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Analysis of Multimodal Medical Image Fusion using Discrete Wavelet Transform

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ABSTARCT: Medical image fusion is the development of register and merges various pitchers of one or several imaging modalities to progress image value and decrease uncertainty and employment to improve the applicability of medicinal image for clinical opinion or evaluation of medicinal difficulty. Multimodal medicinal picture fusion algorithms and equipment have achieved remarkable getting result in progress the truthfulness of clinical decision making support on medicinal imagery. The main aim is to improve the understanding of medical images with help of discrete wavelet transformation technology. DWT mainly uses merge rules that involve the average pixel. The discrete wavelet transformation has been implemented using fusion technology for the fusion of medical images. The fusion performance is calculated based on PSNR, MSE and whole progression moment. The outcome displays the success of the fusion scheme stand on the wavelet transformation, Imaging (MRI) and positron production tomography (PET). More MRI (Magnetic resonance imaging) and PET (Positron emission tomography) scan variants performed for medical diagnosis

Keywords: Multimodal medical image fusion, fusion rules, DWT, HAAR, MRI, PET.

I. INTRODUCTION

Pictures combination implies that the progression of reconciling related data a large amount of image information with the new final image is appropriate and meets the ultimate objectives of human visual recognition and computer processing. The merged image should gradually have total data, which is becoming increasingly valuable for human or mechanical observation. The benefits of image fusion [1, 2] are improved reliability and reliability. In medical figure, CT, attractive reverberation imaging MRI, PET, SPECT and extra fields.

Image processing method that reflects human data in different locations. In this article, we will present and discuss the objective of merging computed tomography images and magnetic resonance images. So far, several processes for merging written images have been planned. Some techniques are identified through the fusion of multimodal picture. Picture fusion mainly controls three types, such as pixels, characteristics and decision level techniques. Due to its simplicity of execution and computational competence, pixel-level picture synthesis system is often exploited the fusion of medical images. Therefore, he gets involved in the proposed work. There are several essential necessities for picture fusion process [5]. The merged picture must retain all the significant in sequence in input picture combination must be not beginning object that may lead to a misdiagnosis. First, incredibly significant steps must be achieved. Procedure, pictures chronicle. Multimodal registration means the coincidence of the same scene obtained from diverse antenna. The corresponding characteristics, picture listing method may break up into three categories: point-based, outside based or size foundation methods [6, 5, 9].

Point-based check entails determining the coordinates of related position in special pictures using these corresponding points to estimate the geometric transformation. Exterior support check entails determining surfaces of images to match and minimizing the measurement of the space amid this resultant plane.

Volume-based registration require optimizing of data that takes into account some predefined features, which measures match of all geometrically resultant join up of voxels. A few methods of picture fusion have been initiate in the prose, with the effortless average point to point using SNR (signal/noise ratio) [11].

II. RELATED WORK

In medicine, image processing technology plays an important role. Computing processing automation is the most real and prominent method. Brain diseases can be recognized by magnetic character (MRI) and (PET). Extra MRI and PET scan variations have been used for medical diagnosis. Medical experts need a solid computational scrutinize and its associated analysis. In favor of the verdict and action of diseases, accurate information is obtained during diverse remedial images method i.e. (CT), (PET) and MRI). In figure giving out, image fusion is a method of merging two images into a single image.

Compared to the original single scan image, the single fusion image obtained using several multimodal medical images is an improved anatomy with very ideal spectral information [14]. This multimodal fusion picture is positive for experimental analysis by health proficient. In do examine job; the structure is arranged for giving out magnetic resonance imaging or PET. Preprocessing techniques improve the excellence enter pictures, and illegible. On behalf of preprocessing method, we apply a Gaussian filter with spatial filter technology. The superior image is transmitted to the fusion of dissimilar regions of the head image through the (DWT). This structure achieves approximately 90-95% of perfect results by temper shade changes. Fusion images were obtained exclusive of behind ethereal or anatomical records. The experimentation checked on image data sets of Alzheimer's disease, average affiliation or regular coronary syndrome. Measure and graphed come out show in (DWT) can extensively improve the featured merged pictures.

Fusion of medical images: Multimodal medical imaging algorithms and equipment have demonstrated significant realization in evolution the correctness of medical image-based decision making. The choice of imaging model for the objective clinical study requires specific medical knowledge for the research body. It is almost not possible to imprison factor of an imaging modality to guarantee the medical accurateness and robustness of the analysis and analysis of the results. (a) Identify, improve and develop useful imaging methods for medical image fusion (b) Develop dissimilar medical image fusion technologies (c) Applications of medical image fusion intended for studying human organs of concentration in assessments of medical conditions.

Image fusion methods: There are many methods for image fusion applications [13], but image fusion technologies are basically divided into two categories, namely spatial domain fusion methods and transformation domain fusion methods. These explanations are as follows:

(i) Space domain fusion technology. In space domain technology, we directly process the image pixels. Manipulate pixel values to obtain the desired result. These techniques are based on gray-scale mapping, where the type of mapping used depends on the criteria selected for improvement. The disadvantage of spatial domain methods is that they produce spatial distortion in the merged image.

(ii) The fusion technology based on the transformation or frequency domain technology is based on the operation of the orthogonal transformation of the image, not on the image itself. Domain transformation technology is suitable for processing images based on frequency content.

III. PROPOSED APPOROCH

Image fusion based on the wavelet transformation. The original concept and theory of multi-solution analysis based on wavelet comes from Mallat.

The Wavelet transformation is a numerical implement that can detect local characteristics in the signal procedure. It can also be used to decompose two-dimensional (2D) signals (such as 2D grayscale image signals) at different levels of resolution for multiple resolution analysis. Wavelet transformation has been widely used in numerous fields, such as texture analysis, data compression, feature detection and image fusion. In this section, we briefly analysis and evaluate wavelet based image fusion techniques.

$I(x, y) = W^{-1}(Ø (W (I_1(x,y)), (W (I_1(x,y))))$

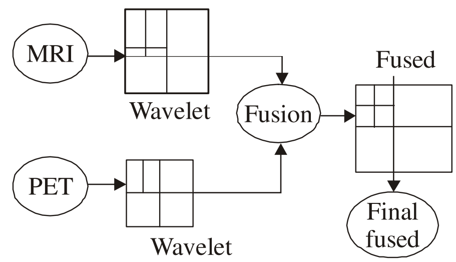

Fig. 1. Image Fusion using discrete wavelet transform.

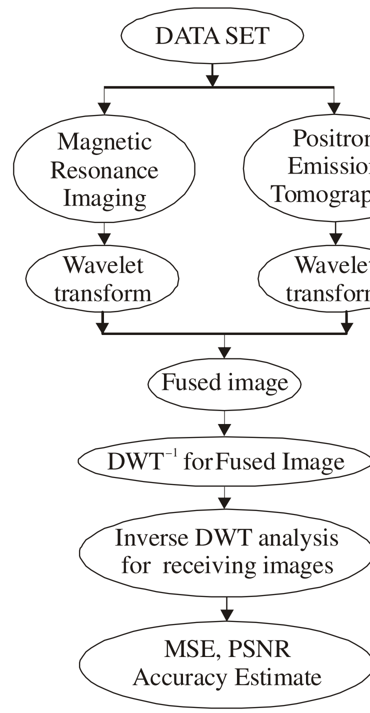

Fig. 2. Proposed Flow Chart [12].

Wavelet Transformation Wavelet study corresponds to the next logical step: window techniques with regions of varying size. Wavelet analysis allows longer time intervals to be used where more precise low frequency in sequence is needed and shorter time interval to be used in areas where high frequency in sequence is required.

In one measurement (1D), the basic idea of DWT is to represent a signal as a wave overlay.

Assume that the discrete signal is stand for through f (t); then, the wavelet decomposition is definite as $(t) = m, n$ $cm, n\ \psi m, n\ (t)$
where $\psi m, (t) = 2^{-m/2} [\ 2^{-m} t - n\ ]$ and m and n are integers.

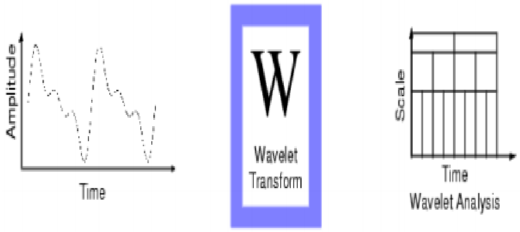

Fig. 3. Using discrete wavelet transform.

Algorithm. Following algorithm has been developed and implemented in MATLAB software.

Steps:

1. Read the image I1 and find its size.
2. Read the second image I2 and find its size.
3. Compute and match the size if not same, make it same.
4. Convert both images from grayscale to indexed image to perform various wavelet functions. If the color map is horizontal, the wavelet convert can be openly applied to the indexed representation otherwise the indexed image be supposed to be transformed to grayscale format.
5. Perform multilevel wavelet decomposition using any wavelet (haar).
6. Generate the coefficient matrices of the level-three approximation and horizontal, vertical and diagonal details.
7. Construct and display approximations and details from the coefficients.
8. Regenerate an image by multilevel inverse wavelet transform.
9. Repeat the same with second image.
10. Now fuse the wavelet coefficients using either of averaging, maximum or minimum technique.
11. Generate a final matrix of fused wavelet coefficients.
12. Compute the inverse wavelet transforms to get the fused image.
13. Finally compute the PSNR and MSE and display the results.

Results: We have considered wavelets namely Haar, for fusing the PET and MRI images. With fusion rule were implemented. Since Haar wavelet along with maximum rule produced better results in terms of PSNR and MSE so they were used for further analysis.

The two input images are first read and converted to indexed images. After that the wavelet decomposition is done to find the approximate, horizontal, vertical and diagonal details. The decomposition level and the type of wavelet used are specified.

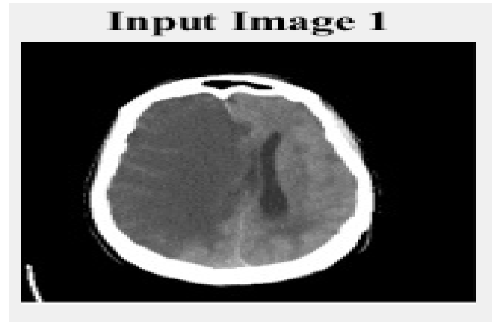

Fig. 4 (a) MRI input image.

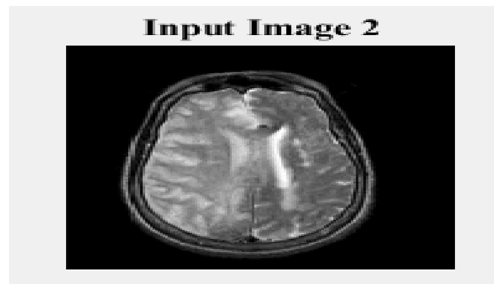

Fig. 4. (b) PET input image.

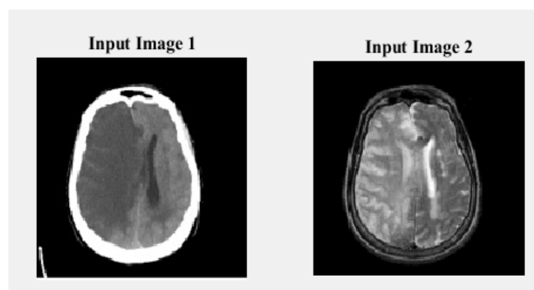

Fig. 5. MRI & PET input images.

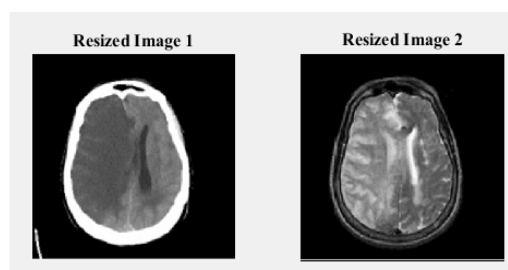

Fig. 6. Resized of MRI & PET input image.

DWT is then performed on the input images. The coefficients found are then fused used a specific fusion rule and then the images are restored back using inverse discrete wavelet transform.

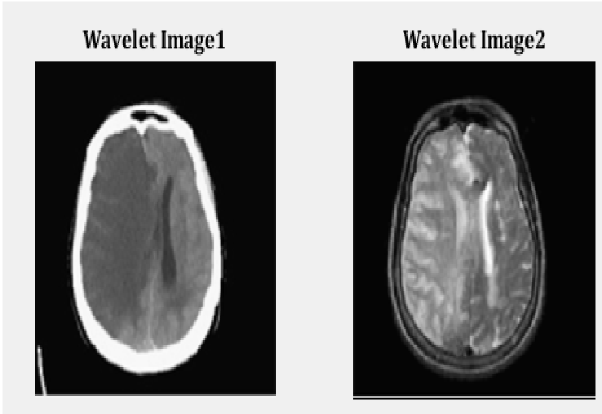

Fig. 7. Wavelet Transforms of MRI & PET images.

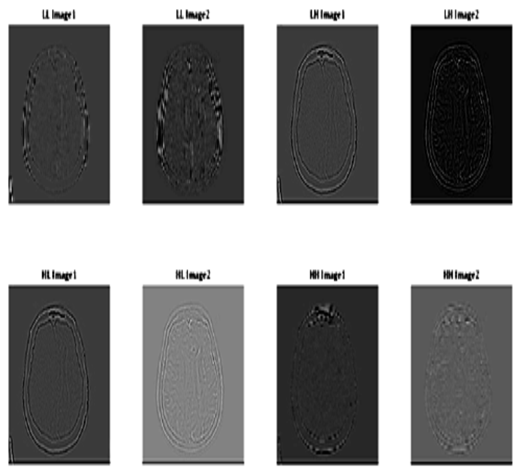

Fig. 8. Wavelet Transforms coefficient of MRI & PET images.

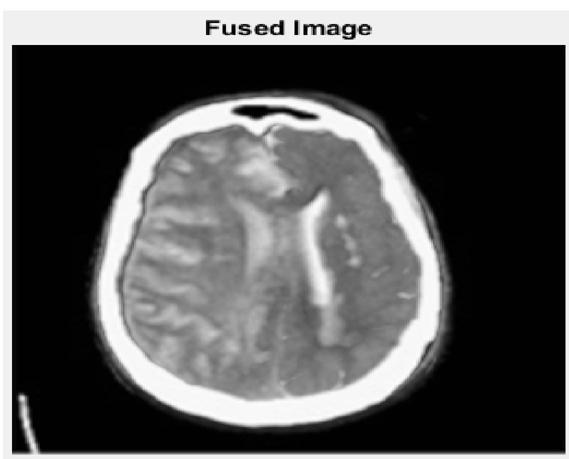

Fig. 9. Fused image of MRI and PET.

A graphic demonstration of the system developed in MATLAB is shown in Fig. 9. In this system, Haar wavelets are use designed for the fusion method.

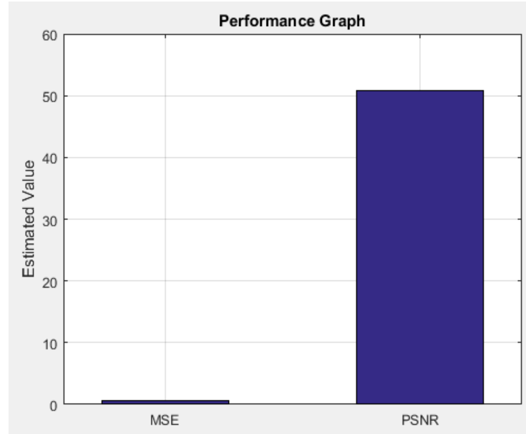

Fig. 10. Performance graph.

Table 1: Performance measure based on PSNR, MSE of the output Fused Image.

Data set	Previous work	Proposed work
PSNR	43.12	50.10
MSE	0.012	0.012

IV. CONCLUSION

This article proposes a wavelet-based fusion method for MRI and PET images. The wavelet decomposition of the data set will be divided into four levels, with active areas low and high, respectively. This experiment will test the haar wavelet method. Haar's wavelet is used to merge the database of multiple 3D medical models. The preprocessing method will apply a Gaussian filter of spatial filtering technology, using MSE and PSNR to test the quality of the merged image.

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