IMAGE FUSION USING DEEP LEARNING

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Abstract

Fusing different medical images will increase the accuracy in diagnosis of disease and describe the complicated relationship between them for medical research. The existing methods are time consuming and also requires more number of samples to train the models. In this model, we will retrieve the complicated information from different medical images like Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) by fusing them through multi-stage fusion networks. In the proposed model, we will use Dual Tree Complex Wavelet Transform (DTCWT) to extract the complicated and correlated information from each images and segmentation is done on fused image to get the segmented image. In the proposed method, the fusion of multi model medical images can be done by Dual Tree Complex Wavelet Transform, where the source medical image is converted to grayscale and decomposed, then the wavelet coefficients are extracted using DTCWT. After that, the approximation of wavelets are done to obtain the fused coefficients. Finally Inverse Dual Tree Complex Wavelet Transform is applied to obtain the final fused image. Additionally segmentation is performed to obtain the segmented image for the purpose of getting enhanced visual representation. In the proposed method, the improved quality of final fused image can be obtained.

Keywords: X-ray, Positron Emission Tomography (PET), Single Photon Emission Computed Tomography (SPECT), Magnetic Resonance Imaging (MRI), and Computed Tomography (CT)

I. INTRODUCTION

X-ray, Positron Emission Tomography (PET), Single Photon Emission Computed Tomography (SPECT), Magnetic Resonance Imaging (MRI), and Computed Tomography (CT) medical images, will not provide as much as detailed information for medical based research and diagnosis. They are required to provide a lot of elaborated clinical data.

Medical imaging systems will provide different medical information regarding tissue, that are complicated in most cases. For example, X-rays, are used for identify bone injuries and bone fractures, CT images will give the elaborated information of internal organs, tumors and blood vessels. MRI is used to provide the information about tissues. Whereas the SPECT will show how blood flows to tissues and organs, and finally PET is helps to reveal how the tissues and organs are functioning.

All these features will not be gathered from a single image, in order to extract all the complicated information from a single we are fusing the medical images of single or different systems. The medical image fusion is defined as the process of merging different kinds of medical images or of similar types into a single image that provides more accurate information for diagnosis that will be helpful for better and accurate treatment. The doctors will able to extract the detailed and complicated data from the fused images of the medical images which are not visible in individual images.

II. EXISTING METHODOLOGY

In the field of medical image, imaging techniques such as Computed Tomography (CT), Magnetic Resonance Imaging (MRI), have provided clinicians with information of the human body’s structural characteristics, soft tissue, and so on. Different imaging methods keep different characteristics, and different sensors obtain different imaging information of the same part. The purpose of the fusion is to obtain better contrast, fusion quality, and perceived experience. Traditional medical image fusion methods are divided into spatial domain and transform domain.

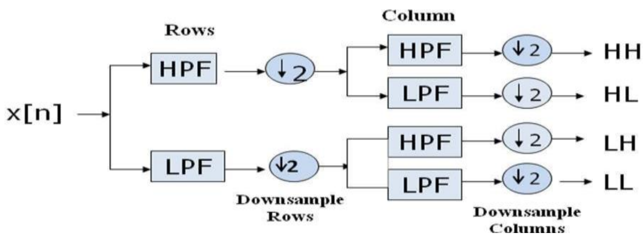

Fig 2.1 Block Diagram of 1 step 2-D DWT

The multimodel medical images like Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) had been fused using Discrete Wavelet Transform. The combination of MRI and CT combines the advantages of clear bone information in CT images and the clear soft tissue of MRI images to compensate for the lack of information in a single imaging. Na et al. proposed a MRI and CT fusion algorithm based on guided filtering (GF). The fused image not only preserves the edge information of the source image but also extracts the feature information, which solves the problem of edge degree and clarity. The visual analysis of fusion results has obvious improvement in contrast and structural similarity.

Fig 2.1. Source CT image of a patient diseased by Sarcoma

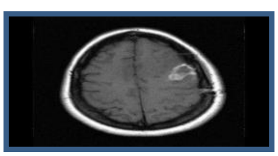

Fig 2.2 Source MRI image of a patient diseased by Sarcoma

III. LITERATURE SURVEY

In 2016, Padmavathi K, Maya V KarKi, Mahima Bhat, Medical image fusion of different modalities using dual tree complex wavelet transform with PCA, in this paper different characteristics of low and high frequency sub bands are taken into account and fusion rules are applied. DTCWT is applied to extract salient information from each modality. Fusion rule is applied with PCA features. Improvement in visual quality can be seen in the proposed method.[1]

In 2013, Rajiv Singh, Ashish Khare, Multimodal medical image fusion using Daubechies complex wavelet transform, Shift sensitivity and lack of phase information in real valued wavelet transforms motivated to use DCxWT for multimodal medical image fusion. It was experimentally found that shift invariance and phase information properties improve the performance of image fusion in complex wavelet domain. Therefore, DCxWT is used for fusion of multimodal medical images.[2]

In 2013, Negar Chabi, Mehran Yazdi, Mohammad Entezarmahdi, An efficient image fusion method based on dual tree complex wavelet transform, Approximate shiftinvariance property and availability of phase information in DTCWT are useful in the fusion process. The approximate shift-invariance property of DTCWT is important in robust sub-band fusion and also makes it to avoid loss of important image content at multiple levels. On the other hand, the availability of phase information in complex coefficients of DTCWT is useful in encoding more coherent structures of the fused images.[3]

In 2014, Himanshi, Vikrant Bhaterja Abhinav Krishn, and Akanksha Sahu, An improved Medical Image Fusion Approach Using PCA and Complex Wavelets, Unlike real valued discrete wavelet transforms, DTCWT provides shift invariance and improved directionality along with preservation of spectral content. The decomposed images are then processed using PCA a based fusion rule to improve upon the resolution and reduce the redundancy. Simulation results demonstrate an improvement in visual quality of the fused image supported by higher values of fusion metrics. [4]

In 2012, B.Yang,S.Li, Pixel level image fusion with simultaneous orthogonal matching pursuit, Thus, this paper proposes a novel image fusion scheme using the signal sparse representation theory. Because image fusion depends on local information of source images, we conduct the sparse representation on overlapping patches instead of the whole image, where a small size of dictionary is needed.[5]

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IV. OUR METHODOLOGY

Modules :

IMAGE DECOMPOSITION: In this module, we developed a website, which will prompt the user to upload the CT and MRI image of a patient. The CT and MRI image will be in the size of 512*512. and also we need to give the input as the maximum coordinate, to fix the coordinate in the uploaded source image for the purpose of fusion. The uploaded image is in the form of RGB. This RGB image is converted into gray scale image, which has the intensity information. After that these source gray scale CT and MRI image is decomposed using DTCWT. The decomposed image is shown in Fig 4.1.1.

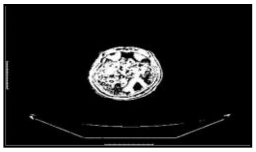

Fig 4.1.1 Decomposed Image

EXTRACTING FEATURES USING DTCWT: After decomposition we will extract the high intensity and low intensity features as wavelet coefficients. It produce the various levels of decomposed images. Each level the images are segmented into sub-bands at six directions like -15º, -45º, 75º, 75º, 45º, 15º to extract the features from the image.

IMAGE FUSION: The extracted coefficients are approximated. Finally, we get the approximated wavelet coefficients. Now the image fusion, that is approximated coefficients are fused to get the fused coefficients. Now we apply the Inverse dual tree complex wavelet transform to restore the fused image. The fused image is shown in figure 5.1.2.

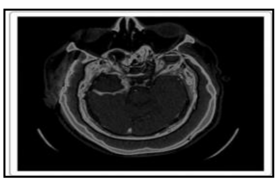

Fig 4.1.2 Image Fusion

IMAGE SEGMENTATION: Image segmentation is a branch of digital image processing which focuses on partitioning an image into different parts according to their features and properties. The primary goal of image segmentation is to simplify the image for easier analysis. In image segmentation, you divide an image into various parts that have similar attributes. Watershed algorithm is used for segmentation in some complex images. Watershed algorithm is based on extracting sure background and foreground and then using markers will make watershed run and detect the exact boundaries. This algorithm generally helps in detecting touching and overlapping objects in image. So the segmentation is performed on the final fused image. The segmented image is shown in figure 4.1.3.

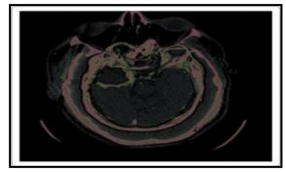

Fig 4.1.3 Segmented Image

V. RESULTS AND DISCUSSION

Medical images are used for diagnosis the disease and helpful for treatment. The fused medical image will be used for more accurate diagnosis and gather the elaborated information for better treatment. But in the fused, we are not achieving more accurate images. In this project, we presented medical fusion based on DTCWT.

DTCWT based fusion will compute the fused multi model image which shows good selectivity of directionality and better shift variance. In this project, our proposed method accepts source images as computed CT, MRI and decompose them with DTCWT. Further, extraction of coefficients and approximation of extracted coefficients are performed. Then the IDTCWT is applied to get the fused image, finally segmentation is performed to obtain the segmented fused image. Hence, the fused image of our proposed scheme, exhibits more refined edges, tissues, spectral, contour and spatial details of the tumor.

FUTURE ENHANCEMENT

Our proposed method of medical image fusion is based on Dual Tree Complex Wavelet Transform (DTCWT), since it has proved that it provides the fused image with more refined in representing spectral, spatial, and soft tissue details of the tumor.

With concern about the performance level, our proposed method has high entropy values, fusion factor and peak signal to noise ratio. Hence proposed algorithm performs well compared to other fusion methods.

As a future work, block level fusion can be applied and the results like performance evaluation, and the final fused image regarding enhanced visual representation can be further improved.

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