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ANALYSIS OF BIOMEDICAL IMAGE USING WAVELET TRANSFORM

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ABSTRACT

Image fusion can be defined as the process by which several images or some of their features are combined together to form a fused image. Its aim is to combine maximum information from multiple images of the same scene such that the obtained new image is more suitable for human visual and machine perception or further image processing and analysis tasks. The fusion of images acquired from dissimilar modalities or instrument has been successfully used for remote sensing images. The biomedical image fusion plays an important role in analysis towards clinical application which can support more accurate information for physician to diagnose different diseases.

KEYWORDS - CT, DWT, Entropy, Image Fusion, MRI.

INTRODUCTION

Image fusion has most common word used in medical diagnostics as well as treatment. Image fusion means it is the combination or merging of two images of same scene to form a single image which more informative than any input image. The resultant image is the high resolution image which is suitable for easy diagnosis. Image fusion techniques play important role in microscopic imaging, remote sensing, computer vision and medical imaging. In medical field, different images are present such as x-ray, CT scan, MRI scan to examine the organs of body. Major advantage of CT image is its both blood vessels and bone all at same time and advantage of MRI image is to gives the information of soft tissue like the membranes covering the brain can be clearly visible. The main aim of medical image fusion is to obtain high resolution image which contains as much details as possible for diagnosis purpose .so if both that is CT and MRI image of same scene fused then the fused image gives more amount of information for diagnosis of that organs, as compared to input image. Image fusion is merging complementary information from multiple images of the same scene to form a new image is more accurate for further machine perception or imaging processing tasks .number of methods exists to perform image fusion .the basic image fusion technique is high pass filtering. In fusion technique simplest method of pixel averaging to more complicated methods such as wavelet transform and principal component fusion
Main objective of biomedical image fusion is to obtain high resolution image with many details for diagnosis purpose .CT and MRI image used for this purpose or use here as input.

Then the wavelet transform is computed, and the fused image is reconstructed. In wavelet transform used for image fusion we obtain the wavelet four coefficients which is called as horizontal, approximation, vertical and diagonal coefficients. These coefficients of each of the image are to be fused together by applying fusion rule. There are different rules used for image fusion here we used Maximum selection fusion rule.

IMAGE FUSION

The idea behind of image fusion using discrete wavelet transform is that the coefficients of high frequency and low frequency bands are performed with certain fusion rule .The most of or widely used image fusion rule is maximum selection rule. This is simple rule just collect the coefficients in each sub band with largest magnitude. This is nothing but the largest discrete wavelet transform (IDWT) for the corresponding absolute wavelet coefficients. At the last stage i.e. fused image reconstructed by using inverse wavelet coefficients.

1 Image fusion methods:-

(1) (IHS) Intensity-hue-saturation transforms based image fusion
(2) Principal component analysis (PCA) based fusion
(3) Multi scale transform based image fusion:-
- (a) High-pass filtering method
- (b) Pyramid methods:- (i) Gaussian pyramid
  - (ii) Laplacian Pyramid
  - (iii) Gradient pyramid
  - (iv) Morphological pyramid
  - (v) Ratio of low pass pyramid
- (c) Wavelet transforms:-
  - (i) Discrete wavelet transforms (DWT)
  - (ii) Stationary wavelet transforms
  - (iii) Multi-wavelet transforms

WAVELET BASED IMAGE FUSION

The wavelet transform gives a time frequency representation of signals .its overcomes the shortcomings of the short time Fourier transform (STFT) which can also be used to analyze non stationary signals .while STFT gives a constant resolution at all frequencies, the discrete wavelet transform uses multi-resolution technique by which different frequencies are analyzed with different resolution. The Discrete wavelet transform (DWT) enabled the application of two -dimensional DWT using one dimensional filter banks.

1 Wavelet Transform

In Wavelet transform signal is decomposed, with each level that is higher frequency and lower frequency band. Two main parts of transform discrete and continuous wavelet transform. In discrete wavelet transform of two dimensional images involves sub –sampling and recursive sampling. At each level we obtain three images as HH(containing diagonal information in high frequency),LH(containing horizontal information in high frequency) and

HL(containing vertical information in high frequency).These decomposition produces one approximation image known as LL(low frequency information).By using recursively process LL sub band can be achieved

FLOW OF PROPOSED WORK

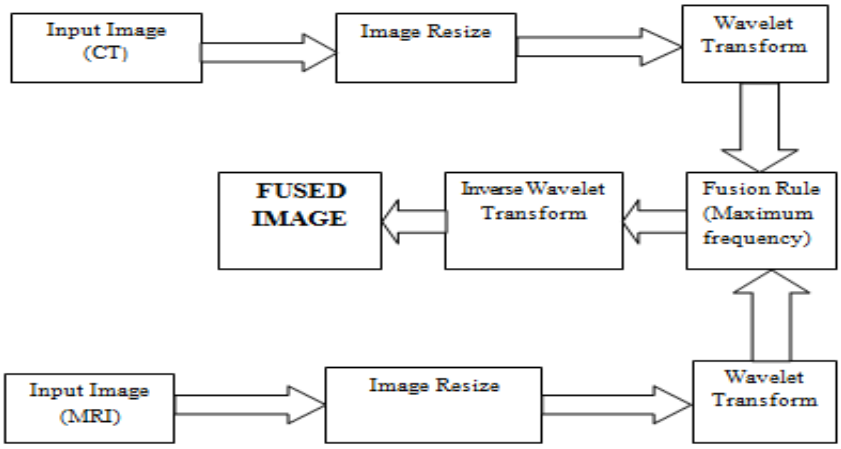


Fig-1 Flow of proposed work

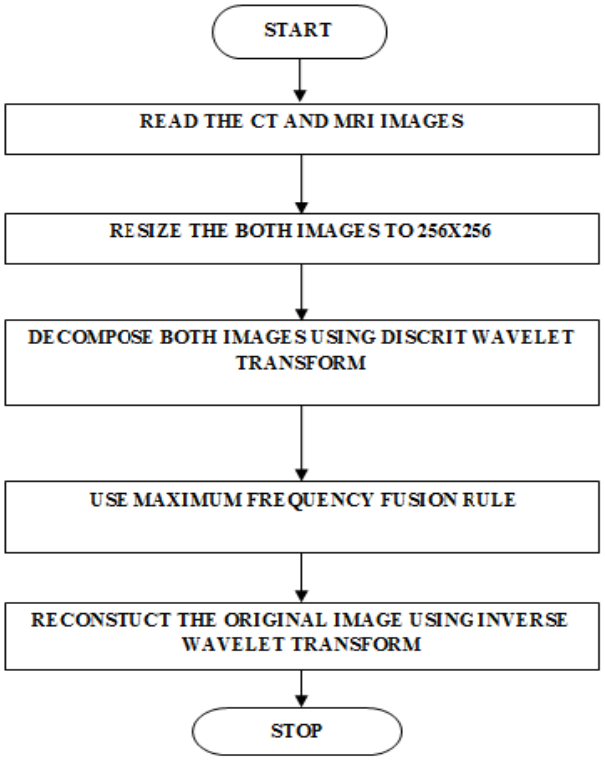


Fig-2 Flowchart of proposed work

The flow for our proposed work is given in Fig.1. and flow chart of proposed work as given in fig.2

1] Input image:

There are two input images one is CT image and other is MRI image.

2] Image Resize:

One of the main issues in image fusion is image resize. For the resultant output image to be distinct and have a better visual interpretation. It is necessary to have both the CT & MRI images of same size. Same size of images becomes a basic requirement for point to point correspondence between two pixel values.

3] Wavelet Transform:

In Wavelet transform signal is decomposed, with higher frequency and lower frequency band. Two main types of transform discrete and continuous wavelet transform. In discrete wavelet transform of two dimensional image involves sub –sampling and recursive sampling. At each level we obtain three images as HH(containing diagonal information in high frequency),LH(containing horizontal information in high frequency) and HL(containing vertical information in high frequency).These decomposition produces one approximation image known as LL(low frequency information).

4] Fusion Rule (Maximum frequency):

The wavelet transform coefficients obtained from the input images need to be combined to form a new set of coefficients to be used for backward transform. There are various fusion rules to form the fused wavelet coefficients matrix using the coefficients of the input images. In this proposed work, taking the largest absolute values of the corresponding wavelet coefficients among input images is chosen as the basic fusion rule. Proposed work use maximum frequency fusion rule.

5] Inverse Wavelet Transform:

In inverse wavelet transform the fused image is reconstructed.

6] Fused Image:

At the final step get the aligned image that is registered image and having the fused coefficient of both the input images. When transforming points from one image to other different selection criteria is being to estimate a resulting fused image quality of images improves.

EXPERIMENTAL RESULTS AND ANALYSIS

There are two types of analysis visual analysis and mathematical analysis

1. VISUAL ANALYSIS

By using wavelet transform we can observe the edges of fused image which is very useful for correct diagnosis. This shows in table 1.

2. MATHEMATICAL ANALYSIS

In this analysis we take the four parameters entropy, correlation, PSNR and Erms for comparison point of view for fused image and original image. Here we take the reference of normal patient images with abnormal patients. Out of these four parameters entropy gives us the correct analyses which gather the more information from input images to fused image. This shows in table 2.

Table1.Visual Analysis

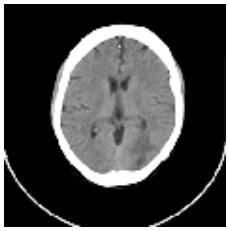
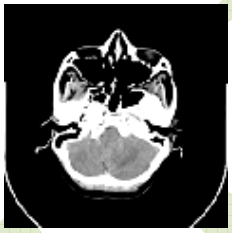
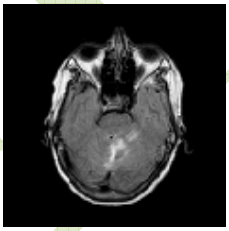
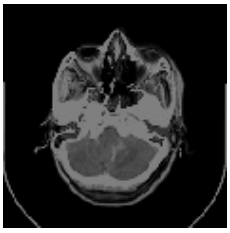
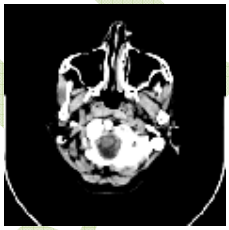
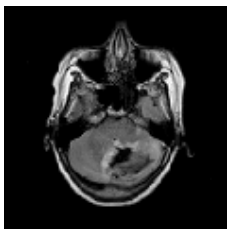
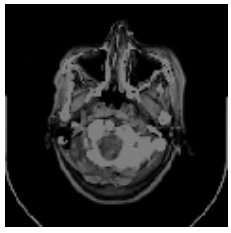
PATIENT	CT IMAGE	MRI IMAGE	FUSED IMAGE
1. LEFT SIDE TUMOR			
2. BRAIN HAMRAGE			
3. ISCHEMIA			

Table 2 Mathematical Analysis

Patient		PSNR		Correlation		Erms		Entropy
		CT	MRI	CT	MRI	CT	MRI	Fused Image
Normal	P_{Ref}	12.4717	15.6641	0.9817	0.6836	0.2379	0.1647	5.0399
Abnormal	P-1	13.7360	16.0250	0.9708	0.6297	0.2057	0.1580	3.4252
	P-2	13.2301	17.0289	0.9042	0.7833	0.2180	0.1408	3.6517
	P-3	14.2156	16.9009	0.8877	0.7281	0.1946	0.1429	3.6474

CONCLUSION

By using wavelet transform we fused the CT and MRI images for getting correct diagnosis of affected part of body by observing the edges which is not observing in original CT and MRI images.

In this work I do both analyses: Visual Analysis and Mathematical Analysis with reference images.

01. By using visual analysis we easily observe the edges in fused image which is useful correct diagnosis.

02. By using mathematical analysis I got how much information carry from input image to fused image.

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