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Implementation of Image Fusion Technique using Multimodal Approach

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ABSTRACT: Image Fusion is defined as the process of combining two or more different images into a new single image. In this process the new single image so formed retain important features from each and every Image with extended information content. Image fusion is a strong tool which is used to increase the quality of image. The fused image will include the fundamental features of all of the images and it is more valuable than any of the input images. Various kinds of images are fused together to obtain valuable information and to preserve the edges and important points of the images as good as to successfully reduce noise in multi focus images. Here we are combining principal component analysis (PCA) with discrete wavelet transform (DWT) to produce fused image.

KEYWORDS: Discreet Wavelet Transform (DWT), Image Fusion, Principal Component Analysis (PCA).

I. INTRODUCTION

Image Fusion is defined as the process of combining two or more different images into a new single image. In this process the new single image so formed retain important features from each image with extended information content. Image fusion is a powerful tool which is used to enhance the quality of image. With rapid developments in technology information, it is now feasible to obtain information from multisource images. However, all the physical and geometrical information required for exact evaluation would no longer be available by way of analyzing the images individually. In multisensory images, there is often a trade-off between spatial and spectral resolutions resulting in information loss [1].

Image fusion combines perfectly registered images from more than one source to produce a high quality fused image with spatial and spectral information. It integrates complementary information from various modalities based on specific rules to offer greater visual images of a scenario, suitable for processing. An image will also be represented either by its original spatial representation or in frequency domain.

Wavelet transform is a type signal representation that can provide the frequency content material of the signal at a particular instant of time. In [2] the wavelet based image fusion process proposed in which steps commonly involved are registering source images, performing wavelet transform on each input image, then generating a fusion decision map based on a defined fusion rule and constructing fused wavelet coefficient map from the wavelet coefficients of the input images according to the fusion decision map. Finally, transform back to the spatial domain. Image fusion based on wavelet transform is the most commonly used technique, which fuses the source image information in wavelet domain according to a couple fusion rules.

The MATLAB package offered a significant advantage as it has provided access to the Image Processing Toolbox that offers a comprehensive suite of standard algorithms and graphical tools for image processing, analysis and visualization. However, using the Image Processing Toolbox in MATLAB would enable instant access to standard image processing algorithms and would also allow the application to be easily ported to any environment that is supported by MATLAB, so MATLAB was chosen as the computational package that would be used to develop the application.

The rest of the paper is organized as follows. The second section gives the relevant literature survey associated with fusion approaches. Section III details the new hybrid architecture proposed in this paper. In section IV, the results obtained by applying wavelet based algorithms to test images are analyzed in detail. The paper is concluded in section V.

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II. RELATED WORK

Susmitha Vekkot and Pancham Shukla [3] have focused on the fusion of images from different sources using multi resolution wavelet transforms. A novel architecture with a hybrid algorithm is proposed which applies pixel based maximum selection rule to low frequency approximations and filter mask based fusion to high frequency details of wavelet decomposition. A Graphical User Interface is developed for image fusion to make the research outcomes available to the end user.

Paresh Rawat, Sapna Gangrade and Pankaj Vyas [4] have focused on Multi Resolution fusion by adopting discrete wavelet transform (DWT) technique. This paper highlights wavelet based pixel-level fusion. In this paper they adopted a novel approach to decompose the original images into high and low frequency parts to the smallest pixel and then fuse both the parts separately using same fusion rules to get an accurate, high resolution image with preserved spectral characteristics.

Srinivasa Rao Dammavalam, Seetha Maddala and Krishna Prasad MHM [5] have proposed a fuzzy logic method to fuse images from different sensors, in order to enhance the quality and compared proposed method with two other methods i.e. image fusion using wavelet transform and weighted average discrete wavelet transform based image fusion using genetic algorithm.

Deepak Kumar Sahu and M.P.Parsai [6] presented a literature review on some of the image fusion techniques for image fusion like, primitive fusion (Averaging Method, Select Maximum, and Select Minimum), Discrete Wavelet transform based fusion, Principal component analysis (PCA) based fusion etc.

Myna A.N and J. Prakash [7] presented a hybrid approach for fusing two multifocus images. Their proposed approach is based on fuzzy logic and Discrete Wavelet Transform (DWT). DWT has been used to improve the performance as fuzzy logic is applied at every level of DWT to fuse the approximation coefficients and Fuzzy logic is applied only an on dissimilar pixel which speeds up the fusion process to a greater extent. Mandeep Kaur Sandhu and Ajay Kumar Dogra [8] have presented a paper which reviews the existing Pixel based fusion algorithms, such as Principle Component Analysis, Brovey, Intensity-Hue-Saturation, Discrete Wavelet Transform, and DCT.

III. PROPOSED SYSTEM

In our approach, we take normal image and we will pre-process the image, which includes resizing, color conversion. Once pre-processing is done blocks have to be generated using discrete wavelet transform. Then we process with PCA with any one blocks and convolute the resultant block with the source block. Apply fusion rule to the resultant block followed by Inverse discrete wavelet transform. As a result fusion image will be obtained. Figure 1 shows the architecture of proposed work.

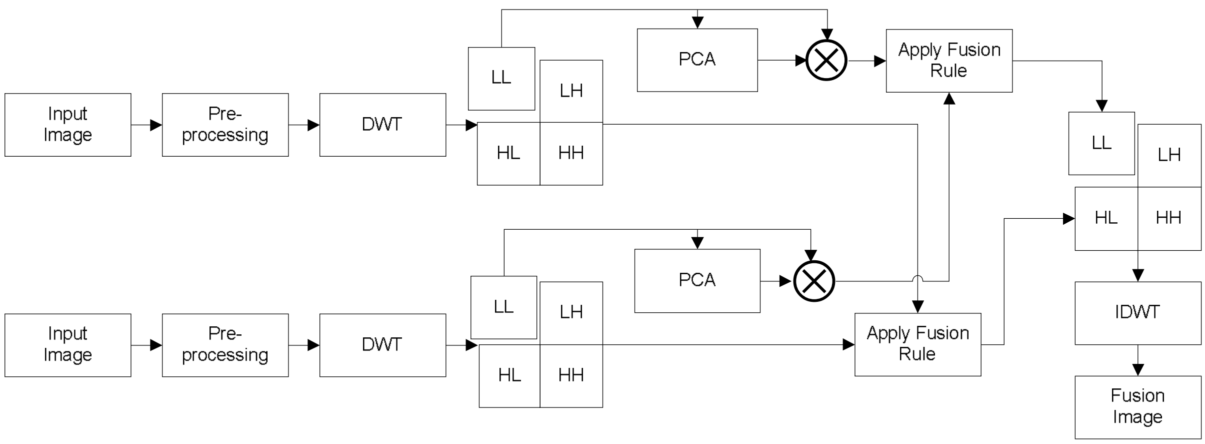

Figure 1: Block Diagram of Proposed Work

A. *Pre-processing*

Pre-processing is a phase where the input images get converted to gray scale from RGB and resized to 150x150. Here we take two samples of input image and apply pre-processing to both images.

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B. Principal Component Analysis (PCA)

Principal Component Analysis (PCA) is a multivariate technique that examines an information table in which perceptions are portrayed by a few between corresponded quantitative ward variables. It will probably remove the vital data from the table, to represent it as a set of new orthogonal variables called principal components, and to show the example of comparability of the perceptions and of the variables as focuses in maps. The nature of the PCA model can be assessed utilizing cross-acceptance systems, for example, the bootstrap and the jacknife. PCA can be evaluated as Correspondence Analysis (CA) keeping in mind the end goal to handle subjective variables and as Multiple Factor Analysis (MFA) with a specific end goal to handle heterogeneous sets of variables. Mathematically, PCA relies on the Eigen-decomposition of positive semi-definite matrices and upon the Singular Value Decomposition (SVD) of rectangular matrices.

C. Wavelet Based Image Fusion

Wavelets are finite duration oscillatory functions with zero average value. The irregularity and well localization properties make them better basis for evaluation of signals with discontinuities. Wavelets can also be described by using two features viz. The scaling perform $f(t)$, also known as 'father wavelet' and the wavelet function or 'mom wavelet'. 'mother' wavelet $\psi(t)$ undergoes translation and scaling operations to offer self similar wavelet families as in (1).

$$\psi_{a,b}(t) = \frac{1}{\sqrt{a}}\psi\left(\frac{t-b}{a}\right), (a, b\varepsilon R), a > 0 \qquad (1)$$

Where a is scale parameter and b is the translation parameter.

Practical implementation of wavelet transforms requires discretisation of its translation and scale parameters by taking,

$$a = {a_0}^{j}, b = m{a_0}^{j}b_0 \qquad j, m\varepsilon Z \qquad (2)$$

Thus, the wavelet family can be defined as,

$$\psi_{j,m}(t) = {a_0}^{-\frac{j}{2}}\psi({a_0}^{-j}t - mb_0)j, m\varepsilon Z \qquad (3)$$

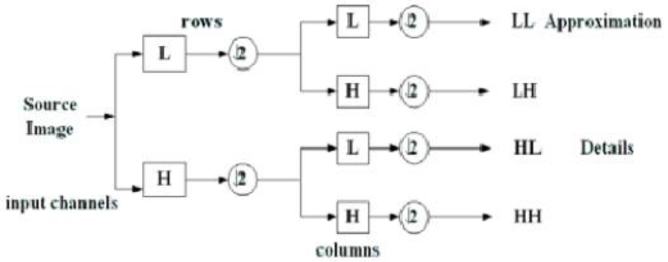

Figure.2Two-dimensional sub-band coding algorithm for DWT

If discretisation is on a dyadic grid with $a_0 = 0$ and $b_0 = 1$, it is called standard DWT [9]. Wavelet transformation involves constant Q filtering and subsequent Nyquist sampling as given by Fig. 1 [10]. Orthogonal, regular filter bank when iterated infinitely gives orthogonal wavelet bases [11]. The scaling function is treated as a low pass filter and the mother wavelet as high pass filter in DWT implementation.

Source image is decomposed in rows and columns by low-pass (L) and high-pass (H) filtering and subsequent down sampling at each level to get approximation (LL) and detail (LH, HL and HH) coefficients. Scaling function is associated with smooth filters or low pass filters and wavelet function with high-pass filtering.

Wavelet decomposition of the images is used due to its inherent multi resolution character. Discrete Wavelet transform (DWT) has been used in the proposed method to reduce the size of the image at each level. An image of decision 2k x 2k pixels at degree L reduces to size 2k-1x2k-1 pixels at degree L+1. At every degree the image is decomposed into 4 sub images obtained by using low-pass filter L and a high pass filter H working along the image rows and columns. Figure 3 suggests the DWT decomposition at level 1 and level 2 respectively.

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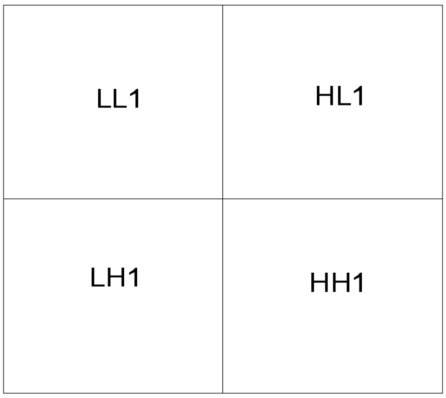
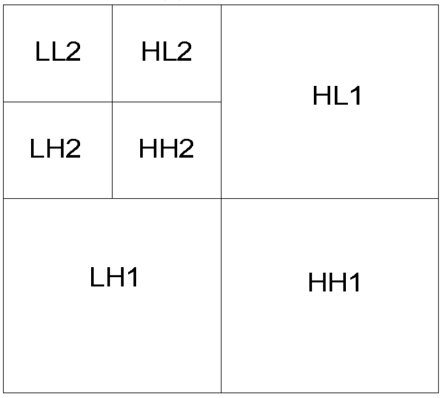


(a) Level 1

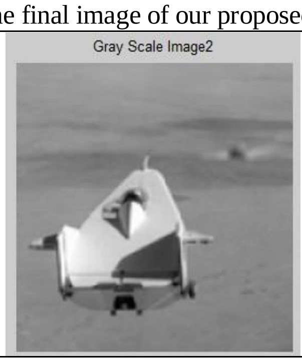


(b) Level 2

Figure.3 Image Decomposition using DWT

IV. Results and Discussion

Figure 4 shows the experimental results of our proposed work. Where (a) and (b) are the input images, (c) and (d) respective Decomposed DWT Images. Images which is generated by principal component analysis is shown in the figure (e) and (f). Figure (h) shows the final image of our proposed work.

			
(a) Input Image1	(b) Input Image 2	(c) DWT Decomposed Image1	(d) DWT Decomposed Image2

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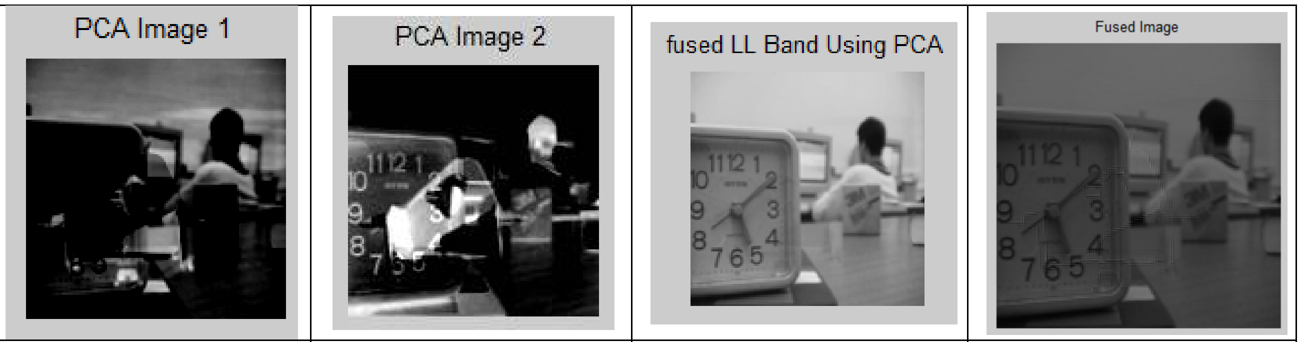

(e) PCA Image1   (f) PCA Image2   (g) Fused LL Band   (h) Fused Image

Figure 4 Result of Proposed Work

V. CONCLUSION

In this paper, a new hybrid methodology has been proposed to fuse the image. It is very clear from the above figures that there is change in the quality of image after fusion with the proposed method over the existing techniques. This represents the improvement in the objective quality of the image. Hence our proposed method has better efficiency in fusing images.

REFERENCES

[1] M Shashikala and N Kumarvel, “A Comparative Analysis of Feature based Image Fusion Methods”, Volume 6, Issue 8, 2007.
[2] Zhu Shu-long, “Image Fusion using Wavelet Transform”, 2002.
[3] Susmitha Vekkot and Pancham Shukla, “A Novel Architecture for Wavelet based Image Fusion”, 2009.
[4] Paresh Rawat, Sapna Gangrade and Pankaj Vyas, “Implementation of Hybrid Image Fusion Technique Using Wavelet Based Fusion Rules”, Volume 1, Issue 1, 2011.
[5] Srinivasa Rao Dammavalam, Seetha Maddala and Krishna Prasad MHM, “Quality Assessment of Pixel-Level Image Fusion Using Fuzzy Logic”, Volume 3, Issue 1, 2012.
[6] Deepak Kumar Sahu and M.P. Parsai, “Different Image Fusion Techniques –A Critical Review”, Volume 2, Issue 5, 2012.
[7] Myna.A.N and J.Prakash, “A Novel Hybrid Approach for Multi-focus Image Fusion using Fuzzy Logic and Wavelets”, Volume 3, Issue 2, 2014.
[8] Mandeep Kaur Sandhu and Ajay Kumar Dorga, “ A Hybrid Pixel based Fusion Approach”, Volume 1, Issue 7, 2013.
[9] I. Daubechies, “The wavelet transform, time-frequency localization and signal analysis,” IEEE Trans. Info. Theory, 36:961-1005, 1990.
[10] H. Zhang, L. Liu and N. Lin, “A novel wavelet medical image fusion method,” International Conference on Multimedia and Ubiquitous Engineering (MUE’07), Seoul, Korea, 2007.
[11] M. Vetterli and C.Herley, “Wavelets and filter banks: theory and design,” IEEE Transactions on Signal Processing, Volume 40, Issue 9, pp. 2207-2232, 1992.