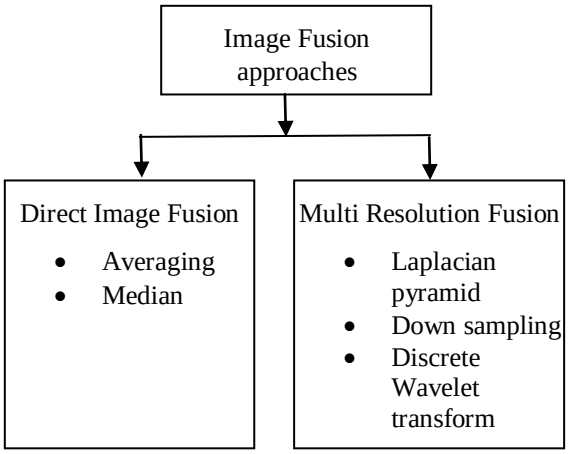

Figure 2 Classification of the image fusion approaches

In Direct Fusion, the pixel values from the source images are directly summed up and taken average to form the pixel of the composite image at that location.

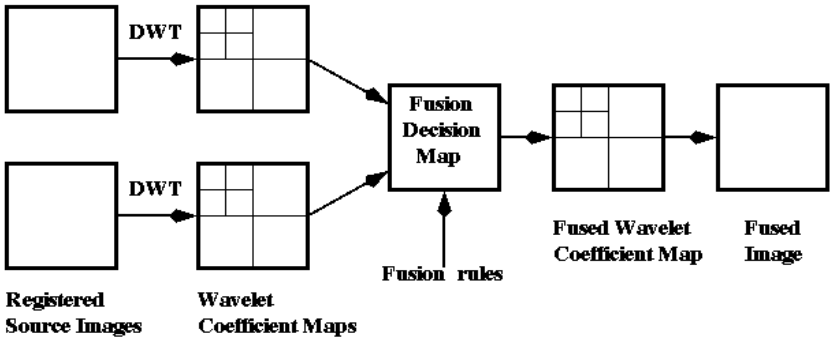

Figure 3 Block diagram of Wavelet Image Fusion

Multi Resolution Fusion uses transform for representing the source image at multi scales or sizes. This provides us the capability to implement the fusion at different features level, such as high frequency and low frequency sub bands.

The most common widely used transform for image fusion at multi scale is Wavelet Transform. It is because it gives the opportunity to do simultaneous time-frequency analysis

III CHALENGES IN MEDICAL IMAGE FUSION

There are broad range of methods of medical image fusion were designed to address the medical challenges imitated from captured images of the human body parts, organs, and tissues and cells. There are huge applications of the image fusion techniques in the historical analysis and medical diagnostics, multimodal image fusion is another method used for medical imaging applications. By multi modal means images with different modalities: Viz. CT, scan and MRI, [1, 9], visible, or ultraviolet, etc The prime goal of the multimodal fusion is to decrease the amount of data for emphasizing on the band specific information.

As with time more medical image data is acquired and resulted many mystery to doctors and investigators [1 and 10], as how to merge huge amount data and abstract higher quality information for users, how to get rid of data redundancy, etc. The fusion technique, with a data fusion to organizes, connects, and combines multiple source and multi temporal data, gives the powerful tool for these data processing problems.

IV REVIEW OF THE FUSION METHODS

Yang. *et. al.* [4] in their research paper has presented a very good survey and has reviewed of the diffirent pixel level image fusion approaches. Rockinger O, *et. al.* [21] in the year 1998 has presented a case study of Pixel-level image fusion for the sequence of images. But the method was only efficient enough for simple image sequences. When more features are there or large objects are there in the scenes then performance of this method degrades.

Ferris D. D *et al.* [24, 25] have designed the application of pixel level image fusion for the application in the fields of military. Ferris *et al.* has discussed the multi sensory image fusion approaches for application in military special operations and law enforcement applications. Smith proposed a real time image fusion technique for application in vision aid of military helicopter pilot age. Paresh et al. [8] has worked for implementing the wavelet fusion using the concept of pixel level fusion rules.

As already mentioned, that the image fusion methods are broadly classified as the Direct Fusion method and Multi Resolution Fusion. Therefore here both the categories are reviewed sequentially. In Direct Fusion, the pixel intensities from the input images are directly summed up and taken average to form the pixel of merged image at that location. Multi resolution fusion methods mostly uses pyramid or wavelet transform approaches for representing the source image at multi-scale. There are three methods in multi resolution fusion scheme, namely Pixel based fusion, Area based fusion and Region based fusion. Many methods exist to perform image fusion. The very basic one is the high pass filtering technique. Later techniques are based on DWT, uniform rational filter bank, and laplacian pyramid.

Anjali Malviya and S. G. Bhirud [3] in 2009 present's pixel based and region based fusion schemes, including a wavelet based algorithm. An area based maximum selection rule, and consistency verification steps are used for feature selection. The algorithms are checked for multi sensor as well as multi focus image fusion. The performance evaluation was done based on various objective metrics and the results obtained were promising, comparable with existing algorithms but the method was complicated and computationally complex.

Susmitha Vekkot, and Pancham Shukla [5] in 2009 proposed a hybrid architecture for Wavelet based Image Fusion. They proposed an algorithm which applies pixel based maximum selection rule to low frequency approximations and filter mask based fusion to high frequency details of wavelet decomposition. The proposed hybrid architecture is the combination of advantages of pixel and region based fusion in a single image which can help the development of sophisticated algorithms enhancing the edges and structural details. Pixel based rules operate on individual pixels in the image, but does not take into account some important details like edges, boundaries and salient features larger than a single pixel. Region based fusion may reduce the contrast in some images and does not always succeed in effectively removing ringing artefacts and noise in source images hence both are integrated for fusion of multi focused images.

Jun Kong et. al.[7] in 2008 proposed a region based multi-focus image fusion algorithm using spatial frequency and genetic algorithm. They divide the source images into blocks, and then selected the corresponding blocks with higher spatial frequency value to construct the resultant fused image. The method was suitable when there is miss-registration or movements in objects.

V REVIEW OF MEDICAL IMAGE FUSION

Nayera et al. [1] have sugested to use the discrete wavelet transform (DWT) along with the pixel level fusion rules but the performance of the method is not consistent for various medical images. They have used the concept of multi modality to fuse CT and MRI images. Bhavana. Et al, [16] have presented a brief survey of multi modality fusion techniques for medical images. The survey has concluded the advantages and advantages of different fusion methods for such images.

This alloys us to select the finest fusion methods for a specific application. Bhavana. et al, [6] proposed a method for watermarking the medical images they have presented the utility of fusion for multi-model images. They have fused the CT scan images and MRI images together for improving the features. But method was mearly specific and limited to the multi-model images. In most of the case these images are not available and only single medical image is given.

Peng et al. [9] have designed the medical image fusion method for application in multi modal images using the Multi wavelet and non sub sample directional filters banks and in the transform domain. Maruturi et al. [10] have presented to fuse the MRI and FDG-PET medical images with the use of wavelet fusion

VI CONCLUSIONS

This paper addressed the various challenges in medical image fusion and enhancement Paper also reviews the various existing work done in the field of the medical image fusion. Following major conclusions can be stated from the study of the current research paper:

- With the recent developments in multispectral high resolution field and invent of cost effective image sensor technologies designs, multi image fusion have become the open field for researchers.
- In last few years an image fusion is widely used for many medical imaging applications.
- These applications includes as in retinopathy, night vision, multimodality fusion of CT and MRI image of brain, improving the results of the medical image segmentation of feature extraction and in medical imaging analysis and diagnostic systems applications.
- The medical images are acquired using various noisy environments using the multiple sensors nodes. So it needs to enhance the perceptual quality of the images before processing.
- Pixel based wavelet fusion methods are commonly used because of their simplicity for enhancing the image qualities.
- But there performance is not consistent with different kind of medical imaging environments. Therefore, it is required to improve the efficiency of these fusion methods.
- It is required to develop the adaptive fusion method which is environment independent. It is also require preserving the information content after being fused by wavelet domain.
- An efficient Image fusion method can be generated by analyzing the performance of various wavelet filters over different image modalities.
- Evaluating performance of color contrast enhancement methods for fusing the color medical images is an issue to address.
- Entropy based analysis may improve the performance of the medical images.

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