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OPTIMIZED SELECTIVE HYBRID FUSION OF REGISTERED IMAGES

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Abstract:

Infusion of images the process involves gathering important information from two or more images which gives better consolidated results for further analysis in any domain. In practice before the fusion of images applied the images have to be registered, registration helps in aligning the images which is necessary before fusion of images is performed. In this paper, pre-registered images using SIFT and RANSAC are utilized to use in our proposed method of fusion that is an optimized selective hybrid fusion of registered images. The technique is proposed and investigated for obtaining better results. The proposed method utilizes the DWT transform with different rules to perform fusion of DWT bands such as average, maximum, edge and energy based rules which are combined in a novel way to achieve higher results in comparison. Entropy is the evaluation metric used for performance comparison. As the experiments are performed the proposed method more effective and gives improved results for fusion of images

Keywords: Image Registration, Image fusion, SIFT, RANSAC, Multispectral Images, and DWT**.**

INTRODUCTION

The integrating process of the redundant data in the several images into the one image is called as Image fusion [1-2].It focuses on the coordination of complementary and disparate data to improve the apparent of information in the images and also maximize the interpretation reliability. It contains broad utilization in the field of health diagnosis, computer vision, intelligent transportation systems, and remote sensing [3-4].Additionally, Image fusion is the accurate registration method to solve the issue. Group wise image registration and pairwise image registration are the two types of the image registration. Group wise image registration techniques register several images at a period and Pairwise image registration technique register two images in same time. The operation of the Pairwise registration is mainly depends upon the template [5], [6]. Hence several group wise registration algorithms have been innovated [7-8].Depending upon the feature, region and intensity registration techniques are categorized. In the intensity dependent system, Transformation connection between the images is quantified by determining the likeness among the images. Information Theory, Intensity differences, and CC are continuously

Utilized same type evaluations. MI is considered as best in the field of registration. The transformation complexity is solely depends upon the application. Based on the parameters of the degree of the freedom in the transformation complexity is considered. Transformation can be rigid once the geometric linking between the 2 points is fixed. By utilizing the affine transformation scaling correction, global gross complete distortion is done. In the medical image, for obtaining the valuable and a more rich data, the benefits of more than one images is considered from the several

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imaging equipment with the multi-modality fusion. Image fusion and the image registration are the two dependent processes. To perform the image fusion and the image registration at a time, few algorithms have been introduced.

As compared with original image fusion image is better therefore the diagnosis is simple and also image fusion is utilized in the various application such as remote sensing, defense, space research etc. Images are transferred to frequency domain from time domain, by utilizing the transform domain. Wavelet Transform is considered as the multi-resolution image decomposition device that gives several kinds of channel showing features of images by utilizing several frequency sub-bands. The approximation and detailed coefficients gets separated once the image decomposition is done. Initially image is converted to transform domain from the spatial domain with the help of DWT. Edges and sharpness is conveyed by this domain. In 1-D singularity, DWT is more efficient, which provides the best spatial contents. DWT transform needs down sampling, because it is a shifted variant.

Here, optimized selective hybrid image fusion and registration methods is introduced and evaluated for the intention of obtaining a best fused image quality.

LITERATURE REVIEW

Several algorithms have been developed by many researchers in the field of Transform domain and Non-transform domain. Transform domain methods operates upon the various criterions than pixel fusion. Here /Source or original image is send to Transform domain. Later rectified image performed with fusion technology where several fusion criteria are considered on the rectified image to give other rectified image consisting the coefficients of fused frequency, at last the obtained rectified image undergoes inverse transformation which creates the real fused image. In Spatial domain method which operates upon the image pixels. This highly concentrates upon pixel fusion. This is the fundamental technique adopted in earlier for image fusion. Variations are performed upon the pixels of the images and the improved version of image is created.

Discrete Transform dependent technique and Pyramid dependent technique are the two kinds of the Frequency domain methods. Gradient Pyramid, Palladian Pyramid etc. are the examples of Pyramid based techniques. Sometimes block effects are created because of pyramid techniques cannot achieve selection of spatial orientation in process of decomposition. New improvements of the transform dependent methods concludes that Contour let Transform,Shearlet Transform, Curve let Transform are the recent multiscale decomposition methods that are utilized now a days by the researchers for the accurate fusion [9].

For the purpose of fusion, depending on the necessity or the need Transform dependent method or the spatial dependent method is utilized. Efficient fusion process can be caused by combining these two methods such as Transform methods and spatial dependent method. As per the literature survey, image fusion can be classification is dependent upon the Multi-scale Decomposition Methods is generally gets the multi-scale illustrations of the input images and later additionally get into various Fusion and Transform techniques for obtaining the last fusion image. Quality

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of the image does not change even when the images are varied to several scales, this is the main advantage of this technique [9-16].Spare representation is the recent technique which depend upon the sparse coding element mechanism. Generally it has been linked with various image transformation problems for instances, interpolation, picture de-noising, and recognition. Sparse Representation detail are the patches of the images it require atom's straight mix selected beginning with dictionary illustrations. Some illustrations such as group SR, joint sparsely model, pursuit, gradient constrained SR,simultaneous OMP orthogonal matching[9-18].

Pixel-fusion is done directly upon pixels. Here, manipulations and alterations which are done on source image pixels with few mathematical evaluations. Instances like HIS, PCA, every spatial domain methods, matting decomposition, independent element estimation etc. Frequently explained blends of above represented techniques: that is once the combination of main merits or the point of interest about all current image combination techniques that provides hybrid techniques recently came for the image fusion algorithms. Practically analyzed by several research works and its result conclude that hybrid techniques are better than the distinctive techniques of fusion. Contour let-SR, IHS-wavelet, morphological element estimation-SR,multi-scale transform –SR,Hybrid waveletcontourlet are the some of the illustrations[9].

Systems that requires the image fusion or combination techniques would be expanded as: the formation of MS image with the addition of Panchromatic image (PAN) over Remote Sensing applications, is utilized to Noticeable the blended image that require both spectral and spatial components. In medical uses, blending of various CT, MRI and several images and its combination for forward evaluation in medical area for the purpose of exact diagnosis. Under the System of surveillance, to give appropriate night vision here it considers blending of more infrared visible images, Finally, the system of Photography that needs the images combination for multi-focus focus that will get back all-in focus objects and additionally other photography methods like fusion or blending of several exposure images for the outcome image consisting all-well exposed images[9-19].

PROPOSED METHODOLOGY

In fusion of images the process involves gathering important information from two or more images which gives better consolidated results for further analysis in any domain, as shown in Figure1.

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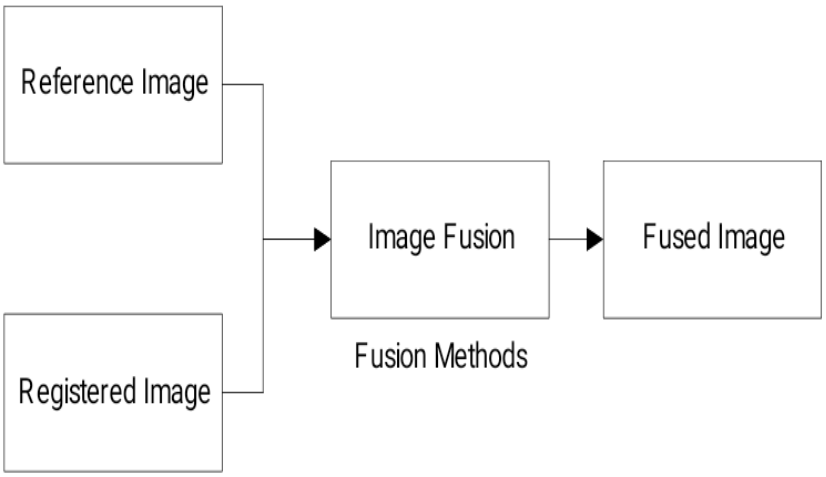

Figure1General Block Diagram

The figure2 below shows the block diagram for the proposed methodology.The progression of the proposed technique as follows:

Two input images are taken for fusion which are already registered.

Controlled Histogram Equalization is applied.

DWT is applied to both images.

Average and Maximum fusion rule and Edge and Energy Fusion rule applied to the HPF and LPF bands of DWT.

We get two fused images fused1 image and fused2 image.

Again the average and maximum fusion rule applied to fused1 and fused2 images to get the final fused image.

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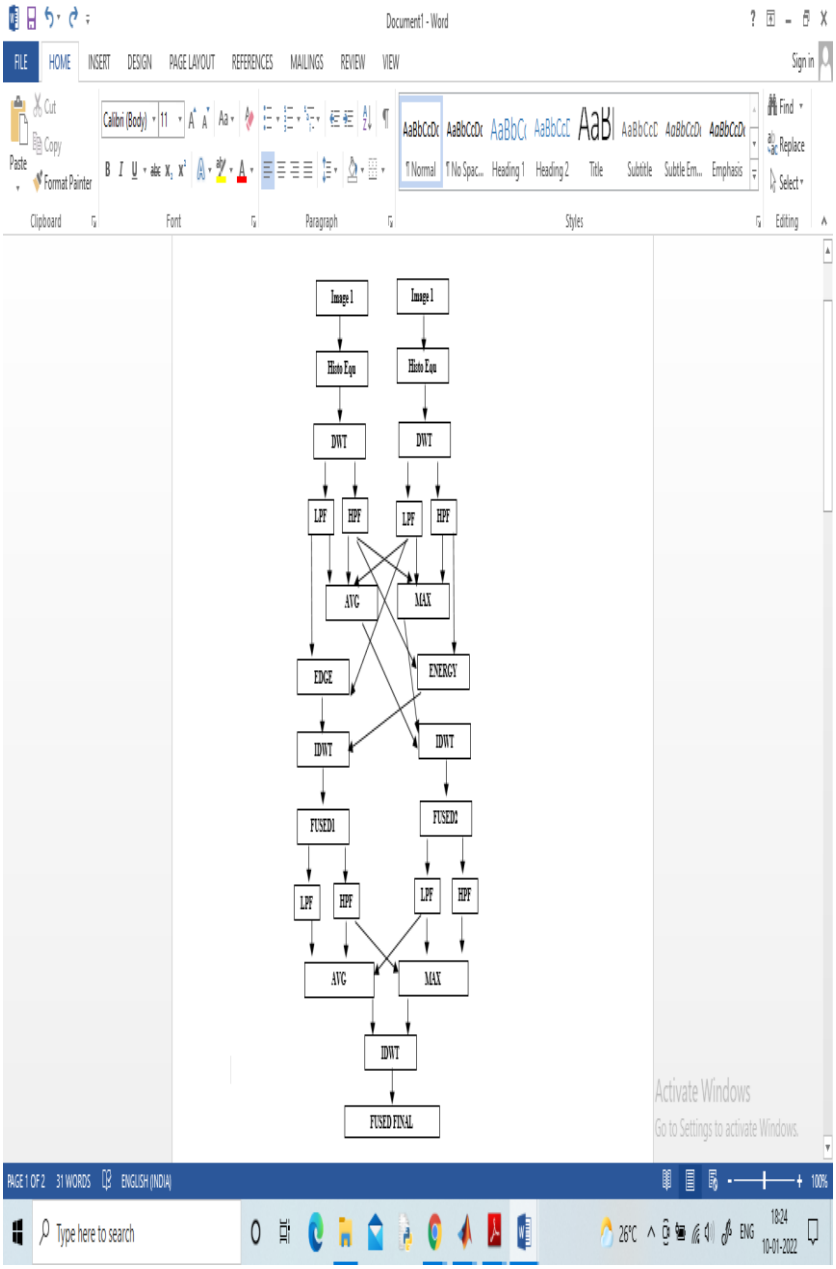

Figure 1: Proposed Fusion Flow Diagram

Spatially controlled histogram:

In this,to remove domination of maximum histogramelements domination upon minimum histogram elements within image histogram and to regulate the grey level stretching for the appropriate development of the image characteristics. Rather than operating the complete histogram transformation at one period, spatially controlled histogram equalization (SCHE) classifies it in to several sub-histograms till it confirms the absence of dominating section in any recently formed sub-histograms. Every sub-band is allocated with a range of dynamic Gray Level (GL), by HE gray levels are

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mapped. Based CDF of histogram values and dynamic range in input image, dynamic range of the resultant image is spread among the sub-histograms. Dominating and washed out of the small characteristics of the input image is avoided by this allotment of stretching range, and confirms the moderate contrast development of each section of the complete image. At last, for each sub-histogram a distinctive function of transformation is evaluated depending upon the traditional HE technique and accordingly gray levels of the input are allocated to the resultant image.

DWT: The wavelet transform quantifies the signal matching with wavelets. When the wavelet value matched with the signal match value, maximum transform value is attained. When the no similarity between wavelet value and the signal match then minimum transform value is attained. This is utilized to identify the regional image features. By utilizing the decimation DWT converts the image into bands. By utilizing two 1-D transform 2-D transform is obtained. Initially the input image is filtered through rows and decimated by 2then input image is filtering by columns. Following sub-bands are obtained by input image decomposition. The sub-band size is 50% of the original signal. Scaling is developed to obtain this. DWT is considered as multi-resolution transform. LL band is same as spatial image. High bands shows several frequencies.

Fusion Rules

In average and maximum fusion rule the average is computed for LL and for remaining three bands maximum is calculated which are applied to IDWT to get fused1 image.

In edge and energy edge is calculated for LL and for remaining energy is calculated which is applied to IDWT to get fused2 image. The sub bands are mixed according to higher edge information and higher energy.

RESULTS

The figure2a-2c shows the entire simulation process of our proposed method. Figures below shows the steps in the proposed method with results obtained and observed. The experiments were performed with the following image dataset TNO Image Fusion Dataset.https://figshare.com/articles/dataset/TNO_Image_Fusion_Dataset/1008029

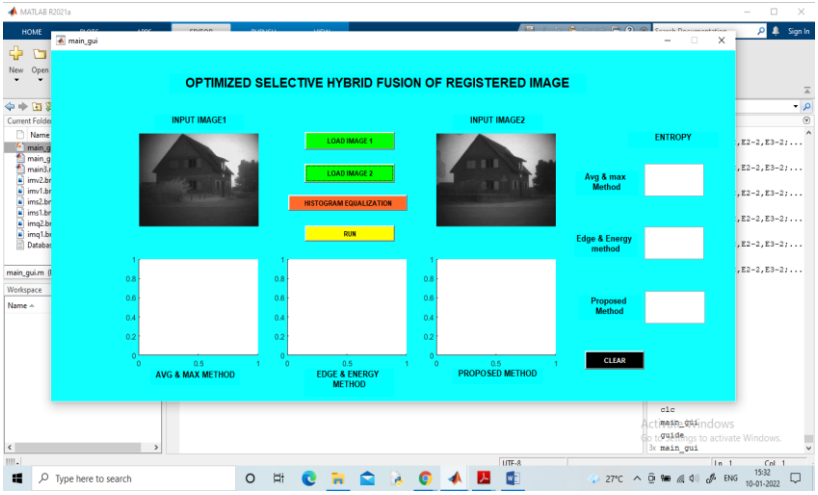

Figure-2a: Images before Histogram Equalization

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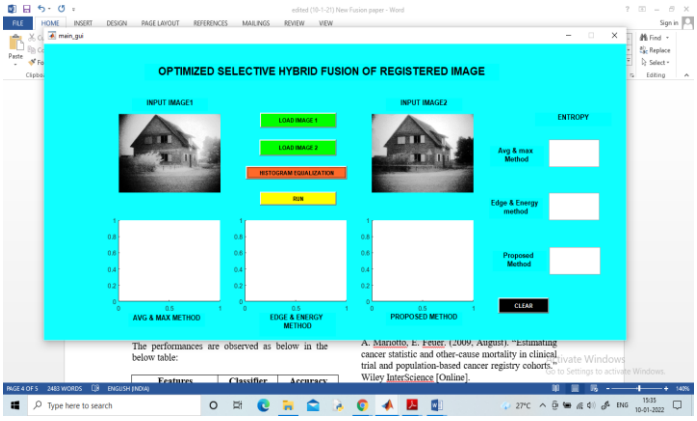

Figure-2b: Images after Histogram Equalization

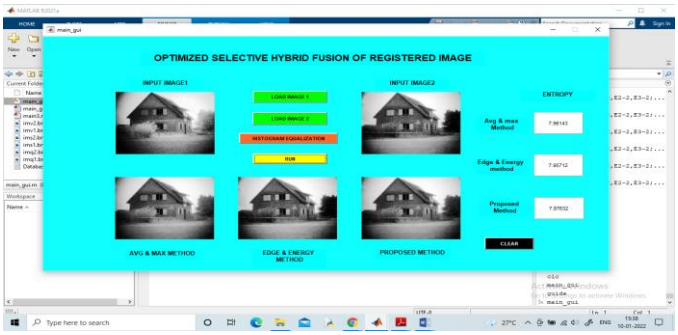

Figure-2c: Simulation of Proposed Method

The performances are observed as below in the below table:

Table 1: Comparison

Image	Method	Entropy
	Avgas & Max Method	7.96
	Edge & Energy Method	7.95
	Proposed method	**7.97**
	Avgas & Max Method	7.97
	Edge & Energy Method	7.93
	Proposed method	**7.97**
	Avgas & Max Method	7.98
	Edge & Energy Method	7.95
	Proposed method	**7.99**

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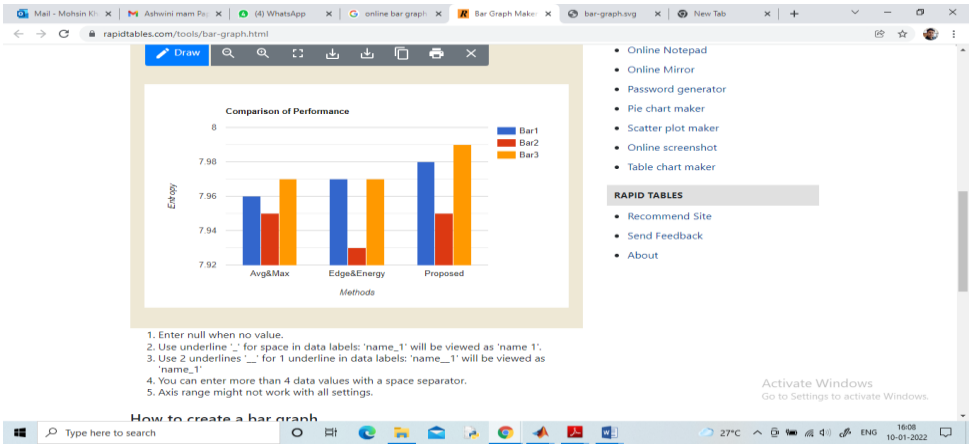

Figure-2d: Accuracy Comparison Chart

CONCLUSION

In this paper the performance of proposed optimized hybrid fusion of registered images tested, the available information in an image is measured with entropy measure which is used as evaluation metric for the performance comparison between existing and proposed technique. The proposed method gives the improved results as listed in the comparison table, hence from the experiments it is known that the proposed technique out performs the other methods for image fusion techniques.

REFERENCES

[1] B Swath, and K VeeraSwamy “Medical Image Fusion Using Transform Techniques”, ICDS 5th, 2020.

[2] R.S. Blum, and Z. Liu, Multi-sensor image fusion and itsapplications, CRC Press, 2005.

[3] H. Zhu, K. Yuen, L. Mihaylova, and H. Leung, “Overview ofenvironment perception for intelligent vehicles,” IEEE Transactionson Intelligent Transportation Systems, vol, 18, no, 10, 2017, pp. 2584-2601.

[4] B. Zitova, and J. Flusser, “Image registration methods: A survey,”Image and Vision. Computing, vol. 21, no. 11, 2003, pp. 977-1000.

[5] M. Gong, S. Zhao, L. Jiao, D. Tian, and S. Wang, “A novel coarseto-fine scheme for automatic image registration based on SIFT andmutual information,” IEEE Transactions on Geoscience and RemoteSensing, vol. 52, no. 7, 2014, pp. 4328-4338.

[6] E.G. Learned-Miller, “Data driven image models throughcontinuous joint alignment,” IEEE Transactions Pattern Analysisand Machine Intelligence, vol. 28, no. 2, 2006, pp. 236-250.

[7] Q. Wang, G. Wu, P.T. Yap, and D. Shen, “Attribute vector guidedgroupwise registration,” NeuroImage, vol. 50, no. 4, 2010, pp. 1485-1496.

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[8] H. Neemuchwala, A. Hero, and P. Carson, “Image matching usingalphaentropy measures and entropic graphs,” Signal Processing, vol.85, no. 2, 2005, pp. 277-296.

[9] S. Li, X. Kang, L. Fang, J. Hu and H. Yin, "Pixel-levelimage fusion: A survey of the state of the art", InformationFusion, vol. 33, pp. 100-112, 2017.

[10] Wang Xin; Li Yingfang; “A New Method ForMultifocusImage Fusion Using Countourlet Transform”, IEEE, 2011.

[11] S. Das*, M. Chowdhury; M. K. Kundu; “Medical ImageFusion Based OnRipplet Transform Type-I”, Progress InElectromagne -tics Research B, Vol. 30, 355– 370, 2011.

[12] Wei-Wei Wang, Peng-Lang Shui and Guo-Xiang Song,"Multifocus image fusion in wavelet domain", Proceedings ofthe 2003 International Conference on Machine Learning andCybernetics (IEEE Cat. No.03EX693).

[13] S. Li and B. Yang, "Multifocus image fusion by combiningcurvelet and wavelet transform", Pattern Recognition Letters,vol. 29, no. 9, pp. 1295-1301, 2008.

[14] U. Patil and U. Mudengudi, "Image fusion usinghierarchical PCA.”, International Conference on ImageInformation Processing, 2011.

[15] R.A. Mandhare, P. Upadhyay and S.Gupta, "Pixel-levelimage fusion using Brovey Transform and Wavelet Transform",International Journal of Advanced Research on Electrical,Electronics and Instrumentation Engineering, Vol. 2, Issue 6,June 2013.

[26] M. Choi, "Erratum to “A new look at IHS-like image fusionmethods” [Information Fusion 2 (2001) 177–186]", InformationFusion, vol. 8, no. 2, p. 217, 2007.

[17] G. Piella and H. Heijmans, "A new quality metric for imagefusion", Proceedings 2003 International Conference on ImageProcessing (Cat. No.03CH37429).

[18] Gehad Mohamed Taher, Mohamed ElSayedWahed andGhada EL Taweal,”New Approach for Image Fusion Based onCurvelet Approach”, International Journal of AdvancedComputer Science and Applications, Vol. 5, No. 7, 2014.

[19] C. K. Solanki and N. M. Patel, “Pixel based and Waveletbased Image fusion Methods with their Comparative Study”,National Conference on Recent Trends in Engineering &Technology, Pg no.13-14, May 2011.