



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Special Issue 2, April 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

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6381 907 438

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Image Fusion using MRI and CT scans

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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: Medical imaging, Image fusion, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Discrete Wavelet Transform (DWT), Guided filtering.

I. INTRODUCTION

Medical imaging techniques such as X-ray, CT, MRI, SPECT, and PET provide different information regarding tissues, making it necessary to fuse these images for more accurate diagnosis and treatment. Medical image fusion is the process of merging different types or similar types of medical images into a single image that provides more accurate information for diagnosis. Image fusion can be done at pixel, characteristics, and decision levels, with Discrete Wavelet Transform (DWT) being the most commonly used technique. However, DWT has limitations, including shift variance and poor directionality, which can lead to errors in fused images. To overcome these limitations, Dual Tree Complex Wavelet Transform (DTCWT) can be used to fuse different medical images. DTCWT provides better directionality and shift variance, making it easier to process the edges and contours of the source image. DTCWT has increased shift variance and directionality features, making it a better image fusion tool.

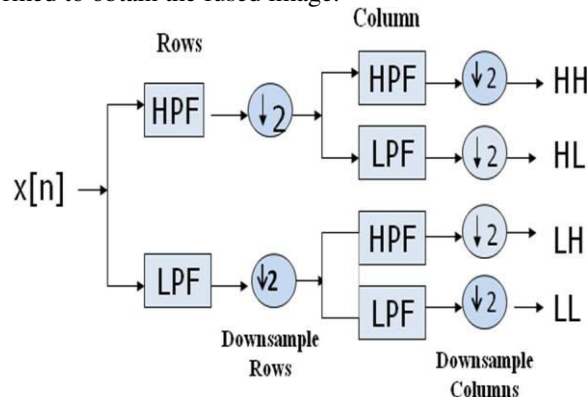
II. RELATED WORK

Medical imaging techniques like CT and MRI provide clinicians with valuable information about the structural characteristics of the human body. Image fusion is used to combine different imaging methods to obtain better contrast and improve the perceived experience. The traditional medical image fusion methods are spatial domain and transform domain. In this regard, Discrete Wavelet Transform (DWT) is an effective technique used to fuse multimodal medical images such as CT and MRI. DWT can maintain different input frequency signals to have stable output and has a good visual and quantitative fusion effect. In DWT-based image fusion, the source image is preprocessed and enhanced, and the intensity component is extracted from the CT image using the IHS transform. Then, the DWT transform is performed on the intensity components of MRI and CT to obtain high- and low-frequency subbands, which are fused using different fusion rules, and the inverse DWT transform is applied to obtain the fused image. However, DWT has limitations such as not providing sufficient directional information and resulting in an image with shift variance and additive noise. Despite these limitations, DWT remains an effective technique for fusing medical images and improving the perceived experience. The proposed MRI and CT fusion algorithm based on guided filtering (GF) has shown improved contrast and structural similarity in fused images.

III. METHODOLOGY

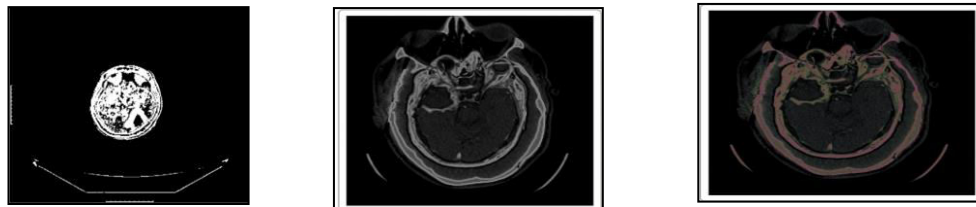
Multimodal medical images like Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) had been fused using Discrete Wavelet Transform. The combination of MRI and CT combines the advantages of clear bone information in CT images and the clear soft tissue of MRI images to compensate for the lack 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.

Discrete wavelet transform can make different input frequency signals maintaining stable output and has good positioning in the time domain and frequency domain, which helps to preserve the specific information of the image. The discrete wavelet transform overcomes the limitations of the principal component analysis and has a good visual and quantitative fusion effect. The source image is preprocessed and enhanced, and the intensity component is extracted from the CT image using the IHS transform, which preserves more anatomical information and reduces color distortion. The DWT transform is performed on the intensity components of MRI and CT to obtain high- and low-frequency subbands. The high- and low-frequency subbands are, respectively, fused by different fusion rules, and the inverse DWT transform is performed to obtain the fused image.



IV. EXPERIMENTAL RESULTS

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 values of entropy, fusion factor and peak signal to noise ratio. Hence our proposed algorithm performs well compared to other fusion methods.



V. CONCLUSION

Medical images are used for diagnosis the disease and are 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 order to achieve visually intensified fused image. In this project, we presented medical fusion based on dual-tree complex wavelet transform.

The dual-tree complex wavelet transform-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 such as computed tomography (CT) and magnetic resonance imaging (MRI) and decomposes them with DTCWT.

Further, extraction of coefficients and approximation of extracted coefficients are performed. Then the inverse dual tree complex wavelet transform 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.

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