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AN ANALYSIS OF EFFECTIVENESS 0F TWO STAGE IMPLEMENTATION OF IMAGE FUSION BASED ON 2D LP-DCT, DWT WITH MPCA

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ABSTRACT: In the present world, the use of digital images in communication has drastically increased. Digital image processing is a wide research area on images. It focuses on techniques for image quality, enhancement, segmentation, compression, etc. The limited depth of focus of Optical lenses in CCD devices limits the images to have all the relevant objects in focus. Multi focus Image fusion is the method of merging similar data from two or more multi resolute input images into an output image. The output image will be more explanatory than any of the input images. Fusion is an important method within many different fields such as remote sensing, robotics and medical applications. Many researchers reported various image fusion methods based on high pass filtering technique, DWT (Discrete Wavelet Transform), uniform rational filter bank and LP (Laplacian Pyramid). The existing method using the multi-focus image fusion based on Laplacian pyramid technique is not giving good fused image in terms of performance parameters like Standard deviation, Entropy and Average Gradient for blurred and dull intensity images. Also, it requires more than one multi resoluted input image. A new fusion method is proposed with the combination of contrast stretching and modified PCA (Principal Component Analysis), it may give good fused image in terms of performance parameter as well as visual and human perception compared to the standard and existing image fusion methods. The proposed method will also work well for blurred and dull intensity images.

Keywords- Image Fusion, Dwt, Laplacian, PCA.

I.INTRODUCTION

The word image fusion is expressed as the method of retrieving data available in various domains. The process of image fusion is explained as the collection of all the similar information from several images and their incorporation into some images formerly a single image. This single image is more instructive and gives absolute results than a single source image. The aim of image fusion is to combine substitute, multisensory, multitemporal and/or Multiview data into a new image. The quality of the newly formed image depends on its characteristics and measurement on the certain applications.

Image fusion has covered various application areas in remote sensing and astronomy. Multisensory fusion focuses on achieving high spatial and spectral resolutions by integrating images using two sensors. In medical applications also simultaneous assessment of MRI and/or PET images. The multi sensor fusion of detectable at infrared images have various applications like military, security and surveillance areas. According to Multiview fusion a group of images of the similar site captured by the identical sensor from various perspectives is fused to get an output with highest resolution than the sensor is used to get back 3D presentation of this site.

The multitemporal image data create special enhanced data sets but generally at the cost of this spectral characteristics. The goal of the multitemporal approach is focused on medical imaging like detection of organs and tumours, remote sensing, observing land and forest utilization.

Image Fusion Levels and Techniques

Pixel Level

This is the fundamental technique in image fusion carried it lowest level, based on the input images average it integrates the values and intensities of images and producers a single output image

Future Level

In this level we extract the futures of relevant images individually and after applying the fusion algorithm results the improved image.

Block or Region Based

As the name itself this fusion reflects pixel blocks of the image. It is the highest-level technique based on multistage representation and the measurements are computed according to the regions.

The spatial domain techniques directly involve the manipulations of the picture elements in an image. the frequency domain methods are mainly focused on the image transformation to its corresponding frequency domain. It means the fourier transform of the image is evaluated first and then inverse fourier transform is applied to get the output image. the fusion techniques include averaging, Brovey method, PCA, IHS represents the spatial domain approaches.

II. LITERATURE SURVEY

Zhang, Z., & Blum, R. S. (1998, November). Proposed a framework for image fusion based on multiscale decomposition. It proposed a form of shift-invariant discrete wavelet transform is employed for image fusion. This shift invariant discrete wavelength transform use a complete class of wavelet basis called a Discrete Wavelength Frame (DWF). Experimental results exhibit those multiscale coefficients grouping and region-based activity level measurement and verification can enhance the performance of image fusion for any kind of for any kind of MSD methods. In case of misregistration exist the DWF transform provide powerful performance.

Jin, H. Y., Yang, X. H., Jiao, L. C., & Liu, F. (2005, September). proposed reconstruction of fusion images by considering the new coefficients depend on Laplacian pyramid directional filter banks (LPDFB). The paper focused on directional information of the images is reconstructed on the edge contour kept effectively. Initially for each signal LP decomposition is performed. Each feature is dissolved by directional filter banks (DFB) and generates two classes of coefficients. Based on finding maximum exact value of comparable position a formed class of coefficients can be constructed. ultimately the fusion images can be reconstructed based on new coefficients.

Luo, R. C., Yih, C. C., & Su, K. L. (2002) Proposed a prototype of multi sensor fusion and integration along with different fusion techniques and sensor technology are discussed. Multisensor based applications in biomedical engineering, defence, robotics etc are presented. Finally, this paper presents an overview of the area of interest to researchers on evolving field of multi sensor fusion and integration.

Burt, P. J., & Kolczynski, R. J. (1993, May) Proposed an approach for employing image fusion and exhibits that this method results in various fusion applications. The pyramid transform breaks every original image into a group of component samples. After that sample selection is exhibited at each sample position of the pyramid for the mixed image. Finally, an inverse transform for the composite pyramid and then integrates the choosed samples.

Pu, T., & Ni, G. (2000) Proposed a contrast-based image fusion technique implemented the wavelet multiresolution study consists of several steps - initially the multiresolution architecture of multiples input source images is acquired using the discrete wavelet transform. Next, depending on the direct contrast the multiresolution architecture of the fused image can be obtained by choosing the comparable subclass signals of every source image. With the help of inverse wavelet transform ultimately the fused image is rebuilt. Using SNR (signal to noise ratio) mathematically this approach exhibits better performance and keeps the visual salient information of input images.

Long, G., Xiao, L., & Chen, X. (2005) Proposed a curvlet transform yields better performance in terms of PSNR. Face recognition is the most significant for many applications like criminal investigations and forensic applications, credit cards and secure access to buildings etc. The curvlet transform is a multiscale directional transform permits an optimal non adaptive sparse representation of object with edges.

LIU Gui-xi,YANG Wan-hai, Proposed a pixel level image fusion method depend on multiscale decomposition. Initially, the wavelet transform is used to achieve multiscale decomposition on every image. After that the wavelet coefficients of fused image are builted using multiple operators in accordance to various diffusion rules. This method is used to fuse infrared and visible light images by using karhunen-leove diffusion.

Petrovic, V. S., & Xydeas, C. S. (2004), Proposed a new method of multi resolution signal level image fusion for exact transformation of observable data from certain amount of input image signals into a unique fused image without reduction of data. In this paper, a fuse-and-then decompose method is used. Through the decomposed system architecture data fusion is achieved on a multi resolution gradient map which represents field of image signal data. The fused image is executed by applying high pass quadrature mirror filters on the fused pyramid.

Liu, Z., Tsukada, K., Hanasaki, K., Ho, Y. K., & Dai, Y. P. (2001),Describes an approach for multi-dimensional image fusion depend on a multi resolution transform called steerable pyramids. This transform integrates the multiscale decomposition with various scales. By applying recursive fusion strategy to the Laplacian pyramid to integrate the factors is explained. The impact of the amount of decomposition levels and band pass filters on the fusion output is examined.

Li, S., & Yang, B. (2008), Describes a new region based multi focus image fusion method which yields better results than pixel based fusion methods. During the fusion process the multi focus images are fused by applying the simple average technique. After the avarage fused image is splitted based on normalized cut method. After that the multiple images are splitted based on the segmenting yields an intermediate fused image. At last, the segment regions of the original image are fused based on their spatial frequencies.

Piella, G. (2003), Explains a general scenario of multiresolution image fusion. This paper constructs a new image fusion, either a pixel or a region-based method. In the proposed work, the region-based MR fusion scheme is an enhancement of the traditional pixel-based technique. The multi resolution or multi source segmentation technique depend on pyramid linking and explains mixed algorithms like hierarchical watershed from mathematical morphology.

Heijmans, H. J., & Goutsias, J. (2000), Presents a general method for building linear as well as non linear pyramid decomposition techniques for signal analysis and synthesis. This paper focuses on presenting a theoretical approach to the problem of non-linear wavelet decomposition and constructing tools which are significantly used for building schemes which are non-redundant and provides assurance for the perfect reconstruction.

Qu, G., Zhang, D., & Yan, P. (2002), Describes a new scheme called FBG (Fiber Bragg Grating) sensor interrogation depend on sagnac loop which includes a chirped FBG. This technique provides a good linearity, eminent stability and the flexibility to deal sensitivity against dynamic range. This paper exhibits how much information gathered from the fusion of source images can be applied to evaluate the presentation of various image fusion algorithms.

Wilson, T. A., Rogers, S. K., & Myers Jr, L. R. (1995), Proposes image fusion technique which represents airborne visible and infrared image spectrometer (AVIRIS) hyper spectral sensor data. Initially, a Daubechies orthogonal wavelet basis group is carried out to evaluate a multi resolution decomposition. Then, the coefficients of every image are integrated using a perceptual-based weighting. Finally, the fused coefficients are used for the building of fused image. By using the proposed work the non-wavelet based contrast sensitivity method produces good results and improves the SNR (signal to noise ratio).

Van der Weken, D., Nachtegael, M., & Kerre, E. E. (2004), Proposes various relevant estimations to collate fuzzy sets applied in image processing. In the area of image processing the objective quality measures or measures of comparisons have a significant role. These two measures used as a tool to compute and to equate various algorithms constructed to solve problems such as noise reduction, compression etc., This paper explains the region-based relavent measures by using the above two metrics.

Xydeas, C. S., & Petrovic, V. S. (2000, April), Describes the issue of objectively calculating the performance of pixel level image fusion system. In this paper, OEFP is identified on the visual data to the "edge" data which is available in pixel of an image. The OEFP was differentiate against the outputs of internal image fusion presentation tests.

III. EXISTING METHOD

Nowadays several image fusion approaches working on pixel-based techniques. The convenience of pixel fusion is that the images hold the exact data. The fundamental image fusion technique considers the pixel-by-pixel average of input images, this will lead to unacceptable effects like reduce the contrast. Several researchers notice that multiscale transforms are helpful for analying the information of images for applying fusion, several possibilities depending on multiscale transform have suggested such as L P, GP, DW. the main design of multiscale transform is to carry out a multiresolution decomposition on every original image and then combine these decompositions to contrast a single description. The fused image is alternatively rebuilded by extracting an inverse multiresolution transform.

Laplacian Pyramid

In 1983 burt and Adelson suggest most adequate and simple presentation utilized to characterize image with multi resolution is the image pyramid. The idea of this technique is to divide the input image into sub images with various spatial resolutions with the help of certain mathematical operations. laplacian pyramid is obtained from the gaussian pyramid which is a multiscale representation acquired through a recursive low pass filtering and decimation. therefore, the laplacian decomposition is categorized into multiple steps one is gaussian pyramid decomposition and another one is gaussian pyramid to laplacian pyramid.

IV. PROPOSED WORK

Image fusion produce an output image but combining data form a group of numerous input images using pixel level, feature level, block or region-based methods. The fused image comprised of largest informative data for the region than the separate source image. The Accuracy and enter details of the images are increased because of insertion of similar and associated data. Images should be certified previously they are fused. in pixel level image fusion, PCA method is used which modifies certain amount of correlated variables into amount of uncorrelated variables. the main goals of image fusion using PCA are

1. Fusion process protect the significant data available in the input image
2. Fusion process should not any deviation, unrelated features and noise should be minimized to a highest point

A. Discrete Wavelet Transform

DWT is a systemized and practical tool for signal processing applications and this tool utilize in several emerging standards. In different applications it is the alternative of Fourier theory and it is substitute to the short time Fourier transform. By using Fourier theory signal is break up into cosines and sign terms but by using wavelets signal is estimates on a set of functions (wavelet functions). The main variance between Fourier transform and DWT, in Fourier transform signal is represents in the frequency
domain whereas in DWT signal is represents inn frequency as well as in time domain. DWT broadly used in image processing.
when the original image has been DWT transformed, it is separated into four different frequency bands, one the low pass band "LL", and three others are horizontal "HL", vertical "LH", and diagonal "HH" high pass bands.

<table>
<tr><td>LL^3</td><td>LH^3</td><td rowspan="2">LH^2</td><td rowspan="3">LH^1</td></tr>
<tr><td>HL^3</td><td>HH^3</td></tr>
<tr><td colspan="2">HL^2</td><td>HH^2</td></tr>
</table>

HL^1	HH^1

Figure 4.1: Wavelet Decomposition

B. Modified PCA Algorithm

After 2D LP-DCT based image fusion, MPCA [16, 19, 31-32] method for acquiring the dimensionality reduction image is suggested. The steps involved in implementing the process as shown below

Algorithm 1. MPCA process

Input: Fused image by 2D LP-DCT.

Steps:

1. Input 2D LPDCT- fused image.

2. Calculate C=covariance({I1(:)}]

3. Find out variance and Diagonal matrices by implementing

Eigen function.

4. Estimate maximum value and its index by using sort function

As diagonal matrix.

5. Find the value of p as p=v(1)/sum(v)

6. Extract the features by using FV = p* I1

Output: Features extracted image.

V. SCREENSHOTS

A. Existing System

Sample 1:

Input Image: office.jpg

Output Image:

Sample 2:

Input Image: Stone.jpg

Fused Output Image:

Sample 3:

Input Image: Forest.jpg

Fused Output Image:

Sample 4:

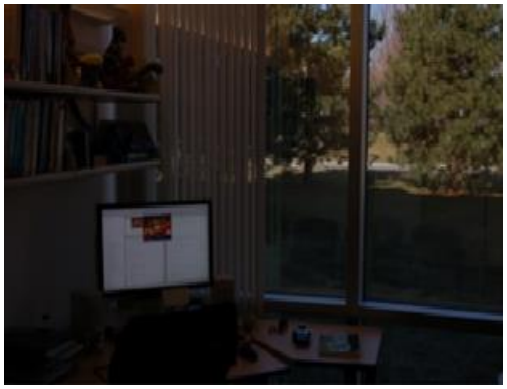
Input Image: Lighthouse.jpg

Fused Output Image:

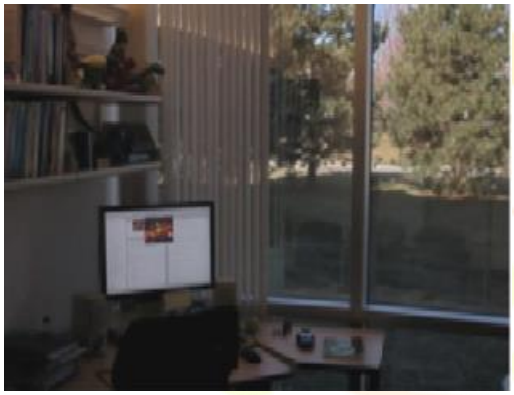
B. Proposed Method:

Sample 1:

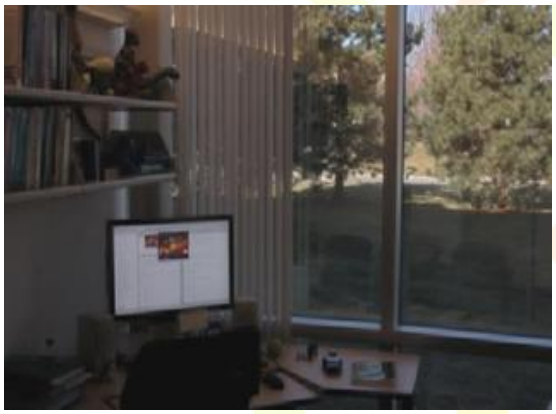
Input Image: Office.jpg



Contrast Stretched Image:



Fused Output Image:



Sample 2:

Input Image: Stone.jpg

Contrast Stretched Image:

Fused Output Image:

Sample 3:

Input Image: Forest.jpg

Contrast Stretched Image:

Fused output Image:

Sample 4:

Input Image: Lighthouse.jpg

Contrast Stretched Image:

Fused Output Image:

VI RESULTS

Table 1: Statistical Analysis of Exististing Method and Proposed Method

S. No	Image Name	Entropy [8]		Mean [18]		RMSE [14]		PFE [17]	
		Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
1	stone.jpg	5.88	5.890	69.86	118.68	73.10	48.71	99.93	66.45
2	lighthouse.jpg	7.62	7.667	87.54	142.86	102.26	59.63	99.60	58.77
3	office.jpg	6.34	6.861	32.87	68.90	42.44	39.07	99.94	93.31
4.	car.jpg	7.30	7.308	98.71	152.35	111.24	59.78	99.60	55.21
5.	forest.tif	6.47	6.787	49.30	85.40	71.43	44.39	99.64	70.02
6.	shutterstock.jpg	6.78	7.055	51.54	100.05	62.46	51.08	99.81	81.44

Table 2: Statistical Analysis of Exististing Method and Proposed Method

S. No	Image Name	MAE [8]		DENT [17]		PSNR [18]	
		Existing	Proposed	Existing	Proposed	Existing	Proposed
1	stone.jpg	69.83	48.39	0.16	0	29.5255	31.2881
2	lighthouse.jpg	87.28	55.61	0.81	0.04	28.0673	30.4102
3	office.jpg	32.87	36.85	0.23	0.31	31.8869	32.2456
4.	car.jpg	98.40	57.25	0.62	0.22	27.7021	30.3989
5.	forest.tif	49.20	40.65	0.47	2.62	29.6255	31.6901
6.	shutterstock.jpg	51.49	48.36	0.25	0.02	30.2086	31.0820

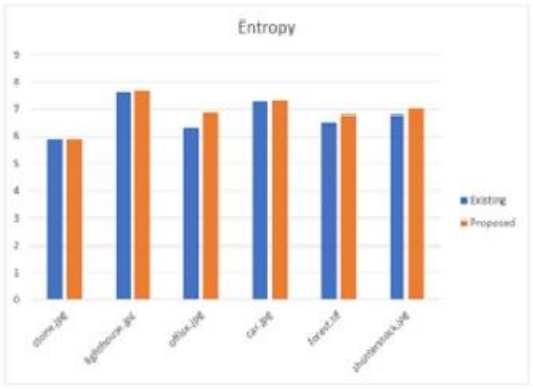


Fig5.1: Performance Evaluation of Entropy

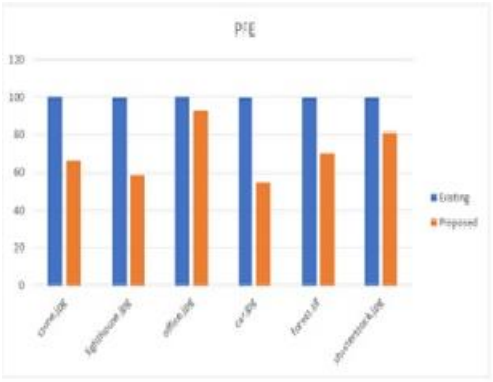


Fig5.5: Performance Evaluation of PFE

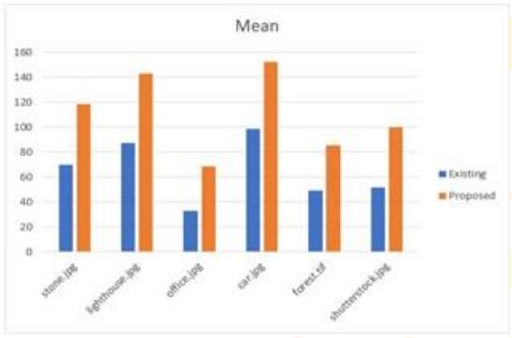


Fig5.2: Performance Evaluation of Mean

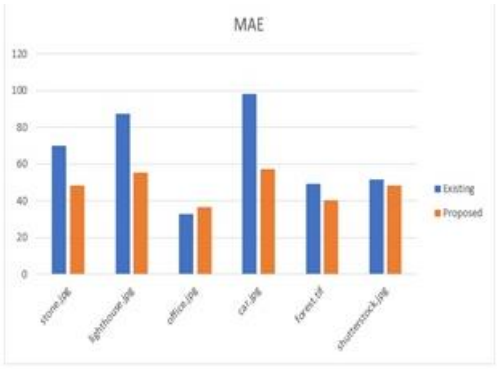


Fig5.6: Performance Evaluation of MAE

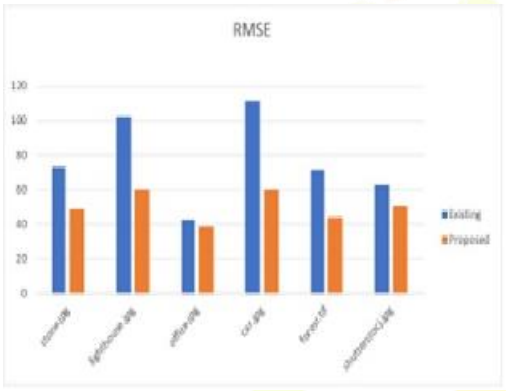


Fig5.3: Performance Evaluation of RMSE

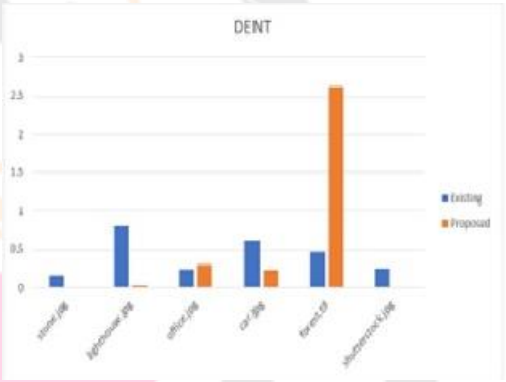


Fig5.7: Performance Evaluation of DENT

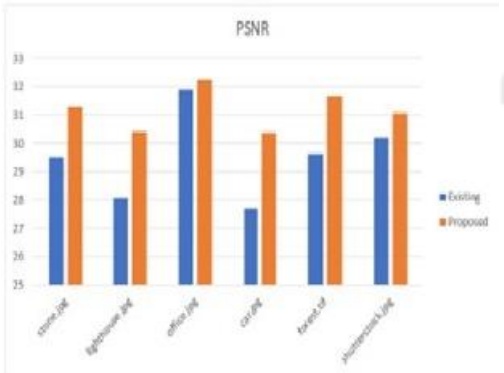


Fig5.8: Performance Evaluation of PSNR

VII.CONCLUSION

Fusion is the process of extracting futures of image DCT based image fusion algorithms for dull images had result with lesser clarity, less PSNR and more RMSE. The proposed work uses contrast stretching method which results better than existing DCT-LP technique. Further modified PCA is integrated with contrast stretching to get more better result. This is clear from the various experimental results. Comparative analysis as done using various fusion metrics such as Entropy, RMSE, PSNR, PFE etc. There is significant improvement in the proposed algorithm over the existed DCT-LP. In near future this work can be extended by using filters to archive more enhancement. Also, to archive full benefits of the proposed algorithm this work to use in real cameras by using embedded system.

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