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Efficient MRI and CT Images Fusion Technique: Analysis

Prerana G Agarkar, Prof. Deepali R Sale
E&TC Department & Savitribai Phule Pune University
Maharashtra, India

Abstract— The objective of image fusion is to mix the first input pictures to supply a unique type of multiple images of component as associate degree output. From the literature review study, it is clear that the most widely used technique for image fusion is Wavelet Transform because of its performance and less complexity. But for curved edges, the accuracy of edge localization in the Wavelet Transform is low. So, there is a need for an alternative approach which has a high accuracy of curve localization such as the Curvelet Transform. Recently we study the method of image fusion in which Wavelet and Curvelet Transform are together used for better image fusion. However, this method is still suffered from limitations like more complexity, lengthy method, etc. In this project, we are extending hybrid approach of image fusion with goal of improving the performance. To improve the speed of fusion, we are using Fast Curvelet Transform method along with Wavelet Transform. In addition to this, we are using Contrast Limited Adaptive Histogram Equalization function in the preprocessing part, for enhancing the fused image accuracy. The implementation of this method is done by using MATLAB simulator.

Keywords— Image Fusion, Functional Images, Anatomical Images, Adaptive Histogram Equalization, Magnetic Resonance Imaging, Computed Tomography.

I. INTRODUCTION

Image fusion is the process by which two or more images are combined into a single image retaining the important features from each of the original images. The fusion of images is often required for images acquired from different instrument modalities or capture techniques of the same scene or objects. Several approaches to image fusion can be distinguished, depending on whether the images are fused. The purpose of image fusion is to combine information from several different source images to one image, which becomes reliable and much easier to be comprehended by people [1]. The objective of image fusion is to combine complementary as well as redundant information from multiple images to create a fused image output. Therefore, the new image generated should contain a more accurate description of the scene than any of the individual source image and is more suitable for human visual and machine perception or further image processing and analysis task [2]. The main principles of image fusion are the redundancy, the complementary, the time-limit and low cost [3].

Image fusion with more information as possible, the same as an image of the scene is the process of merging two images. Image fusion in several different image processing fields, satellite imaging, remote sensing and medical imaging is as important advances in satellite image fusion study. Imaging has evolved to serve in and then it extended to the field of medical imaging. Many fusion algorithms are introduced extending from simple averaging to curvelet transform. Wavelet fusion algorithm in both satellite and medical image is fusion applications successful. Wavelet fusion algorithm in curved shapes is of the basic range fusion [6].

Thus, there is another algorithm that can handle curved shapes, a curved object image fusion for Curvelet transform would result in a better application of fusion efficiency. Diagnosis possible, as more and more details to get a high resolution image with medical imaging is the main objective of MRI and CT techniques in medical imaging techniques are both techniques to be imaged organ special sophisticated symptom. So, it is expected that MRI CT images in the same part of mergers and more would result in a unified image and more details. Having to deal with limited capacity due to the curved shapes, curved Wavelet transform for the application of MRI and CT image fusion is presented. Although this approach also have suffered from various types of borders [7] [8].

As we studied that the objective of fusion is to combine information from multiple images of the same scene. The result of image fusion is a new image which is more suitable for human and machine perception or further image-processing tasks such as segmentation, feature extraction and object recognition. Multi-resolution 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 [9].

Both high spatial and high spectral information in a single image processing requires numerous conditions. However, the instruments either by design or due to observational constraints are not able to provide such information; this is a possible solution for data fusion [10]. FIkitsa image fusion doctors a patient's CT and MRI medical images to a more accurate diagnosis can combine with a tumour, but it's inconvenient and tedious to finish this work and, more importantly, using the same images with different experiences darts inconsistent decisions. Thus, it reduced the workload of doctors and diagnosed to improve cohesion efficiently to develop automated image fusion system. The simplest way of image

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fusion is two images pixel by pixel average [13]. However, this method usually on the undesirable side effects leads to low contrast, such as due to Multi-resolution transforms human visual system. A good mathematical model can contribute and vice versa can provide information on changes in the multi resolution image fusion technique has attracted more and more interest [11][12].

In this paper, new method is presented for efficient fusion of MRI and CT images so that overall performance has to be improved and hence this fused image is further used to detect or identify the disease. In next section II, we are presenting the literature survey over the various methods presented for Disease detection. In section III, the proposed approach and its system block diagram is depicted. In section IV, we are presenting the current state of implementation and results achieved. Finally conclusion and future work is predicted in section V.

II. LITERATURE REVIEW

There are several methods for CT and MRI images, which are listed below on some writers have suggested methods of Fusion:

- Wavelet transform time-frequency characteristic is successfully applied in image processing sector [6].
- However, one dimension to its excellent feature two dimensions or dimensions cannot be simply extended. Separable Wavelet which was spread by one-dimensional Wavelet directivity is limited [7].
- A range target, E. J. Candes and D. L. Donoho Curvelet transform theory forward in 2000 [8]. In Curvelet transform, Ridgelet transform special filtering process and scale of this image properties fit well. However, Curvelet transform digital realization was sub-band division complex, block, normalization, smoothing the Ridgelet analysis and so on.
- Curvelet pyramid decomposition unbound data redundancy [9]. The E. J. Candes Curvelet Transform (FCT) fast forward to that Second generation Curvelet which is more simple and 2005 [10] was easily understood was transform. Its fast algorithm was easily understood. Li Huihui's Curvelet transform based on the second-generation [11] multi-focus image fusion research.
- Per year Van den Elsen et al. A single composite image of the same subject with different instrument images and diagnoses full proposed providing information [14].
- H. Lee, B.S. Manjunath and S.K. Mitra Wavelet transform multisensory image fusion [15].
- The researchers also proposed wavelet based Fusion method retains the size of conversion and Tower [16, 17] inherits the main properties.
- Two dimensional wavelet images is Chief method by David discrete transform through the proposed merger to [16].
- Mallat and merging of wavelet coefficients Zhong preserved if a revision to undergo, because transform non-redundant [17] does the inverse transform quantization etc then proposed that amendment.
- Svensson et al. The proposed cluster feature extraction and data fusion in Wavelet domain [18].
- Garzelli possibilities and limitations on image fusion [19] explained to use wavelets. Lau Wai Leung et al. entropy and image noise index (INI) [23] compared to use image fusion techniques.
- Chavez et al. Multi resolution and multispectral data is [21] to merge the proposed three different ways.
- Rockinger, O'Brien, proposed new merger landslide feature [24] for the promotion of the maximum value selection rule approximation using Shift Invariant Discrete Wavelet transform coefficients (SIDWT) is based on the principle.
- Ramac, l. c., Uner, m. K, Varshney, p. k proposed Morphological filters and Wavelet-based image fusion concealed weapon detection [25].
- Nuñez, j., Multi resolution decomposition [26] proposed image fusion with wavelet-based additive.
- Tote, Alexander van Ruyven, JJ and Valeton, introduced a hierarchical scheme merger JM image based on multi resolution decomposition of a low-pass contrast pyramid ratio [27].
- Vivek Joonki Paik Jeongho Maik, Shin and presented a pattern selective fusion method to identify the salient features in multiple source images and a single silicon image [28] through a combination of features in color images provides a mechanism for combining.
- Wayne Doua, Yunhao chain various methods is [29] to reveal the nature of the relationship between the target image fusion methods.
- Andrew p. Bradley review a number of approaches to reducing, or removing, the problem of shift variance in the DWT. To overcome this, they proposed over complete DWT (OCDWT) [30] which is efficient in edge detection and also it is compared with other shift invariant transforms in terms of redundancy and complexity.

III. PROPOSED APPROACH FRAMEWORK AND DESIGN

A. Problem Definition:

The concept of image fusion is nothing but mechanism of merging of two images of same or different scene to produce one single image as output by holding much information from both input images. There are many application areas in which image fusion is widely used such as satellite imaging, remote sensing and medical imaging. The study in the field of image fusion has evolved to serve the advance in satellite imaging and then, it has been extended to the field of medical imaging. Several fusion algorithms have been proposed extending from the simple averaging to the Curvelet transform. As our research more focus on wavelet based and Curvelet based transform, we are further discussing over

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them. The Wavelet fusion algorithm has also succeeded in both satellite and medical image fusion applications. However from previous research studies, limitation of the wavelet fusion algorithm is in the fusion of curved shapes. Thus, there is a need for another algorithm that can handle curved shapes efficiently. The Wavelet transform does not represent the edges and singularities well. So, the application of the Curvelet transform for curved object image fusion would result in better fusion efficiency. This Curvelet fusion based method frequently used previously for fusion of satellite images however not have been used for medical images. Curvelet based method outperforms wavelet based method, however missing some advantages of wavelet transform for image fusion. And hence this becomes further research problem in the domain of image fusion.

B. The Proposed Architecture:

In this project, novel enhanced method is presented which is based on DWT+FCT+CLAHE for fusion of CT and MRI images and then further detection of diseases from fused image. The practical simulation of this work will carry using the MATLAB toolkit, during the simulation we will perform our practical analysis over CT and MRI images and measure its performances in terms of PSNR, RMSE, Time, etc.

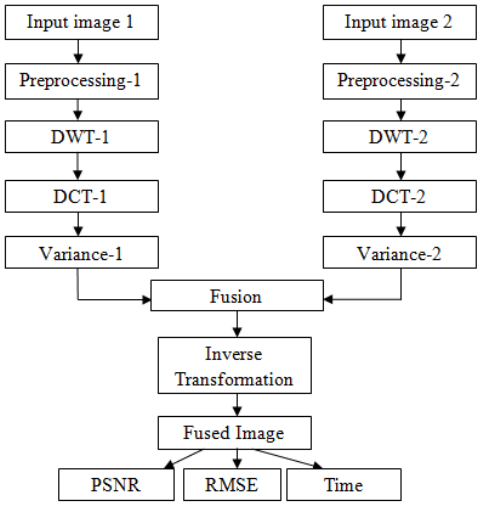

Fig.1: Proposed System Architecture.

IV. WORK DONE

In this section, we are discussing the practical environment, scenarios, performance metrics used, etc. As per the block diagram given in figure1, in this project we achieved results still to Curvelet transformation.

A. Input:

For our practical experiments, we use the dataset containing MRI and CT Images. These images are collected from research websites and sources.

B. Results of work done:

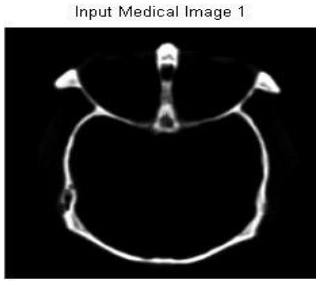

Fig. 2: Input CT image.

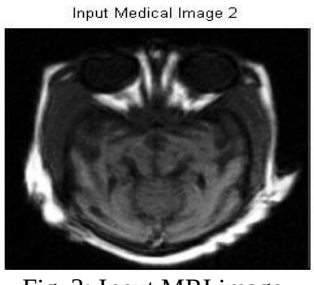

Fig. 3: Input MRI image.

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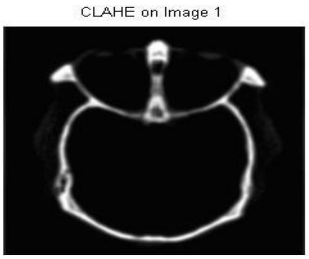

Fig. 4: CLAHE on CT image.

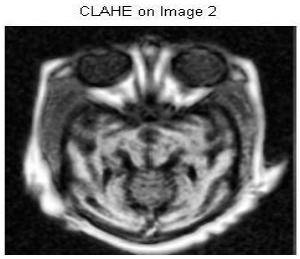

Fig. 5: CLAHE on MRI image.

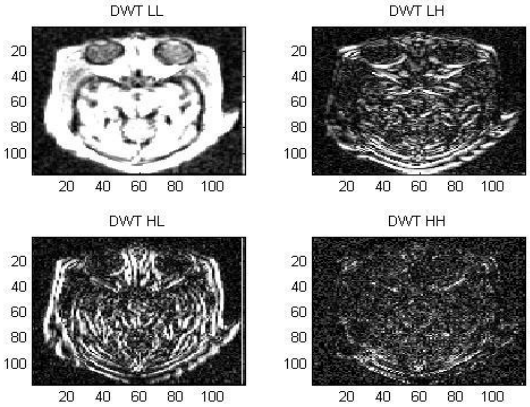

Fig. 6: DWT of MRI image.

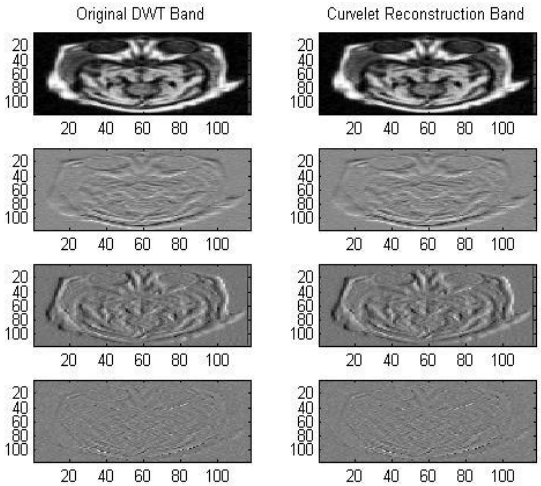

Fig. 7: Applying Curvelet on DWT results.

V. CONCLUSION AND FUTURE WORK

Now-a-days, the fusion techniques are majorly used for various purposes under the real time applications such as medical disease diagnosis. In this paper, we discussed review on different methods of image fusion and presented problem definition with proposed architecture as future road map. For future work, we suggest to work on complete analysis and implementation of proposed work and claim its efficiency against existing method.

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AUTHOR'S BIOGRAPHY

Ms. Prerana G Agarkar is pursuing her M.E. Electronics and Telecommunication in Communication Network from Pad. Dr. D. Y. Patil Institute of Engineering and Technology, Pimpri, Pune. She received B.E. Degree in Electronics and Communication Engineering from R.T.M.N University, Nagpur, India.

Prof. Deepali R Sale is pursuing her Ph.D in image processing (image fusion). She has completed her M.E. (Electronics) from College of Engineering, Pune. She is presently working as a Assistant Professor in Pad. Dr. D. Y. Patil Institute of Engineering and Technology, Pimpri, Pune. She has about 10 years of Teaching Experience. She has about 20 papers published in National /International Journals and conferences. She is a member of IETE, India, IEEE, USA

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