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Novel Approach for Image Fusion Using NSCT and Masking Technique

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ABSTRACT: A perceptual image fusion method is proposed that employs explicit luminance and contrast masking models. These models are combined to give the perceptual importance of each coefficient produced by the Non sub-sampled Contourlet Transform (NSCT) of each input image. This combined model of perceptual importance is used to select which coefficients are retained and furthermore to determine how to present the retained information in the most effective way. Here the luminance masking and contrast masking are used to improve the image fusion. This work is the first to give a principled approach to image fusion from a perceptual perspective. Furthermore, the proposed method is shown to give improved quantitative and qualitative results compared to previously developed methods.

KEYWORDS: Non sub-sampled Contourlet Transform (NSCT), Image Fusion, luminance masking and contrast masking.

I. INTRODUCTION

Biomedical is the area of study in which every single day is new beginning. With modern apparatus new works are made, consequences of new works are discussed over time and step is taken to overcome the problems of it. “Biomedical” is the era which includes many sub fields. Radiology belongs to one of them. Radiology is unified with biomedical imaging this means that, in biomedical field some of the diagnosis is dependent on medical imaging. This imaging diagnosis technology of biomedical era is called as radiology. This system consists of many different forms of images, individual image corresponds relevant and restricted information. Computed tomography (CT) is type of medical image that represents information pertaining to inner organs. On the other hand, Magnetic Resonance Image (MRI) depicts information depending on structure. X- Rays presents information of hard parts of the body. This is how; individual medical pictures represent their own formation of information. The person, who works on medical image studies, will select one type of medical image among all for the particular application in the bio-medical experiment. The situation may arise in the medical field work, where in the information of two sorts of images is to be considered by the person working on particular type of disease. In such a situation, we will be having two answers with us, first one is we should go through both type of images and make study of it for diagnose purpose one more option is we suppose to design a system that will integrate information of two or more than two, different medical images into one single image, without missing out any original information i.e. any relevant statistics. This is the reason for adapting image fusion technique in the present working module in image processing. Image fusion is one system that will integrate the information of two different images representing different characteristics into single form preserving the static information at maximum rate for diagnostic purpose.

NSCT means Non Sub-sampled Counterlet Transform. NSCT transform contains Non Sub-sampled Pyramid (NSP) and the Non Sub-sampled Directional Filter Banks (NSDFB). After fusing by this transform we are enhancing quality of transformed coefficients through some masking methods like contrast masking and luminance masking. In contrast masking we are increasing contrast of images and in luminance masking we are increasing luminance of images. Then these masked images are reconstructed to get one more informative image by using Inverse Non Sub-sampled Counterlet Transform. There by we can increase quality clarity of images so that doctor can visually looking into these image and they will come to know about any defects or disease in the body part (here we are scanning brain part) they can easily nurture patients, making patients healthy.

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II. LITERATURE SURVEY

Author C. Karthikeyan et.al, [01] proposed a work, in this paper, the performance of similarity measures such as Edge Based Similarity Measure and Structural Similarity Index Measure is evaluated and also compared with the existing medical image fusion techniques. Materials and Methods: Multimodality Medical Image fusion is the process of fusing two Medical images obtained from two different sensors for better diagnosis. This paper proposes a method for fusion of Medical images using Dual Tree Complex Wavelet Transform (DTCWT) and Self Organizing Feature Map (SOFM).

Author Shubham Garg et.al, [02] introduced a work on image fusion. In Laplacian pyramid algorithm implement pixel level selection approach so that the fused image can be constructed pixel by pixel level considering the features of two images at a time. In the Laplacian pyramid algorithm the input images are decomposed into four parts and then wavelet transformation is performed by predictive coding technique. Finally decomposed parts of images are combined pixel by pixel using E Laplacian pyramid technique. Finally to fuse the images inverse wavelet transformation is applied. Performance of the system is evaluated on various parameters like Mean, Standard Deviation(SD), Entropy, Covariance, Correlation Coefficient(CC), Structural Similarity Index for Measuring Image Quality(SSIM), Mutual Information(MI), Peak Signal to noise ratio(PSNR), Mean Square error(MSE).

Author Shristy Khandelwal et.al, [03] represented Picture combination strategy of melding two or more pictures of same scene to shape single combined picture which shows fundamental data in the intertwined picture. In this paper diverse systems have been inspected and the primary target is to increase picture quality and reduce the error.

Richa Gautam et.al, [04] has done study on fusion of images. In this paper we have proposed a method for fusing CT (Computed Tomography) and MRI (Medical Resonance Imaging) images based on second generation curvelet transform. Proposed method is compared with the results obtained after applying the other methods based on Discrete Wavelet Transform (DWT), Principal Component Analysis (PCA), and Discrete Cosine Transform (DCT). Entropy, Standard Deviation, Peak Signal to Noise Ratio (PSNR), Percentage Fit Error (PFE) and Spatial Frequency (SF) are used as performance metric evaluators.

Author B.Renuka Devi et.al, [05] represented the work in the paper. In this paper, author is going to propose a Image fusion method based on Teaching Learning Based Optimization. Taking two multifocused images, we are going to divide them into blocks then the contrast visibility of the two image blocks then is calculated. TLBO algorithm is performed to obtain optimal coefficients and fused image is acquired finally using this Optimal Coefficients. For different set of multi focus images, different quantitative measured are calculated. Then the results of proposed method are compared with existing Particle Swarm Optimization.

Author Zhiqiang Zhou et.al, [06] work provides more obviously comparing of the, in which the differences between the figures may be difficult to see. In addition, more fusion results on some other infrared and visible source images are presented to test the performance of the proposed fusion method. From the comparison of enlarged patches in figures, we can more obviously see that the fence and the trees are clearer in the fused image obtained by the hybrid-MSD method. This is because the proposed fusion method has good abilities to preserve the background scenery and details of the visible image, while the conventional DT-CWT fusion method may degrade the background contents with the unsuitably introduced infrared image information.

As we know that fusion technique should integrate the information pertaining to two different sources of image types. The special care has to be taken in building the complete structure of the fusion system as small mistake in the fusion module will guide the diagnostics person in wrong conclusions and making a way for some one's life in trouble.

The work is proposed in the work presented here, information of two different sources of images is integrated into a single frame without any loss of the information while fusing process. The overview of the proposed method is explained briefly in the paper below.

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III. METHODOLOGY

This section briefs about the procedure we have designed for Image Fusion. Proposed approach takes image as input. here we mean MRI images. MRI type of images is used as the dataset in the current working module. Any fusion technique will begin only when the images to be integrated are transformed to the relevant form for the better fusion purpose. This is main role player in the image fusion module. We have made used of pyramid based fusion technique here, i.e. NSCT. The decomposed bands are fused among each other by making use of the fusion rule. Used fusion rule is maximum coefficient available in the images. The fusion technique may cause the negative impact on the resultant image by degrading the quality of the image, to make improvisation of the resultant image; luminance masking and contrast masking techniques are involved to enhance the image contrast. Final fused coefficients are obtained after applying the masking models. Then these fused coefficients are combined with the transformed image and apply the inverse INSCT. The inverse transform will help in rebuilding the pixel level information of the image which can be easily perceived by the user for the analysis of the two integrated information, if we won't follow the inverse transform module then information will remain in coefficient level and will cause a difficulties in analyzing the information of the final fused image out of two different images.

A. Preprocessing:

Pre-processing is a compulsory method of any process. Both image1 and image2 are passed to pre processing module separately. The images are to be fused are converted some basic form for easy process of the fusion module. Here basic level means gray level. The weights of images to be fused are checked and the depending on weights of the pixels and difference of weights in images, image is transformed to gray scale level. This RGB to gray conversion is done by following the Eq. (1)

$$GrayImg = 0.2989 * R + 0.5870 * G + 01140 * B \quad (1)$$

Here,
$R \rightarrow Red\ color\ Palne\ from\ color\ image$
$R \rightarrow Green\ color\ Palne\ from\ color\ image$
$B \rightarrow Blue\ color\ Palne\ from\ color\ image$

B. Fusion Techniques

With every single day being something new in the pocket biomedical is assuming a noteworthy part in our day by day lives. New enhanced device are given in this module by making exchange on the present status and troublesome are over come. Biomedical resembles an ocean with bunches of data in it. One of the types of it is called as radiology. In the radiology diagnosis is finished by investigating restorative pictures. The data in the medical picture helps in conclusion prepare. Yet, as depicted in the past module medicinal pictures are of much sort each communicating distinctive sorts of data in it. So it is required that the amassed study is to be done on every one of the pictures. It is conceivable to study everything except it expends additional time. Henceforth experts have built up a module where in data in the picture can be included and after that examined. The procedure of such collection of data is called "Fusion system". There are numerous systems open for the fusion purpose.

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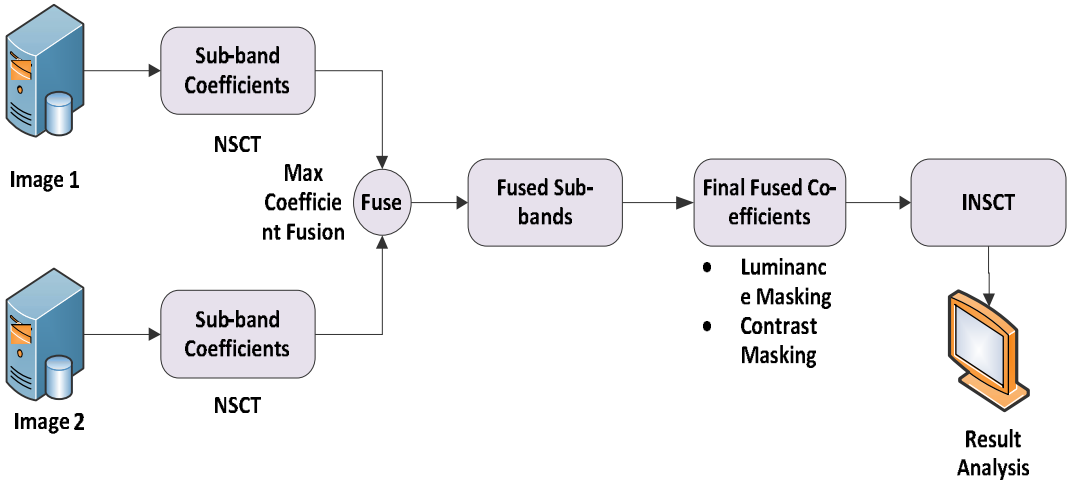

Figure 1 Architectural Block Diagram of Proposed Work on Fusion.

C. Contourlet Transform

A "genuine" two-dimensional change called contourlet transform, which depends on nonseparable channel bank filters and gives a productive directional multiresolution image. The CT depicts picture by first applying a transform of multiscale, trailed by a neighborhood directional transform to accumulate the close-by premise capacities at a similar scale into straight structures. For instance, the Laplacian pyramid (LP) is first used to catch the point discontinuities, and after that taken after by a direction filter banks (DFB) to connection point discontinuities into straight structures. Specifically, contourlets have extend supports at different scales, headings, and perspective proportions. The contourlets fulfill anisotropy standard and can capture natural geometric structure data of pictures and accomplish preferred expression over discrete wavelet transform (DWT), particularly for the edges and shapes. Be that as it may, in view of the downsampling and psampling, the CT is absence of move invariance and brings about ringing artifacts. Be that as it may, the move invariance is attractive in picture examination applications, for example, edge discovery, shape portrayal, picture combination, etc. Particularly, amid the acknowledgment of the CT, the investigation filters and Synthesis Filterrs of LP deterioration are nonseparable bi-orthogonal channel saves money with band width bigger than $\pi/2$. In view of multisampled rate hypothesis, downsample on separated picture may bring about lowpass and highpass recurrence associating. Thusly, the recurrence associating influences lie in directional subbands, which originates from the highpass subbands separated by DFB. The recurrence associating will bring about data toward a path to show up in various directional subbands in the meantime. This must debilitate the directional selectivity of contourlets.

D. NSCT:

The wavelet transform has disservice, for example, directions and non-optimal-sparse depiction of pictures. To defeat these constraints, the new multi scale transform named as Contourlet is presented in picture fusion technique. Contourlet change has great course affectability, and gets precisely the image edge data, however the Contourlet transform does not have the move invariance. The contourlet transforms has a noteworthy shortcomings, which is that its images are not limited in the frequency space. The new Contourlet transform with move invariance, called non-subsample contourlet change (NSCT) has been proposed.CT gives exact picture edge data.

To conquer the issue of Contourlet change NSCT is used.The fundamental property of NSCT is giving a multidirectional, multiscale, move invariant picture disintegration that can be proficiently executed by methods for the combination strategies or calculations.

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NSCT is shift invariant form of CT (Contourlet change) and has some magnificent properties including multilevel and multidirectional properties. NSCT gives a superior representation of the shapes. CT utilizes the Laplacian pyramid for multiscale deterioration and the DFB for directional decomposition. To minimize the frequency associating of CT and to achieve the shift invariance, NSCT takes out the down samplers and the up samplers under theprocess of decomposition and the recreation of the picture; it is based upon the non-subsampled pyramid channel filters and the non-subsampled Directional filters, by applying this transform we will get low and high frequency part of info picture. Apply diverse level of transforms to CT and MRI picture. [07].

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As shown in the Figure 2, the algorithm steps are depicted in the form of Flowchart here. The images with given parameters are considered. For given parameters directional filters are designed with proper filtering coefficients. For number of levels repeat a process of pyramid decomposition of the the presented images in the program.

If
the level is greater than 0
then
copy the results of the decomposition
else
pass the information for the DFB decomposition.
Finally the coefficients are developed.

E. Fusion Rules:

Image fusion is the component where in pixel determination, expansion of pixels, and subtraction of pixels or averaging of pixels; such fundamental operations are performed. In light of the image arrangements these strategies can be utilized, despite the fact that these means are not generally successful, coordinating a strong calculation with these methods will build the adequacy. For the proposed technique we are utilizing taking after strides as combination strategy.

a) Maximum with absolute value:

In this technique the pixels are chosen by figuring absolute value estimation of the pixels the subsequent two qualities will be then analyzed, whichever is the most elevated one, that will be considered and new picture is framed. This will work with most extreme force values. This is the method used in the proposed work for the final fused image formation out of two separate images.

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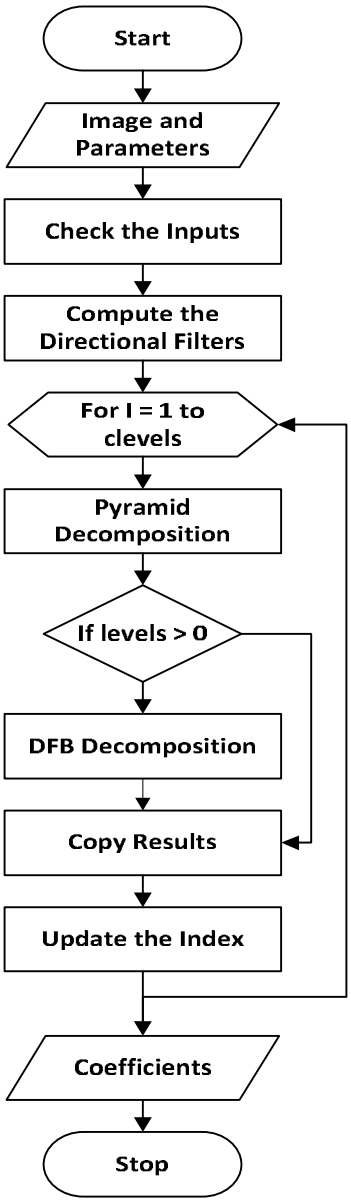

Figure 2 Flow-Chart of NSCT

IV. RESULTS

This section comprise of the general outcomes, correlation between various parameters at various level of the venture work. The correlation is the numerical examination made for the conclusion motivation behind current work. Here for this situation we have made utilization of such two parameters that gives the conditions based examination of the gave work. These are:

- Signal to Noise Ratio (PSNR)
- Mean Square Error (MSE)

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The examination of Signal to Noise Ratio proportion for given pictures regarding decibels are called as PSNR. This computation incorporates the assessment of greatest energy of flag to the exhibited error in the flag. The execution of fusion and inserting procedure will cause a misfortune which is in a roundabout way corresponding to the PSNR esteem. Improvement in the estimation of PSNR demonstrates advancement of the execution. The condition utilized for the count of PSNR is as given in underneath Eq. (2);

$$PSNR = 10 \log_{10} \left(\frac{R^2}{MSE} \right)^2 \quad (2)$$

Where,

R is total available power, in our work it is 255 (total number of pixels)

MSE is Mean Square Error, which can be given as Eq. (3).

$$MSE = \sum_{M,N} [Image_1(m,n) - Image_2(m,n)]^2 \quad (3)$$

The comparative execution to PSNR we have thought of one as more parameter that is Root Mean Square Error. This is the count of square foundation of MSE. Scientific portrayal of the RMSE is given beneath Eq. (4).

$$RMSE = \sqrt{MSE} \quad (4)$$

The work results are depicted in the Figure 3.3 that shows how the image will be merged with the maintaining the parameters at its high value.

The PSNR of various cases are given in the particular table. The MSE is likewise incorporated into the table. The general execution of the framework is given in better way.

TABLE 1 Comparison of Parameters of PSNR And MSE

Image	PSNR	MSE
Image 1	34.5161	22.9866
Image 2	35.8526	16.8974
Image 3	34.299	24.1649
Image 4	34.6161	23.9866
Image 5	34.0523	24.1010

(a)

(b)

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(c)

Figure 3.3 Results Outcome of work, (a) Input Images 1, (b) Input Images 2 and (c) Fused Image.

V. CONCLUSION

Conventional transform-based image fusion algorithms implicitly assume that there is a simple linear relationship between coefficient magnitude and perceptual importance. This is a gross simplification. Our work has addressed this by producing a principled model of the perceptual importance of coefficients within image fusion and evaluating its performance objectively and subjectively across a representative dataset. The proposed method use the NSCT for image decomposition and the maximum fusion technique is used for the fusion with the more information from two sources.

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