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DESIGN AND DEVELOPMENT OF ENHANCED IMAGE FUSION TECHNIQUE IN VISUAL SENSOR NETWORK USING WAVELET TRANSFORM FOR AN EFFICIENT SURVIELLANCE PURPOSE

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ABSTRACT
Image fusion is process of combining two different images of same scene which are multi focused by nature. It has the major application in the field of visual sensor network for efficient surveillance monitoring. The thesis presents a novel hybrid image fusion technique that has the capabilities to be used in the real time environment such as central computer of visual sensor network for efficient surveillance purpose.
The proposed method contains three different steps and the final step shows the final result of the proposed method. The three steps includes: first step is fuse the images using DWT, second step is to fuse the images using SWT and the final third step is to fuse the previous two results using averaging operations.
The proposed technique is experimented on various dataset of different sizes from different databases but in the thesis the results are presented at the fixed image size for easy comparison. It is found that this proposed method shows the best fusion results on comparing with some of the most prevailing standard methods. The experimental results are performed on the basis of qualitative and quantitative analysis. The comparative computational time is also evaluated for better judgement of the effectiveness of proposed method on same system where the other compared method's results are evaluated. The proposed method has the ability to be implemented on any real time applications.

1. Introduction

Generally two sorts of vision are described. They are human vision and PC vision. Human vision is refined system that resources and follows up on visual updates. It has progressed for a long time, essentially for obstruction or survival. Basic PC vision structure requires a camera, a camera interface and a PC.

Iamge combination is the way toward consolidating at least two or more than two pictures into the single picture to upgrade the data content. Picture combination systems are significantly utilized in applications remote detecting, military, stargazing and therapeutic imaging. Picture blend systems are noteworthy as it improves the introduction of article affirmation structures by fusing various wellsprings of satellite, airborne and ground based imaging structures with other related instructive files

2. Literature Review

A huge amount of research and work has been done on picture blend methodologies since mid-nineteen eighties. The most direct strategy for consolidating pictures is by taking the diminish scale ordinary of the pixels of source pictures. This direct technique gives extraordinary results to the detriment of lessened intricacy level. These techniques of merging pictures can be associated with different educational accumulations depending on their spatial and transient characteristics. Spatial zone frameworks and Frequency region techniques are used for joining the photos. Spatial region methodology procedure picture pixels to achieve the perfect result while repeat space frameworks first trade the image into repeat zone by applying Fourier change and after that procure the resultant picture by performing inverse Fourier change. These procedures are taken a gander at using execution estimation qualities, for instance, Peak signal to Noise ratio (PSNR), Mean square error, and entropy.

1. IHS (Intensity-Hue-Saturation) Transform technique.
2. Principal Component Analysis (PCA) technique.
3. Pyramid technique.
4. High pass filtering technique.
5. Wavelet Transform technique.
6. Artificial Neural Networks technique

3.Proposed Algorithm

Input image: Two multi-focused images blurred at different parts i.e. left and right focused images. In left focused image, the left part of the image is clear and visible and the right part is blurred, while in the right focused image, the right part of the image is clear and visible and the left part is blurred.

Output image: Overall improved high quality fused image.
Step 1: Apply 2D-SWT on the two multi-focused images i.e. I and J. The images I and J each are transformed into four parts i.e. I = [approximate (A), horizontal (H), vertical (V), and diagonal (D)] and similarly J = [approximate (AA) horizontal (HH), vertical (VV), and diagonal (DD)].
Step 2: Apply below operations on the transformed components:

$$AAA = (A + AA) \times 0.5;$$
$$HHH = Max (H, HH);$$
$$VVV = Max (V, VV);$$
$$DDD = Max (D, DD);$$

Step 3: Apply 2D-ISWT on the enhanced AAA, HHH, VVV and DDD as shown below. IJ is the fused image.

$$IJ = ISWT (AAA, HHH, VVV, DDD)$$

Step 4: Apply 2D-DWT on the same two multi-focused images i.e. I and J. The images I and J each are transformed into four parts i.e. I = [approximate (A'), horizontal (H'), vertical (V'), and diagonal (D')] and similarly J = [approximate (A'A') horizontal (H'H'), vertical (V'V'), and diagonal (D'D')].
Step 5: Apply below operations on the transformed components:

$$A'A'A' = (A' + A'A') \times 0.5;$$
$$H'H'H' = Max (H', H'H');$$
$$V'V'V' = Max (V', V'V');$$
$$D'D'D' = Max (D', D'D');$$

Step 6: Apply 2D-IDWT on the enhanced A'A'A', H'H'H', V'V'V' and D'D'D' as shown below. I'J' is the fused image.

$$I'J' = ISWT (A'A'A', H'H'H', V'V'V', D'D'D')$$

Step 7: IJ and I'J' are the two enhanced and fused images using SWT and DWT respectively. Now apply the average operation on IJ and I'J' as shown below:

$$F\_IJ = (IJ + I'J') \times 0.5;$$

Step 8: F_IJ is the final and high quality fused image.

4. EXPERIMENTAL RESULTS AND ANALYSIS

The experimental results are evaluated on the standard Lytro dataset available at open access database. This dataset is of multi-focus image. The testing is performed on the grayscale images to easily analyse the testing results. The image size resolution is set at the 256×256 pixels. The experimental results of the proposed method are compared with some of the major and most prevalent available techniques like Averaging, DWT (1-level), DWT (3-level), SWT and PCA. The final fusion results are compared using qualitative as well as quantitative analysis. Also the proposed method is also compared on the basis of the execution time. All the compared methods and proposed method are tested on the system of same configuration. This is required for the evaluation of the computational efficiency.
The dataset over which the experimental testing is performed is shown in the Figure 4.1, 4.3, 4.5, 4.7, 4.9, 4.11, 4.12.

Figure 4.1 Dataset 1

(a) (b) (c)

Figure 4.2. Fused Images (a) Fused image 1 using DWT (b) Fused image 2 using SWT (c) Final result of proposed method

Figure 4.3. Dataset 2

Figure 4.4. Fused Images (a) Fused image 1 using DWT (b) Fused image 2 using SWT (c) Final result of proposed method

Figure 4.5. Dataset 3

(a) (b) (c)

Figure 4.6. Fused (a) Fused image 1 using DWT (b) Fused image 2 using SWT (c) Final result of proposed method

Figure 4.7. Dataset 4

(a) (b) (c)

Figure 4.8. Fused Images (a) Fused image 1 using DWT (b) Fused image 2 using SWT (c) Final result of proposed method

Figure 4.9. Dataset 5

(a) (b) (c)

Figure 4.10. Fused (a) Fused image 1 using DWT (b) Fused image 2 using SWT (c) Final result of proposed method

Figure 4.11. Dataset 6

(a) (b) (c)

Figure 4.12. Fused Images (a) Fused image 1 using DWT (b) Fused image 2 using SWT (c) Final result of proposed method

4.1 Quantitative analysis

The experimental testing is performed on overall all the multi-focus images of the database. But here in the thesis, the results are presented on the limited dataset. The Table 4.1 and Figure 4.13 to 4.19 comparatively analyses the result of proposed method with other standard methods on the basis of quantitative results. On comparing the results in the Table 4.1 and Figure 4.13 to 4.19, it is observed that the bold values of the proposed method shows the best results in terms of quantitative analysis. The overall image quality of the proposed method results is also far better than all other methods. The Table 4.1 is analysed using graphically for more better and easy understanding and analysis.

Table 4.1 Average results (without reference) on grayscale dataset. The best results are shown in bold.

Methods	SD	CC	API	AG	He	MI	$Q^{AB/F}$
Averaging	50.115	0.9131	96.012	3.686	4.265	3.125	0.798
DWT (1-level)	50.302	0.9254	98.066	4.598	4.258	5.125	0.888
DWT (3-level)	50.412	0.9472	97.118	3.265	4.569	4.989	0.799
SWT	51.052	0.9451	98.012	4.235	4.111	4.119	0.826
PCA	51.312	0.9543	99.091	4.598	5.020	4.989	0.581
Proposedmethod	**52.521**	**0.9699**	**100.871**	**5.551**	**5.111**	**5.811**	**0.955**

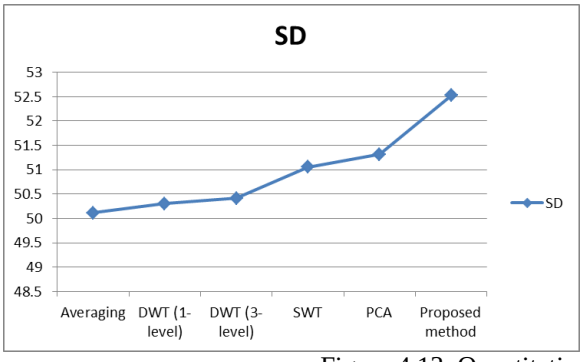

Figure 4.13. Quantitative analysis using SD value

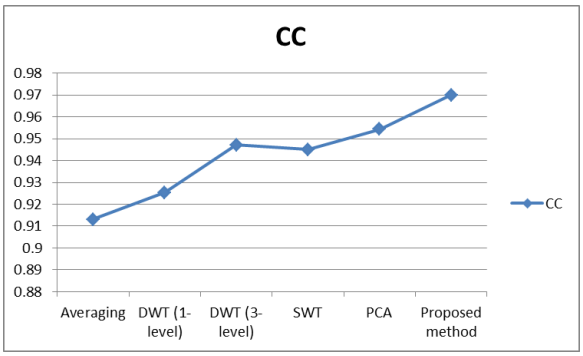

Figure 4.14. Quantitative analysis using CC value

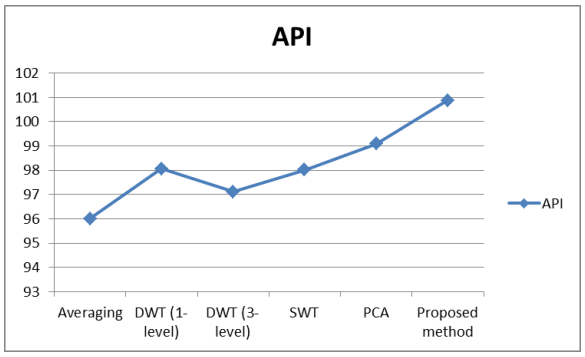

Figure 4.15. Quantitative analysis using API value

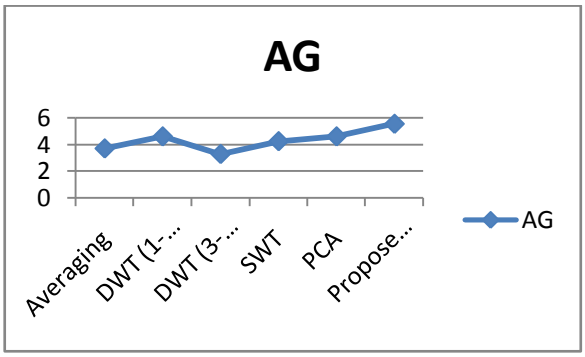

Figure 4.16. Quantitative analysis using AG value

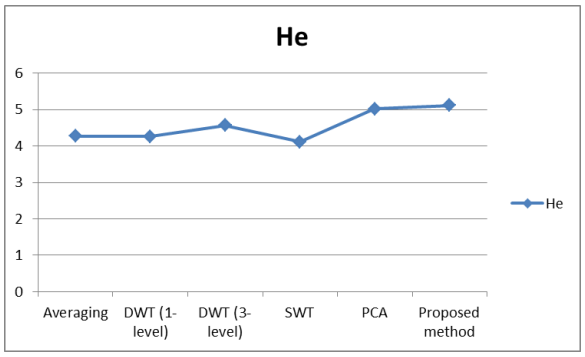

Figure 4.17. Quantitative analysis using He value

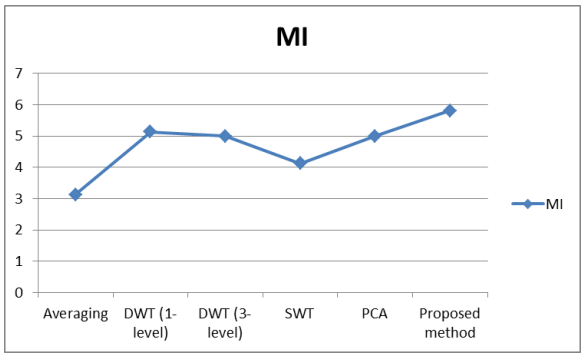

Figure 4.18. Quantitative analysis using MI value

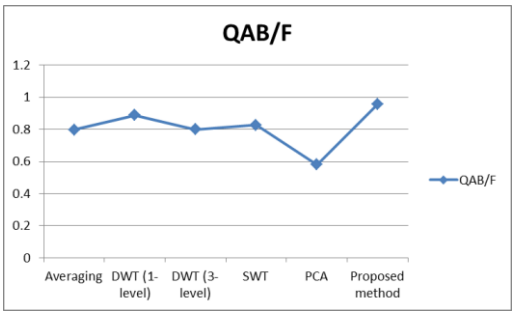

Figure 4.19. Quantitative analysis using Q^{AB}/F value

4.2 Computational analysis

The Table 4.2 compares the execution time of proposed method with other standard methods. This table is graphically analysed in the Figure 4.52

Table 4.2 Average results (without reference) on grayscale dataset. The best results are shown in bold.

Methods	**Time (in seconds)**
Averaging	1.1155
DWT (1-level)	3.1302
DWT (3-level)	7.0023
SWT	4.0572
PCA	5.3712
Proposed method	**3.2365**

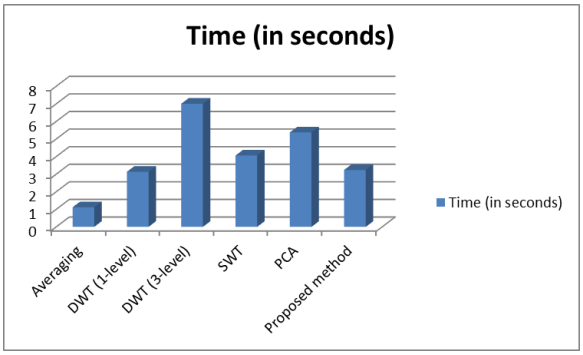

Figure 4.20. Comparative computational analysis

5. CONCLUSION AND FUTURE SCOPE

Image fusion is process of combining two different images of same scene which are multifocused by nature. It has the major application in the field of visual sensor network for efficient surveillance monitoring. The thesis presents a novel hybrid image fusion technique that has the capabilities to be used in the real time environment such as central computer of visual sensor network for efficient surveillance purpose.
The proposed technique is experimented on various dataset of different sizes from different databases. It is found that this proposed method shows the best fusion results on comparing with some of the most prevailing

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The proposed method is the hybrid combination of DWT, SWT and averaging method and it shows better results than all these methods. There is a lot scope to improvise this technique using method noise or any other concept. But it may increase the computational cost. Different other wavelet family can be used for more analysis. The proposed method is experimented at the 1 level of DWT and SWT. It can be tested at other higher levels

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7. REFERENCES

[1] Portilla, J., Strela, V., Wainwright, M., Simoncelli, E.P., “Image Denoising using Gaussian Scale Mixtures in the Wavelet Domain”, TR2002-831, Computer Science Dept, New York University. 2002.
[2] V. Strela, J. Portilla, and E. P. Simoncelli, “Image denoising via a local Gaussian scale mixture model in the wavelet domain,” in Proc. SPIE 45th Annu. Meeting, San Diego, CA, Aug. 2000.
[3] E. P. Simoncelli and E. Adelson, “Noise removal via Bayesian wavelet coring,” in Proc. IEEE International Conference on Image Processing, Lausanne, Switzerland, September 1996, pp. 279–382.
[4] S. G. Chang, B. Yu, and M. Vetterli, “Spatially adaptive wavelet thresholding with context modelling for image denoising,” IEEE Trans. Image Processing, vol. 9, pp. 1522–1531, Sept. 2000.
[5] J. Romberg, H. Choi and R. G. Baraniuk, "Bayesian wavelet domain image modeling using hidden Markov models," IEEE Transactions on Image Processing, vol. 10, pp. 1056-1068, July 2001.
[6] M. Malfait and D. Roose, “Wavelet based image denoising using a Markov Random Field a priori model,” IEEE Transactions on Image Processing, vol. 6, no. 4, pp. 549–565, 1997.
[7] M. Jansen and A. Bulthel, “Empirical bayes approach to improve wavelet thresholding for image noise reduction,” Journal of the American Statistical Association, vol. 96, no. 454, pp. 629–639, June 2001.
[8] A. Jung, “An introduction to a new data analysis tool: Independent Component Analysis”, Proceedings of Workshop GK "Nonlinearity" - Regensburg, Oct. 2001.
[9] A. Hyvärinen, E. Oja, P. Hoyer, and J. Hurri, “Image feature extraction by sparse coding and independent component analysis”, In Proc. Int. Conf. on Pattern Recognition (ICPR'98), pp. 1268-1273, Brisbane, Australia, 1998.
[10] Nason, G.P., “Fast cross-validatory choice of wavelet smoothness, primary resolution and threshold in wavelet shrinkage using the KovacSilverman algorithm”, Technical report, Department of Mathematics, University of Bristol, United King.