Image Fusion Using DTCWT with High Boost Filter Technique

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Abstract: Image fusion is the way of merging several images from multi-modal sources with respective complementary data to create a new image, which carries all the common as well as added futures of each image. With the latest improvements in the domain of imaging technology and multisensory systems have changed into authenticity in wide fields like science imaging, remote sensing, machine visualization and the military apps. Image fusion makes accessible an efficient mode of decreasing this increasing volume of data by removing all the expensive data from the sender photos. This paper proposes a hybrid approach using DTCWT with High boost filtering technique and the simulation of the proposed method is done in MATLAB2012a toolbox. The analysis of our method is performing among performance measuring parameter such MSE and PSNR in which analyze that our methodology gives improved results than the existing methods.

Keywords: *Image Fusion, Matlab, DTCWT*

I. Introduction

Images from many sensors have unlike demonstrations, which have to be changed to an ordinary demonstration for fusion. This demonstration must retain the preeminent revolution of any of the sensor. The alignment of multi-sensor images is also a vital pre working step in image fusion. Multi-sensor registration is also exaggerated by the changes in the sensor images. On the other hand, image fusion does not entertain multi-sensor sources [1]. There can be double-sensor or multi-sensor image fusion which has to be portrayed in this report. Similarly image fusion is typically carried at one of the four dissimilar working altitudes: signal, future and revolution. Signal label image fusion, also acknowledged as pixel-label image fusion, designates fusion at the lowest label, where a number of untreated input image signals are combined to put together a double fused image signal [2]. Object image fusion, moreover called future image fusion, coalesce future and object labels and future descriptor data that have formerly extracted from each input image. Lately the greatest label announcement or symbol label photo fusion corresponds to fusion of futuristic revolution data by local decision takers operating on the sequence of future working on image data formed from each. Figure 1 shows a system using fusion at every four labels of work. This fall-purpose structure could be taken as a basis for whatever photo work mechanism, i.e. an automatic object discovery/identification system using four imaging sensors like perception and UV cameras. The main object is to take care and suitably categories objectives in a presented prospectus.
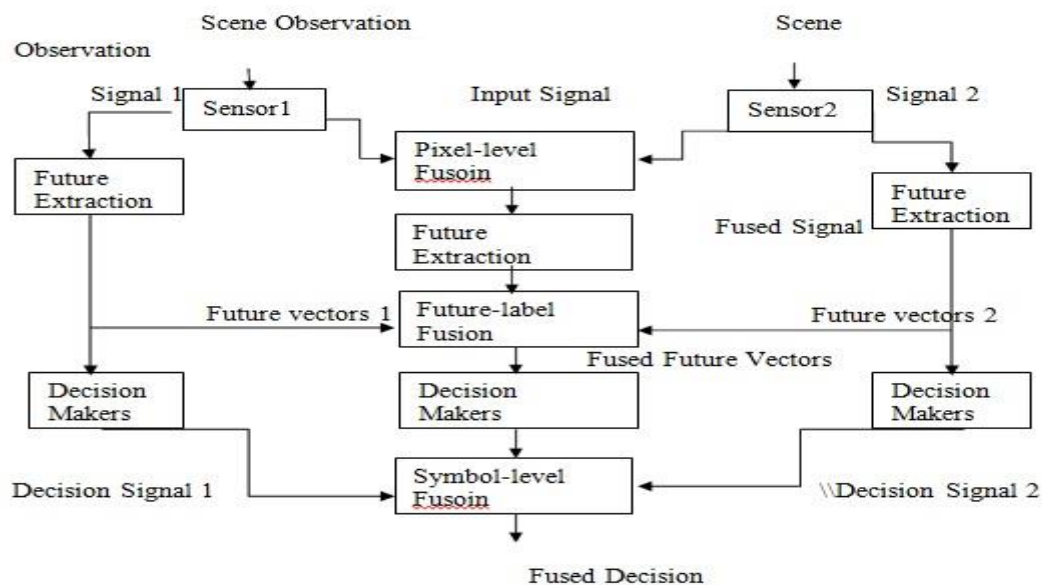

Figure 1: Data Fusion System

Image fusion is a method that endeavors at the integration of incongruent and corresponding data to augment the information there in the source images as well as augment the dependability of the elucidation. This method leads to additional precise data explanation and efficacy [3].

II. Related Work

Rana et al. [4] explored unusual science photo fusion work and their reference to discover out which fusion work gives enhanced output based on the execution measures. Here science photos of magnetic resonance imaging and computed tomography photos are fused to outline fresh photo. This fresh fused photo progresses the data substance for diagnosis. Fusing MRI and CT photos offered more data to doctors and clinical treatment planning system. MRI presents optimized data on soft tissues whereas CT demonstrates optimized data on denser tissues. Fusing these four photos bestows more data than double input photo. In this, wavelength transfusion, the principle component comparison (PCA) and fuzzy logic techniques are utilizing for fusing these four photos and outcomes are compared.

Mini et al. [5] proposed an augmentation technique which exploits Stationary Wavelength transfusion (SWT), modulus maxima and high boost filtering. The photo is decomposed using SWT and its modulus maximum is indomitable. A division of the high pass filtered photo achieved as the result of SWT decomposition and modulus maxima is supplementary to original photo. The system is evaluated visually and dispassionately using measures like dissimilarity, PSNR etc. The execution measures are appraised for dissimilar class of photos and found to be appropriate to all categories of mammographic photos.

Singh et al. [6] proposed a fresh detail-enhancing revelation fusion method using non-linear translation-variant filter (NTF). Due to the captured Standard Dynamic Range (SDR) images under unusual exposure settings, primary the excellent details are extracted based on guided filter. Subsequently, the base layers (i.e., images obtained from NTF) transversely all input images are fused using multi-resolution pyramid. Exposure, dissimilarity, and saturation measures are considered to engender a mask that guides the fusion process of the base layers. In conclusion, the fused base layer is combined with the digger out fine details to achieve detail-enhanced fused image. The purpose is to safeguard details in both tremendously dark and extremely bright regions without High Dynamic Range Image (HDRI) representation and tone mapping step.

Kim et al. [7] initiated a new-fangled method based on the curvelet transform which represents edges better than wavelets. Since edges play anelementary role in image understanding, one good way to develop spatial resolution is to augment the edges. Curvelet-based image fusion method presentsmore affluent information in the spatial and spectral domains simultaneously. They performed IKONOS image fusion. This novel method has accomplished an optimum fusion result.

III. Proposed Work

In this section we are describing our work to extract the essential features by fusing the multiple images from image dataset. In our work DTCWT and Filtering techniques is used to fuse the images.

3.1   DT-CWT (Dual Tree Complex Wavelet Transform)

In the dual tree complex wavelet transform method, the fusion is performed using masquerades to dig out information from decomposed structure of DT-CWT [8]. The DT-CWT arrangement engages both the real and complex coefficients. This complex transform employs two detach DWT decompositions. It is divided into two detach trees, tree A and tree B as revealed in figure 2 below.
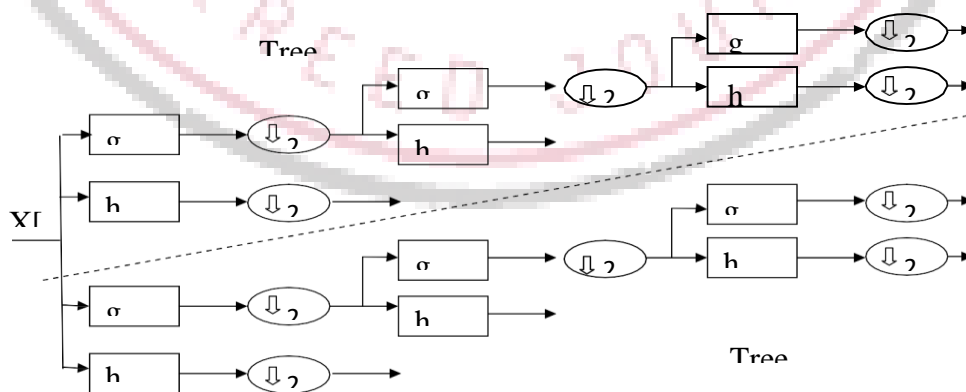

Figure 2: Structure of DT-CTW

The fusion progressionabsorbs the formation of the fusedpyramid using DT-CWT coefficients which are achieved from the decomposed pyramids of the input source images. The fused image is fashioned by applying inverse DT-CWT transform. DT-CWT preserves the restrained texture regions of brain in MRI images. Ringing outcomes are reduced and edge details are also retained more obviously. This DT-CWT is more beneficial than the DWT method as it is directional sensitivity and shift variant in behavior.

3.2   High Pass Filters:
A high pass filter is mostly used for sharpening purpose. When an image is sharpened and contrast is superior between bordering areas with little variation in brightness or low eminence information.
High pass = f(x, y) – low pass

3.2.1 High-boost Filtering: A high-boost filter is also identified as a high-frequency prominence filter. A high-boost filter is used to preserve several of the low-frequency apparatus to abet in the elucidation of an image. In high-boost filtering input image h (m, n) is multiplied by an amplification factor A prior to subtracting the low-pass image. Accordingly, the high-boost filter expression is:

$$High\ Boost = A*f\ m,n - low\ pass$$

Adding and subtracting 1 with gain factor, then
High boost = (A-1) * f(x, y) + f(x, y) – low pass
So

$$High\ Boost = A-1 *f\ x,y + High\ pass$$

3.3 Proposed Algorithm

1. Select Image A from database

2. Select Image B from database

3. Apply DTCWT and decomposed images into sub-bands(LL, LH, HL, HH)

4. Wavelet coefficient into A and B

5. Apply transform function on A, B

6. Apply high pass filter into decomposed layers of A and B

7. Apply Gaussian filter to removes extra noise from decomposed layers

8. Then apply high boost filter to improve intensity of each decomposed layers

9. Apply fusion rule:

   $$Fpk(i,j)\ Apk\ i,j\ ,if\ Apkm\ i,j > Bpkm\ i,j\ Bpk\ i,j\ Ot\square erwise$$

10. Then fused all improved wavelet coefficients

11. Apply INV-DTCWT function

12. Now Compute MSE is as follows:

    $$MSE = 1mn\ (Aij - Bij)2nj = 1mi = 1$$

13. And compute PSNR as follows:

    $$PSNR = 10 \times log10(peak2MSE)$$

IV-Experimental Results

In this section, we show the implementation and comparison of our proposed work and the implementation is done using the C++ programming language. The simulation of our work is done using the well-known MATLAB2012a [9] simulator. The comparison is done among different photo dummy data using PSNR and MSE execution measuring parameter. From this comparison, observe that our proposed technique give better output than the DWT and DTCTW photo fusion technique. For comparing the techniques, we select 4 photo dummy data namely: SARAS, CLOCK, BALOON and LAPORD. Figure 3, figure 4, figure 5 and figure 6 show the MSE and PSNR value of our way is better than the DWT and DTCTW.
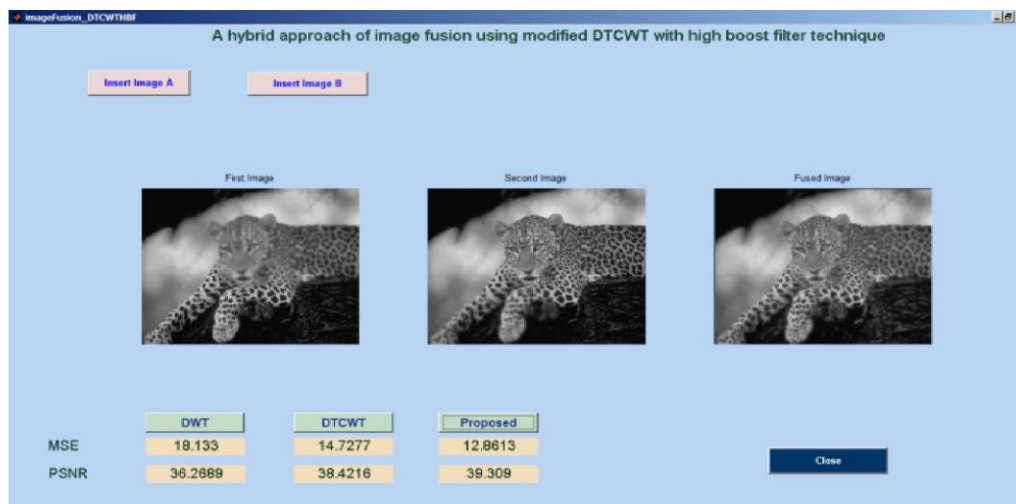
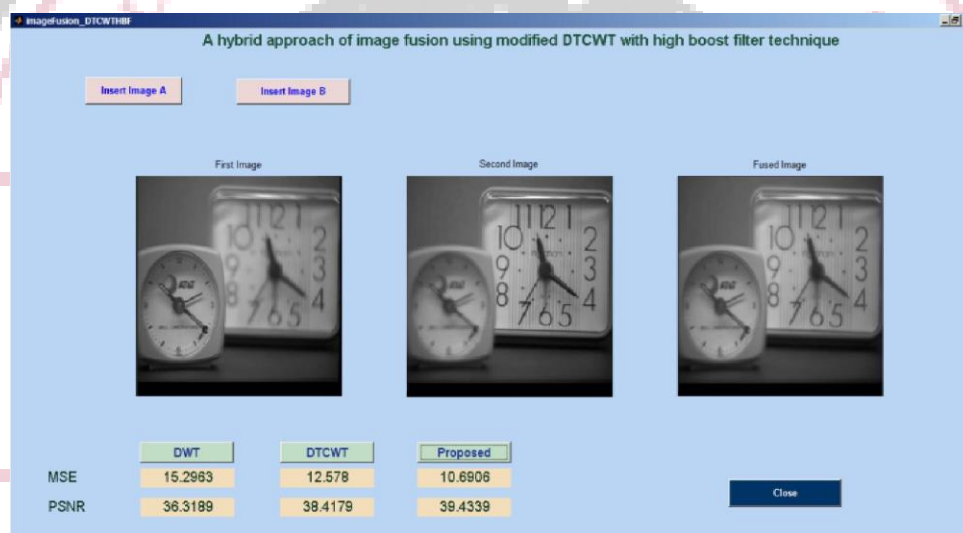Figure 3: leopard fused photo dummy data

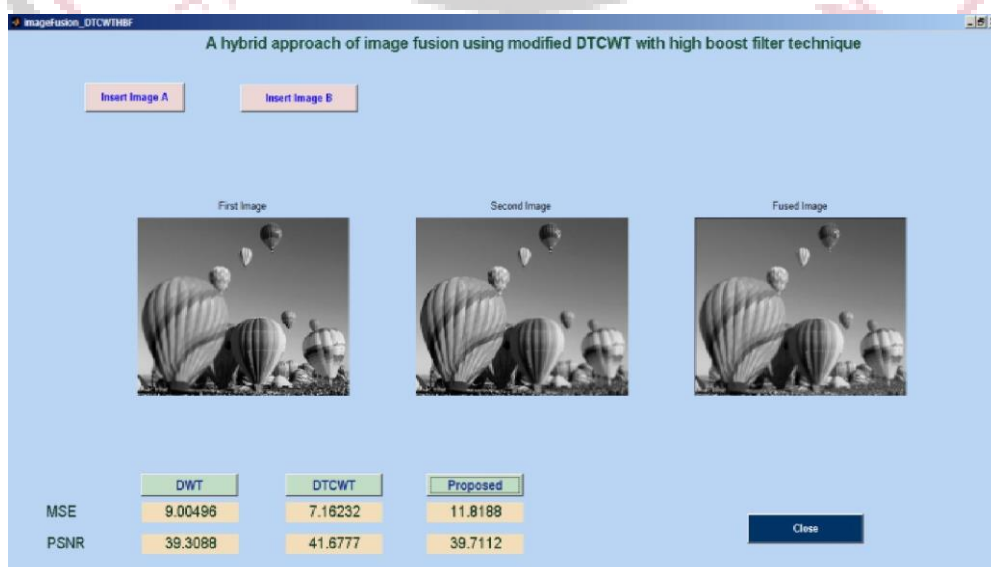Figure 4: CLOCK fused photo dummy data

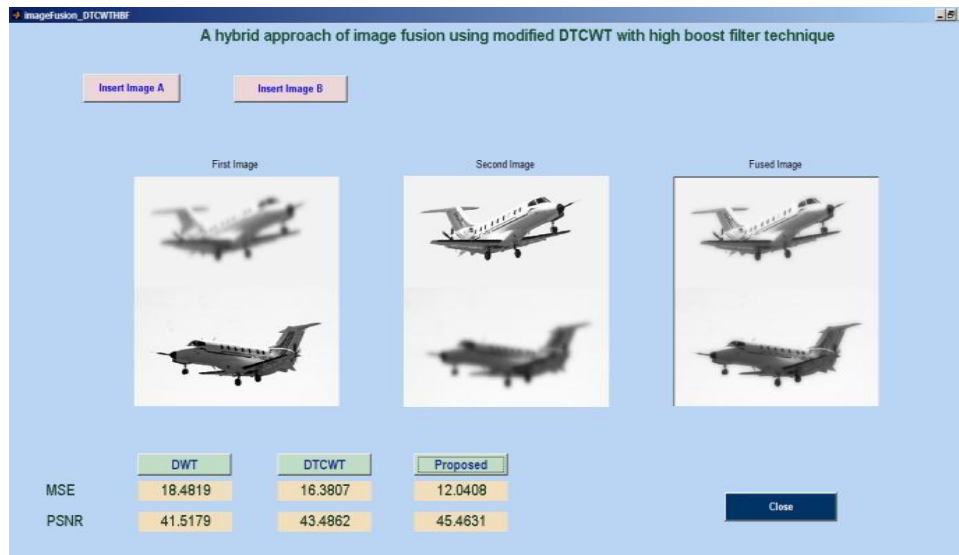Figure 5: Balloon fused photo dummy data

Figure 6: Saras fused photo dummy data

Here table 1 and table 2 shows the reference of the proposed way among DWT and DTCTW in which observe that simulation result is much better for MSE and PSNR execution parameter

Table 1. MSE Comparison of Proposed Method

MSE Comparison			
Method/Image	DWT	DTCWT	Proposed
Saras.jpg	18.481	16.380	12.040
Clock.png	15.296	12.578	10.690
Balloon.png	9.0049	7.1623	11.818
Lapord.png	18.13	14.727	12.861

Table 2 PSNR comparison of all methods

PSNR Comparison			
Method/Image	DWT	DTCWT	Proposed
Saras.jpg	41.517	43.486	45.463
Clock.png	36.318	38.417	39.433
Balloon.png	39.308	41.677	39.711
Lapord.png	36.267	38.421	39.309

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