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Comparative Analysis of Image Fusion using DWT, PCA and BBF

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Abstract: Now-a-days, medical image fusion is one of the upcoming fields which helps in easy diagnostics and helps to bring down the time gap between the diagnosis of the disease and the treatment. In Magnetic Resonance Image (MRI), anatomy and soft tissues are visible and it has high spatial resolution. In Computed Tomography (CT) images bony structures appears brighter. Analysis is done to determine the image fusion algorithm which is more suitable for clinical diagnosis. Analysis is also done on image quality assessment parameters of image fusion. Image fusion is of extraordinary significance in safeguard and data from various images of same scene. It has been reasoned that image fusion utilizing wavelets with larger amount of disintegration indicated better execution in a few measurements and in different measurements PCA demonstrated better execution. We also illustrate different results based on all three methodology and compare results based on time and quality of images using PSNR.

Keywords:Wavelet transform, Principal component analysis, entropy, deviation, mean square error
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I. Introduction

Image Fusion is a procedure of consolidating the important data from an arrangement of images, into a solitary image, to such an extent that the resultant melded image will be more educational and finish than any of the info images. For instance, CT and MR images might be intertwined as a guide to therapeutic conclusion. MR and obvious images might be combined as a guide to pilots arriving in poor climate condition or microwave and noticeable images might be intertwined to identify weapons. The fusion procedure must fulfill the accompanying necessities, for example, it should safeguard all applicable data in the intertwined image, ought to decrease clamor and ought to limit any antiquities in the melded image. There are two ways to deal with image fusion, in particular Direct Fusion and Multi determination fusion. In Direct fusion, the pixel esteems from the source images are summed up and taken normal to shape the pixel of the composite image at that area. Multi determination fusion utilizes pyramid or wavelet change for speaking to the source image at multi scale. Due to the normal for image fusion innovation, it has as of late been broadly connected in different fields such target acknowledgment, PC vision, Concealed weapon recognition and restorative image handling and so on. The benefits of image fusion are enhancing dependability and capacity.

The basic fusion strategy take the normal of the dark level source mages pixel by pixel and deliver some undesired impacts gives poor execution. To defeat this issue, multi scale changes, for example, wavelets, laplacian pyramids and inclination pyramid. Discrete wavelet transform(DWT) would give directional data in deterioration levels and contain interesting data at various resolutions Principal component analysis (PCA) is a numerical instrument which changes various related factors into various uncorrelated factors. The PCA is utilized as a part of image pressure and image order. Image fusion calculations that utilizations PCA is clarified in this paper. The intertwined image is accomplished by weighted normal of source images. The weights for each source image are gotten from the eigen vector comparing to the biggest eigen estimation of the covariance metrices of each source.

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Fusion Algorithms

a. Wavelet Transform

Wavelet hypothesis is an expansion of Fourier hypothesis and it is acquainted as an option with the brief span fourier change. In Fourier hypothesis the flag is deteriorated into sines and cosines yet in wavelets the flag is anticipated on an arrangement of wavelet capacities. Fourier change would give great determination in recurrence space yet wavelet would give great determination in recurrence area and also time area. Wavelet changes are straight changes whose premise capacities are called wavelets. The wavelets utilized as a part of image fusion can be characterized into numerous classifications, for example, orthogonal, bi-orthogonal and so forth. In spite of the fact that these wavelets share some regular properties, every wavelet has a one of a kind image decompression and reproduction qualities that lead distinctive fusion comes about. The Discrete Wavelet Transform (DWT) of image signals creates a non-excess image portrayal, which gives better spatial and ghastly restriction of image data, contrasted and other multi scale portrayals. As of late, Discrete Wavelet Transform has pulled in more enthusiasm for image preparing. The DWT can be deciphered as flag decay in an arrangement of free, spatially situated recurrence channels. The flag S is gone through two reciprocal channels and rises as two signs, estimation and Details. This is called deterioration or analysis. The components can be amassed once more into the first flag without loss of data. This procedure is called reproduction or blend. The scientific control, which infers analysis and blend, is called discrete wavelet change and converse discrete wavelet change.

1. Image Decomposition:

The information flow in one level of 2-D image decomposition is illustrated in figure 1. Wavelet separately filters and down samples the 2-D data (image) in the vertical and horizontal directions (separable filter bank). The input (source) image is $I(x, y)$ filtered by low pass filter L and high pass filter H in horizontal direction and then down sampled by a factor of two (keeping the alternative sample) to create the coefficient matrices $IL(x,y)$ and $IH(x,y)$.

The coefficient matrix $IL(x,y)$ and $IH(x,y)$ are both low pass and high pass filtered in vertical direction and down sampled by a factor of two to create sub bands (sub images) $ILL(x,y)$, $ILH(x,y)$, $IHL(x,y)$, $IHH(x,y)$[7] . Direction characteristics of the sub-signals after wavelet transformation. Its frequency division characteristic is equal to high-and low dual-band filter The signal can be decomposed Images can be decomposed into a number of images with different spatial resolution, frequency characteristics and the flexibility in the choice of wavelets. The $ILL(x,y)$, contains the average image information corresponding to low frequency band of multi scale decomposition. It could be considered as smoothed and sub sampled version of the source image $I(x,y)$. It represents the approximation of source image $I(x,y)$. $I(x,y)$, $IHL(x,y)$,and $IHH(x,y)$ are detailed sub images which contains directional (vertical, horizontal and diagonal) information of the source image $I(x,y)$. Multi-resolution could be achieved by recursively are detailed sub images which contain directional information, applying the same algorithm to low pass coefficients from the previous decomposition.

2. Image Reconstruction :

The information flow in one level of 2-D image reconstruction is illustrated in figure 2. Inverse 2-D wavelet transform is used to reconstruct the image $I(x,y)$, from sub images $ILL(x,y)$, $ILH(x,y)$, $LHL(x,y)$, and $LHH(x,y)$. This involves column up sampling (inserting zeros between samples) and filtering using low pass L and high pass filter H for each sub images. Row up sampling and filtering with low pass filter L and high pass filter H of the resulting image and summation of all matrices would construct the image $I(x, y)$.

3. Block Diagram Of DWT :

The figure 3 shows the main blocks and flow of fusion process using DWT. First consider two registered input image I1 and I2 which are too be fused. Then apply DWT to both I1 and I2, and their coefficients in pixel p are $DI1(p)$ and $DI2(p)$, respectively. The output DWT coefficient in pixel p is $DI3(p)$ given by using "choose-max" selection rule i.e. choosing maximum DWT coefficient. After that Perform Inverse DWT to DI3. Finally, the fused image is displayed. The fusion rule used in this paper is simply averages the approximation coefficients and picks the detailed coefficients in each sub band with the largest magnitude.
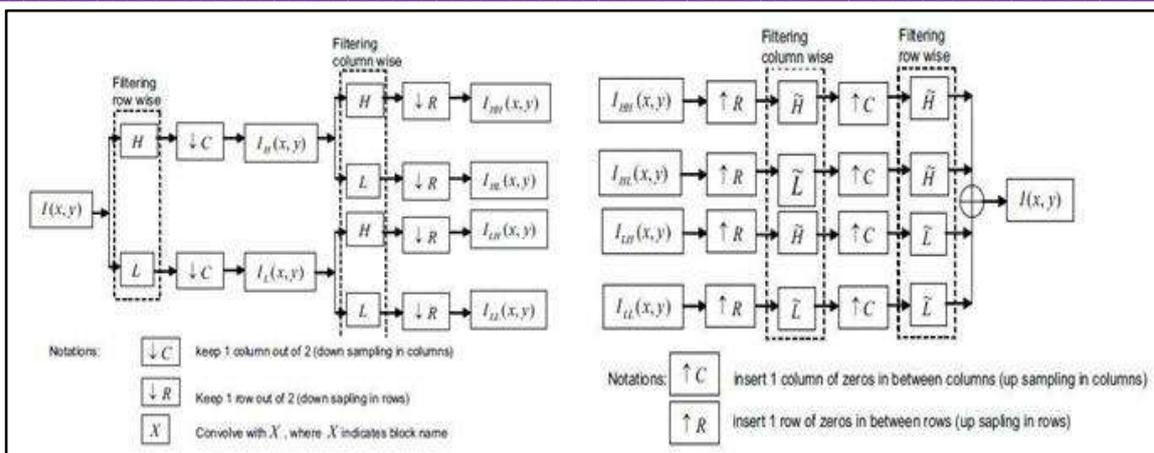
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Figure 1: One Level Of 2-D Image Decomposition[7] Figure 2: One Level Of 2-D Image Reconstruction[7]
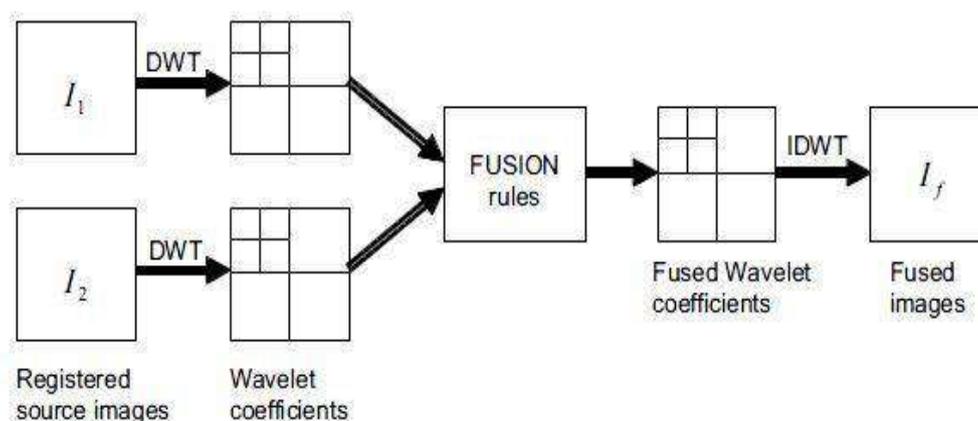

Figure 3: Information Flow Of DWT

B. Principal Component Analysis

PCA change [3] is a factual strategy. It changes a gathering of related factors into a gathering of the first factors. The point is to pack multi-band image data into an image and data can perform greatest in the new image. Amid the fusion procedure, it initially carries on PCA change so that the dim scale mean and fluctuation are predictable with PCA component of the image.

PCA is the least complex genuine eigenvector-based multivariate analysis. It includes courses for distinguishing and to indicate designs in information, so as to highlight their similitudes and contrasts, and in this way diminish measurement without loss of information. In this strategy first the segment vectors are separated, from particular information image frameworks. The covariance framework is ascertained. Corner to corner components of covariance vector will contain fluctuation of every section vector. The Eigen esteems and the vectors of covariance lattice are computed.

Standardize segment vector relating to bigger Eigen esteem by isolating every component with mean of Eigen vector. Those standardized Eigen vector esteems go about as the weight esteems and are multiplied with every pixel of information image. Whole of the two scaled networks are figured and it will be the combined image framework. The data stream chart of PCA-based image fusion calculation is appeared in figure 4.

The input images (images to be fused) I1(x, y) and I2(x, y) are arranged in two column vectors and their empirical means are subtracted. The resulting vector has a dimension of n x 2, where n is length of the each image vector.

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Compute the eigenvector and eigen values for this resulting vector are computed and the eigenvectors corresponding to the larger eigen value obtained[7] .The fused image is: If(x,y) = P1I1(x,y) + P2I2(x,y).
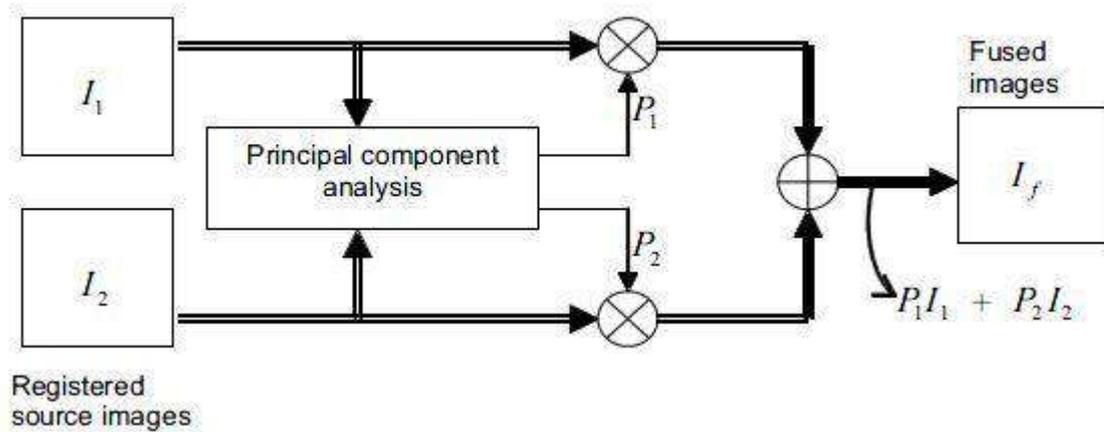

Figure 4 : Information Flow Diagram Of PCA

II.   Simulation Results:

Fig: Basic GUI of Application
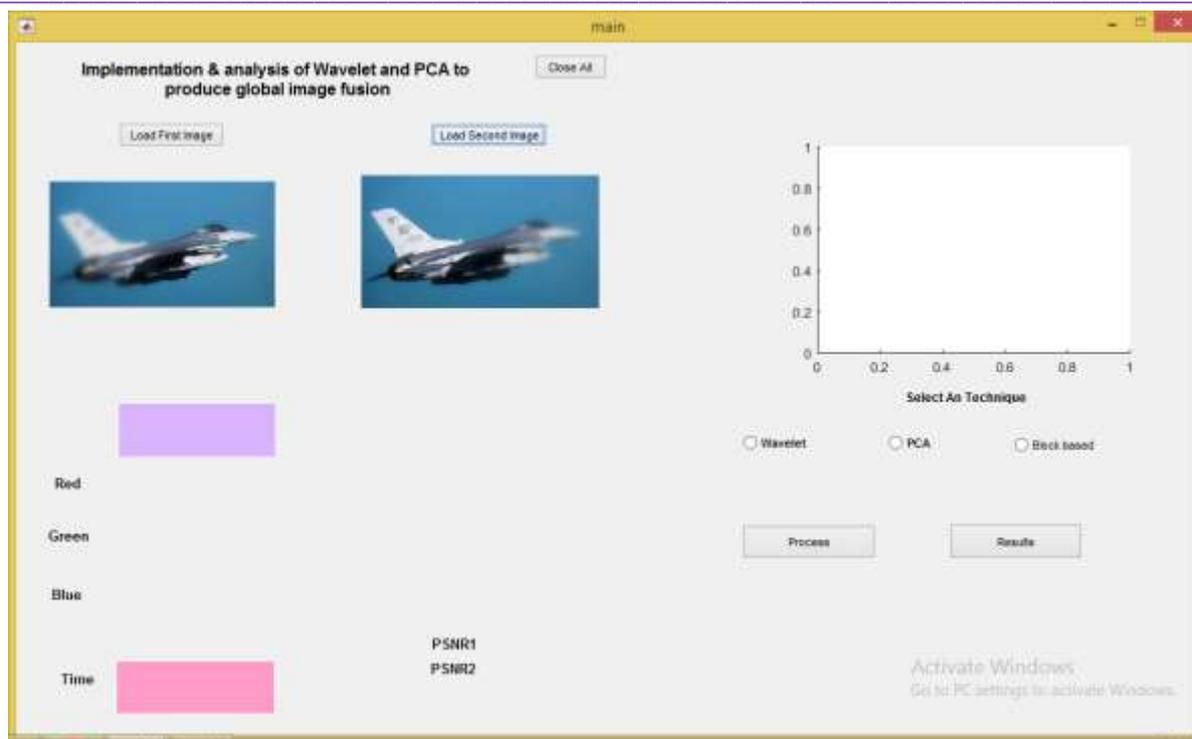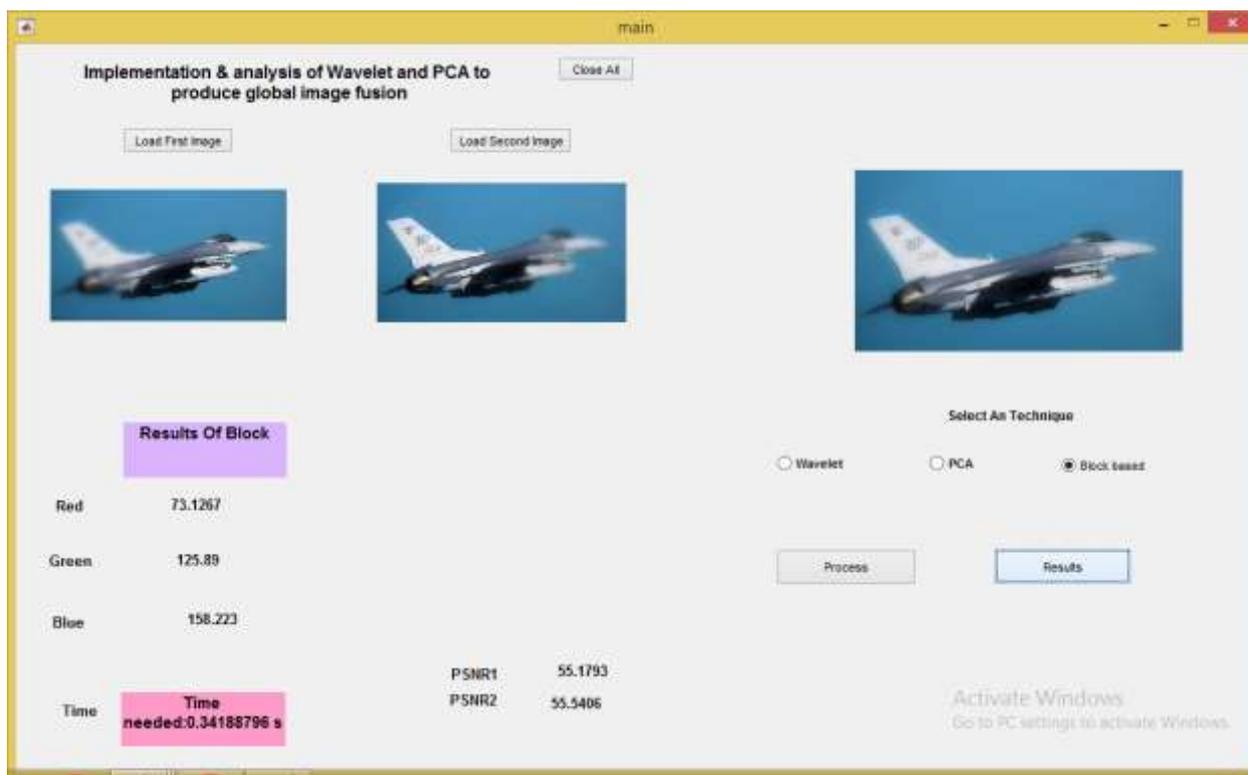
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Fig: Loading Both Images
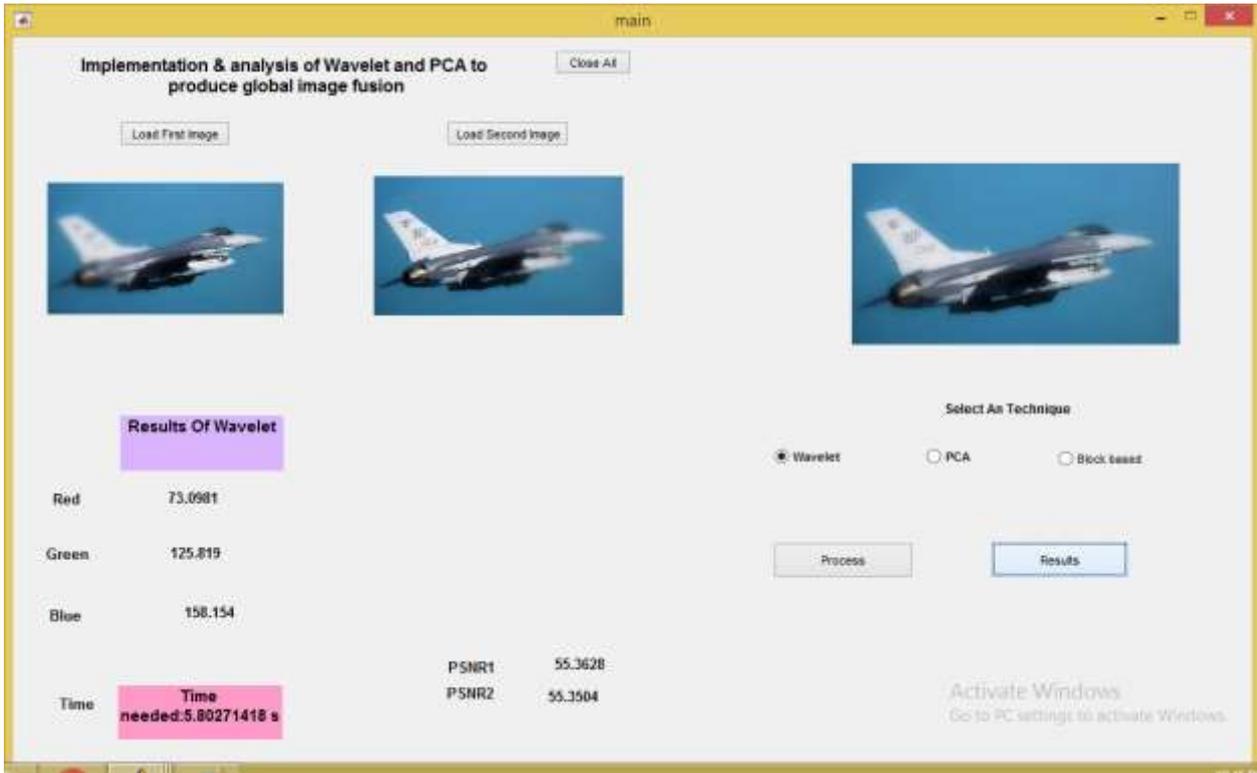

Fig: Result of Block Based Fusion

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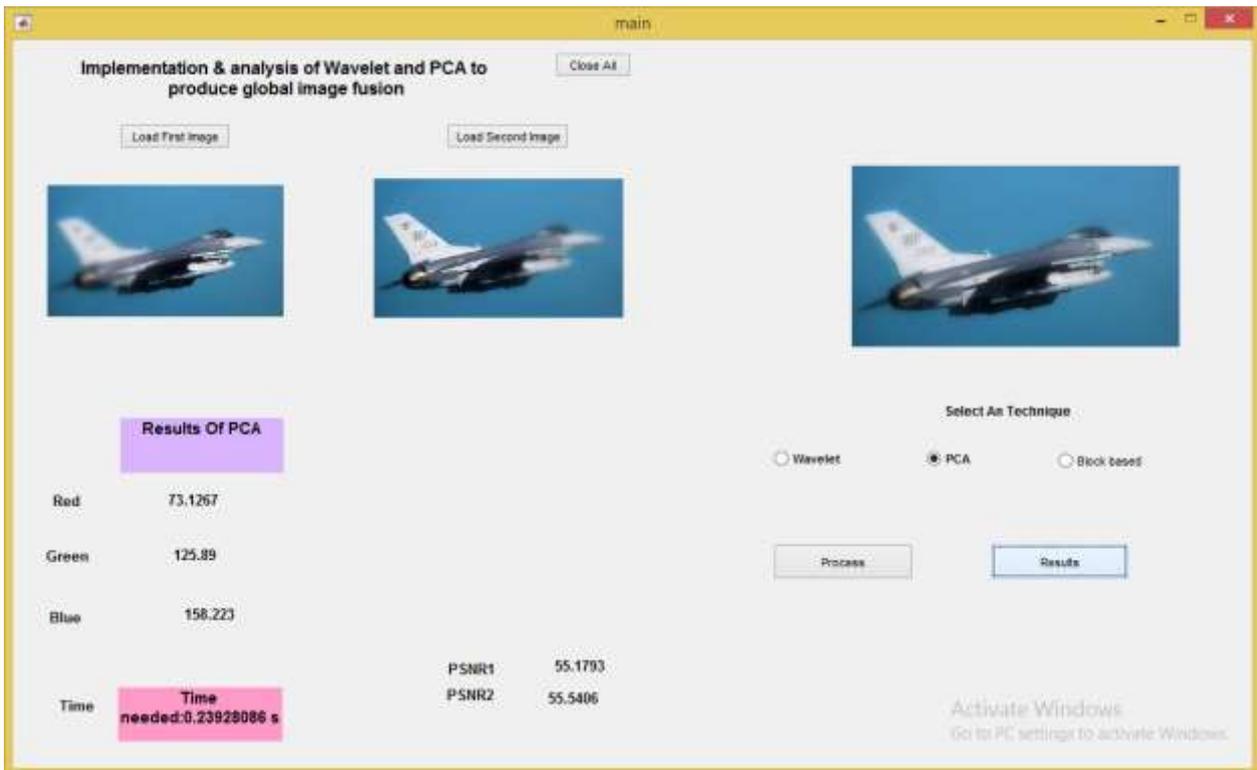Fig: Result of DWT Based Fusion

Fig: Result of PCA Based Fusion

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III. CONCLUSION

Pixel level image fusion utilizing wavelet change and principal component analysis are actualized in PC MATLAB and distinctive execution parameters with and without reference image have been assessed and analyzed. We performed all three fusion techniques on dataset images and calculated the required PSNR and Time complexity results of methodologies. From all experimental results we can conclude that PCA requires less most time as compared to BBF and DWT and at the same time accuracy of DWT and PCA are higher as compared to block based fusion methodology. In future the accuracy of image fusion can be attained much higher using hybridization of more than one image fusion algorithms.

References

[1]   V.P.S. Naidu and J.R. Raol, "Pixel-level Image Fusion using Wavelets and Principal Component Analysis", Defence Science Journal, Vol. 58, No. 3, May 2008, pp. 338-352.

[2]   Sruthy, S.; Parameswaran, L.; Sasi, A.P., "Image fusion technique using DT-CWT", Automation, Computing, Communication, Control and Compressed Sensing, 2013 International Multi-Conference on , vol., no., pp.160,164, 22-23 March 2013.

[3]   "Dipaleegupta" "SiddharthChoubey" " Descret wavelet transform for image processing" ISSN-2250-2459, vol.4, march 201.5

[4]   Jiang Tao, JiDabin, Han Jinfang "Comparison Study of Different Fusion Methods Based on Remote Sensing Image", 3rd International Congress on Image and Signal Processing, ©2010 IEEE.

[5]   "ShaikMahammedwaseem" " Analysis of multi focus gray scale image fusion using wavelets" IJRT,ISSN- 2319-1163, pISSN-2321-7308.

[6]   "G. N. Raut" " P. L. Paikrao" "D. S. Chaudhari" "A Study of Quality Assessment Techniques For Fused Images" IJITEE, ISSN: 2278-3075, Volume-2, Issue-4, March, 2013.

[7]   S. Vasuki, S. Gandhimathi, S. ManickaVinodhini, "Comparative Analysis of Wavelets for Fusion Application", International Conference on Emerging Technology Trends on Advanced Engineering Research (ICETT'12)

[8]   PareshRawat, SapnaGangrade, Pankaj Vyas, "Implementation of Hybrid Image Fusion Technique Using Wavelet Based Fusion Rules", (IJCTEE), 2011.

[9]   Sivakumar, K.Maguesway, Dr.M.Rajaram, "Image Contrast Enhancement Using Singular Value Decomposition for Grey Scale Images", Proceedings of 2011 International Conference on Signal Processing, Communication, Computing and Networking Technologies, (ICSCCN 2011).

[10]   Anjali Malviya and S.G. Bhirud, "Objective Criterion for Performance Evaluation of Image Fusion Techniques", International Journal of Comp., Appl., Vol.1-No.25, 2010.

[11]   Avcibas I., Sankur B., and Sayood K., "Statistical evaluation of image quality measures", Proc., SPIE, 4051, 88-99, 2000.

[12]   FiroozSadjadi, "Comparative Image Fusion Analysis", IEEE CVPR'05, 2005.

[13]   Rick S. Blum, ZhiyunXue and Zhong Zhang, "An Overview of Image Fusion", Multi sensor Image Fusion and Applications, Vol. 6, 2002.

[14]   "Chetan K. Solanki1" " Narendra M. Patel" "Pixel based and Wavelet based Image fusion Methods with their Comparative Study" National Conference on Recent Trends in Engineering & Technology, May 2011 .

[15]   N. INDHUMADH(2011), "Enhanced Image Fusion Algorithm Using Laplacian Pyramid and Spatial frequency Based Wavelet Algorithm" International Journal of Soft Computing and Engineering (IJSCE) Volume-1, Issue-5, pp 298-303

[16]   MirajkarPradnyaP(2013), " MAGE FUSION BASED ON STATIONARY WAVELET TRANSFORM" International Journal of Advanced Engineering Research and Studies

[17]   Anjali Malviya(2009), "Image Fusion of Digital Images", International Journal of Recent Trends in Engineering, Vol 2, No. 3, pp 146-148

[18]   Tao Wan(2008), "Compressive image fusion" , IEEE, pp 1308-1311

[19]   zhangning(2015), "Study on image compression and fusion based on the wavelet transform technology ",International journal on smart sensing and intelligent systems vol. 8, no. 1,pp 480-496,

[20]   Er. Abhishek Sharma(2012), "Design and Analysis of 2-D Wavelet Based GUI Image Fusion System Approach for restoring Image by Performing Wavelet Decomposition International Journal of Advanced Research in Computer Science and Software Engineering, "Volume 2, Issue 10, pp 177-182

[21]   Chao Yang, Bin Yang (2014), "Efficient Compressive Multi-Focus Image Fusion "Journal of Computer and Communications, , 2, pp 78-86

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[22] Rohan Ashok Mandhare(2013), "2690 PIXEL-LEVEL IMAGE FUSION USING BROVEY TRANSFORME AND WAVELET TRANSFORM ",International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE), Vol. 2, Issue 6, pp2690-2695

[23] Jun Kong(2008), "Multi-focus Image Fusion Using Spatial Frequency and Genetic Algorithm ",IJCSNS International Journal of Computer Science and Network Security, VOL.8 No.2, pp 220-224

[24] M.PremKumar(2011), "Performance Evaluation of Image Fusion for Impulse Noise Reduction in Digital Images Using an Image Quality Assessment ",IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 4, No 1,pp407-411

[25] S. A. Quadri (2013), "Pixel-Level Image Fusion using Kalman Algorithm" International Journal of Signal Processing, Image Processing and Pattern Recognition Vol. 6, No. 2, pp 75-86

[26] C. Morris(2014), "two stage spatial domain image fusion techniques", ICTACT journal on image and video processing, volume: 05, issue: 01 , pp8895-898,

[27] ShutaoLi(2002) , "Multifocus image fusion using artificial neural networks ", Elsevier ,pp 85-97

[28] VPS Naidu (2012) , "Discrete Cosine Transform based Image Fusion Techniques" Journal of Communication, Navigation and Signal Processing , Vol. 1, No. 1, pp. 35-45

[29] Sunil Kumar Panjeta (2012), "A Survey on Image fusion Techniques used to Improve Image Quality" International Journal of Applied Engineering Research, ISSN 0973-4562 Vol.7 No.11

[30] Gagandeepkaur (2015), "A New Hybrid Wavelet Based Approach for Image Fusion" ,International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, Issue 1, pp1934- 1043

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