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Implementation of Image Fusion using NIHS Transform and DCT for Multifocus Images

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***Abstract*--Multifocus Image fusion is process of merging information of two or more images of a scene and as a result has *"all-in-focus"* image An efficient algorithm has been proposed to fuse multi-focus images or videos using discrete cosine transform (DCT) and nonlinear intensity hue saturation transform(NIHS) based standards in WVSN. The Improved Nonlinear Intensity-Hue-Saturation (INIHS) transform and Discrete Cosine Transform (DCT) avoid gamut problem, color distortion and improves spatial content respectively. Experiments on plenty of pairs of multi-focus images coded in Joint Photographic Experts Group (JPEG) standard are conducted to assess the fusion performance.**

***Index Terms*—Discrete cosine transform, improved intensity, hue, saturation, image fusion, multifocus, spatial frequency.**

I. INTRODUCTION

The process of intermixing relevant information from two or more images into a single image is image fusion. Finally resulting image will provide more information than any of the input images.

The clarity of information is very important. Image Fusion is a method to improve the quality of information from a set of images. The process of image fusion is to make sense of the good information from each of the given individual images is fused together to form a final resultant image whose quality is better to any of the input images. The sequence of operators can be applied to the images that would make the good information in each of the image prominent. The resultant image is formed by combining such useful information from the input images into a single image. Three main fusion methods have been deal in the literature of image fusion – pixel level, feature level and decision level. Pixel-level is low level of image fusion, deals with pixels obtained at sensor imaging output. Feature-level fusion operation is performed on features withdrawal from source images. Decision-level deals with image descriptors. Fusion process is categorized in two domains: spatial domain and frequency domain.

a. Spatial Domain: Applicable pixel values of source images are added to the pixel value in the fused image. Although spatial domain methods often used to manage to the non-existence of spectral information and introduce some spatial distortions. Degradation in the type of imperfect perceptual feature is introduced by pixel level fusion methods such as averaging and weighted averaging.

b. Transform Domain:Multi-resolution approaches have been planned to defeat this difficulty. Algorithms based on pyramid approach and wavelets are quiet successful. Different pyramid fusion methods outcome in blocking result in significantly various regions of the image.

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II. RELATED WORK

Jagdeep Singh et al. (2014) suggest the discrete cosine transforms (DCT) based methods of image fusion are more suitable and time-saving in real-time systems using DCT based standards of still image or video. DCT based image fusion produced results but with lesser clarity, less PSNR value and more Mean square error and proposes a new algorithm whose overall objective is to improve the results by combining DCT with adaptive histogram equalization.

Sruthy, S et al. (2013) discussed that the Image Fusion is the process of combining information of two or more images into a single image which can retain all important features of the all original images. Here the input to fusion involves set of images taken from different modalities of the same scene. Output is a better quality image; which depends on a particular application. The objective of fusion is to generate an image which describes a scene better or even higher than any single image with respect to some relevant properties providing an informative image. These fusion techniques are important in diagnosing and treating cancer in medical fields. This paper focuses on the development of an image fusion method using Dual Tree Complex Wavelet Transform. The results show the proposed algorithm has a better visual quality than the base methods. Also the quality of the fused image has been evaluated using a set of quality metrics.

VPS Naidu et al. (2012) explain six different types of image fusion algorithms based on discrete cosine transform (DCT) were developed and their performance was evaluated. Fusion performance is not good while using the algorithms with block size less than 8x8 and also the block size equivalent to the image size itself. DCTe and DCTmx based image fusion algorithms performed well. These algorithms are very simple and might be suitable for real time applications.

III. METHODOLOGY

A gamut problem is said to be a subset of color. Certain colors which cannot be expressed within a given color space.

A bit stream is a sequence of bits, representing a stream of data, transmitted continuously over a communications path, serially (one at a time). Dequantization is reverse step of quantization.Decoding can be used to analyse and interpret a image or communication.

IHS explains the popularity of perceptual color space and overpowers the limitation of commonly used RGB color space which does not relate intuitively to the attribute of human color perception. Intensity means total amount of light that reaches the eye. Hue can be defined as the predominant wavelength of a color and saturation can be defined as purity of total amount of white light of a color. The input Multi-focus image undergoes Improved Nonlinear IHS transform (iNIHS), which calculates intensity, hue and saturation value of each pixel to detect the pixel is in RGB color space or CMY color space.

The image is broken into 8*8 block of pixels. From left to right, top to bottom, the DCT is applied. Each block is compressed through quantization. The array of compressed block that constitute the image is stored in a drastically reduced amount of space. Image is reconstructed through decompression, a process that uses the IDCT.

Spatial Frequency (*SF*) measures the overall information level in the regions (activity level) of an image and is computed as

$$SF^2 = RF^2 + SF^2 \quad (1)$$

The row frequency (RF) and column frequency (CF) of an 8x8 image block are given by

$$RF^2 = \frac{1}{8\times8}\sum_{x-0}^{7}\sum_{y-1}^{7}(f(x,y) - f(x,y-1))^2 \quad (2)$$

$$CF^2 = \frac{1}{8\times8}\sum_{x-1}^{7}\sum_{y-0}^{7}(f(x,y) - f(x-1,y))^2 \quad (3)$$

For simplicity, we only consider two source images A and B, but the method can be extended for more than two source images. The fusion process consists of the following steps:

1) The source images should be decoded and de-quantized and then the source image

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applied to intensity hue saturation transform

2) Then divide them into blocks of size 8*8. Denote the block pair at location (i, j) by $A_{i,j}$ and $B_{i,j}$respectively.

3) Compute the spatial frequency of each block and denote the results of $A_{i,j}$ and $B_{i,j}$ by $SFA_{i,j}$ and $SFB_{i,j}$ respectively.

4) Compare the spatial frequencies of two corresponding blocks to decide which should be used to construct the fused image.

5) Quantize the resulting DCT coefficients with a standard quantization table in the standard JPEG coder [12] and then use entropy coding to produce the output bit stream.

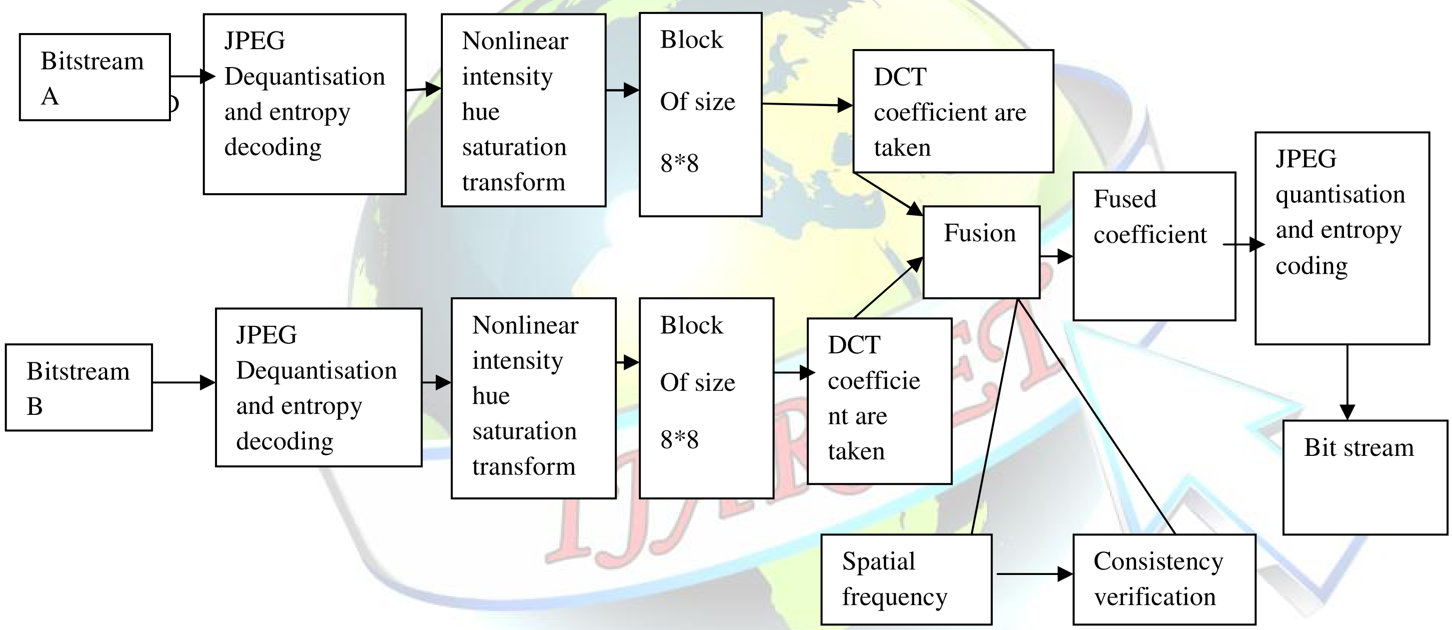

Fig. 1 Scheme of Propsed System

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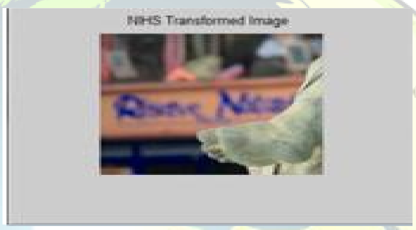
IV. EXPERIMENTAL RESULT

(a)

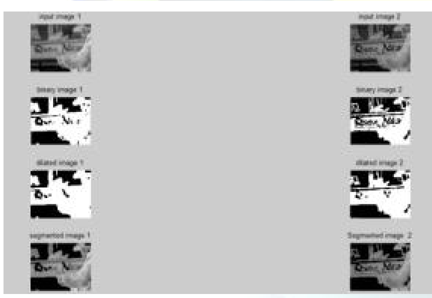
(b)

Fig. 2. (a) Input image 1 (b) Input image 2

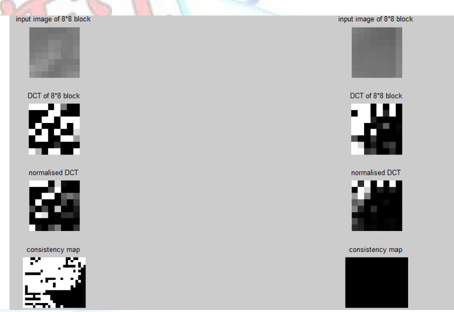


(c)

Fig. 2. (c) NIHS transformed image



(d)



(e)

Fig. 2. (d) segmented image (e) consistency map

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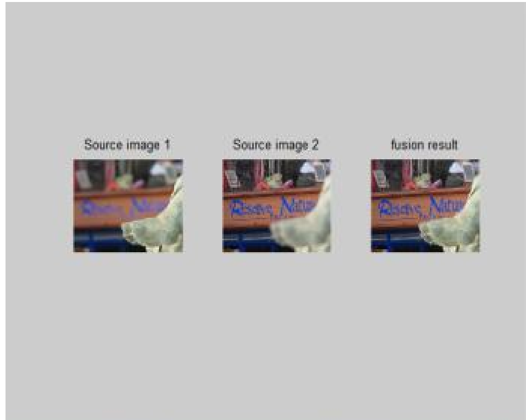

(f)

Fig. 2. (f) Fused output image

V. CONCLUSION

Approach for spatial frequency of multi-focus images fusion using DCT and Non-linear intensity hue saturation transform domain used instead of spatial domain. The coding of images is done in JPEG format.

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