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A new Methodology of Contrast Enhancement for Satellite Images

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Abstract— Contrast Enhancement is a technique of enhancing the contrast level of the images such that the brightness of the image is preserved. The images takes from the satellite are sometimes seems to be not very bright and may contains noisy pixels. So here a new methodology is adopted to improve the contrast of such satellite images. Although there are various schemes implemented for to improve the contrast level of satellite images, but here the contrast enhancement is done using the fusion of the canny edge of the images and adaptive intensity transfer function of the image on low intensity of the image where the contrast is low detected using DWT transformation. The main idea is to transform the satellite image into subbands where the low subband is further processed to increase the contrast of the pixels, the low intensity pixels are detected using canny edge detector and adaptive intensity function is used to increase the intensity of pixels, the enhanced pixels are then fused with high subband region to make the resultant image.

Index Terms—Histogram, privacy preserving, DWT, DCT, Curvelet, Fuzzy Histogram, Gaussian Filter.

I. INTRODUCTION

Image processing techniques are now becoming indispensable in applications such as entertainment, healthcare, surveillance, and security. Their uses can be found in cephalic radiography in medical imaging [1], human identification [2], indoor security surveillance [3], and crowd monitoring in outdoor environments [4]. These application paradigms encompass a wide domain of the types of features contained in the captured images and a diversity of image processing techniques are anticipated to be employed for satisfactory performances in different situations.

Contrast enhancement for gray-level images, implemented in the form of histogram transformations [5] is considered one of the fundamental processes that facilitate subsequent higher level operations such as detection and identification. Color images can be enhanced by separating the image into the chromaticity and intensity components [6]. The contrast enhancement can be performed by hardware devices [7] or software algorithms. The majority of the work for the latter category usually manipulates a histogram of pixel gray-levels in an image by some transformation functions to obtain the required contrast enhancement. Consequently, this operation also delivers the maximum information contained in the image which is the result obtained from an efficient use of the available gray-levels.

CONTRAST ENHANCEMENT

The conventional approach to enhance the image contrast is to manipulate the gray-level of individual pixels to the required value by constructing and transforming an intensity histogram. However, the maximization of the information content carried in the image should be taken into account when constructing the histogram. In the following, benchmark images will be used as examples to illustrate the effects of employing different strategies for histogram transformation and a definition of entropy as a measure of information will also be given. Then, a continuous distribution transformation is proposed for maximizing the information content.

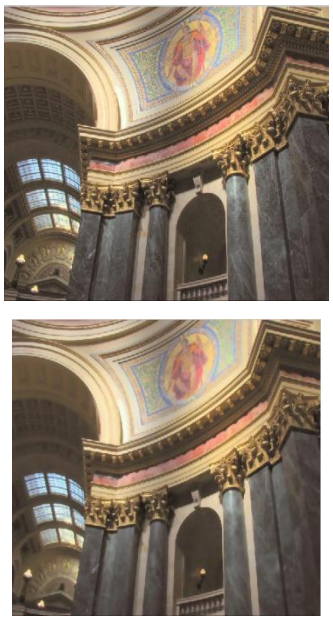

Figure 1. a) Normal Input Image Containing Low Contrast or brightness b) Enhanced Image

SUBBAND DECOMPOSITION USING DWT

The DWT of images is a transform based on the tree structure with D levels that can be implemented by using an appropriate bank of filters. Essentially it is possible to follow two strategies that differ from each other basically

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because of the criterion used to extract strings of image samples to be elaborated by the bank of filters. The first solution, definitely not very used, consists of generating the string by queuing image lines and then executing decomposition on D levels; after this operation, we generate D strings by queuing the columns from the found sub-images and decomposition for each string is applied. The resulting decomposition, in the simplified version extended up to the third level, is shown in figure 2.

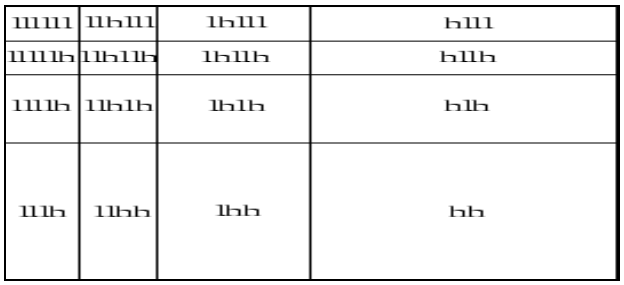

Figure 2. Non-standard 2D-DWT decomposition

The standard solution consists of alternating one decomposition by rows and another one by columns, iterating only on the low-pass sub-image.

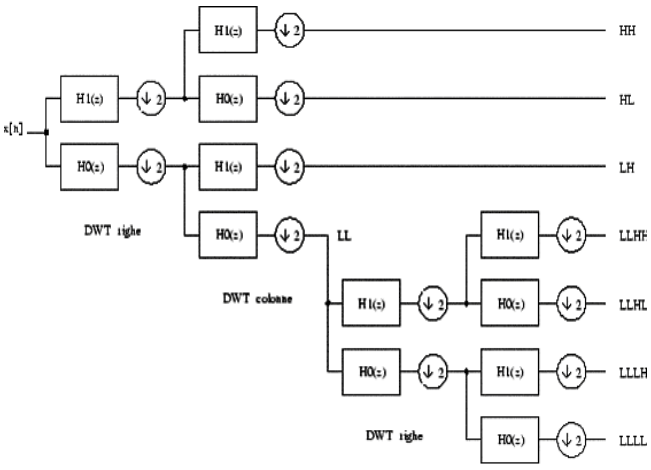

Figure 3. Bank of filters iterated for the 2D-DWT standard

The resulting decomposition is visible in the figure 4.

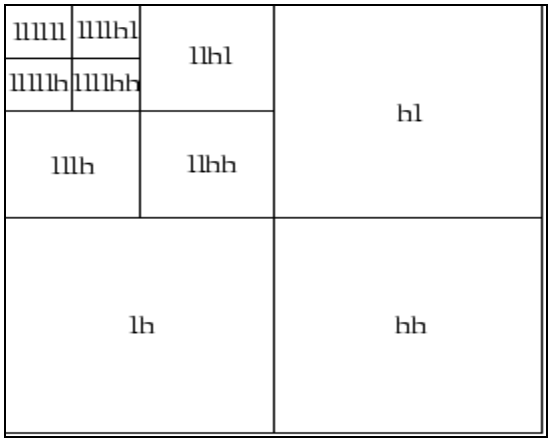

Figure 4. Standard 2D-DWT decomposition

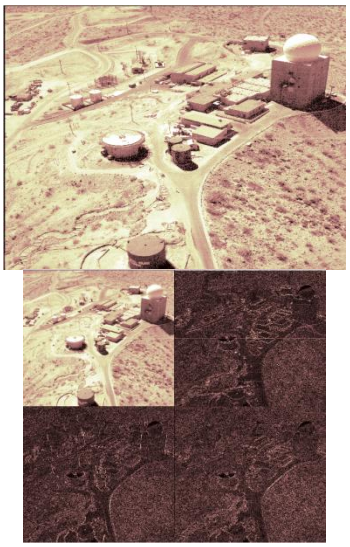

Figure 5. a) Input Image b) 2 level subband decomposition using DWT

II. RELATED WORK

According to Kim [8], one drawback of the histogram equalization can be found in the fact that the brightness of an image can be altered after the histogram equalization, just because of to the flattening property of the histogram equalization. Therefore, it is hardly utilized in consumable electronic products such as TV where preserving the original input brightness may necessary in order not to introduce unnecessary visual deterioration [8]. Kim proposed a technique whereby the input histogram is divided into two sub-histograms on the basis of its mean value. The main motive behind this technique was to preserve the brightness of the image while enhancing its contrast.

Hossain et. al. [9] proposed a technique called Minimum Mean Brightness Error Dynamic Histogram Equalization (MMBEDHE) whereby, the input image is divided into a number of sub-images and then the classical HE is applied to each of them. The absolute average error using this technique was calculated to be very less as compared to since then existing techniques [9]. In the same year, Xie et. al. [10] came up with their technique for image enhancement known as “An Adaptive Image Enhancement Technique Based on Image Characteristic”. According to this method, the actual or original image is primarily subjected to Laplace Filter which is a spatial high-pass filter. Based on its output, the first-order classifying of the image is done. Here the image is smoothened using a low - pass filter and the edges are sharpened using a high - pass filter. At the end, HE is applied to it [10].

In 2010 Yen-Ching Chang and Chun-Ming Chang proposed a simple histogram modification technique. Two boundary values for histogram are found and set to the corresponding values, respectively. It recomputes the probability density function of an image and the updated mapping function is used to perform histogram equalization. The technique can effectively improve the quality of images enhanced by histogram equalization and specification methods [11].

In 2011 Debashis Sen, Member and Sankar K. Pal proposed an automatic exact histogram specification technique. It is used for global and local contrast enhancement of images. It first subjects the image histogram to a modification process and then by maximizes measures that represents an increase in

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information and decreases in ambiguity and thus create a good histogram. It measures image contrast based upon local band-limited approach and center-surround retinal receptive field model approach. This is used in multiple scales frequency band [12].

Consecutively to overcome the problems caused by direct HE an adjustable weighted average contrast enhancement algorithm is proposed in this paper. The proposed algorithm[14] is to improve the effects of image enhancement by HE then an adjustable weighting. The uniqueness of the proposed method is that the weighted average of the histogram equalized, gamma corrected and the original image are combined to obtained the enhanced processed image. Firstly the exponential function i.e. adaptive gamma correction function is adopted for nonlinear smooth transform of an image. The originality of the proposed technique is that, the weighted average of histogram equalization, exponential transformation and the original image are combined and the level of the contrast improvement is adjustable by changing the weighting coefficients. The uniqueness of the proposed technique is that, the weighted average of histogram equalization, exponential transformation and the original image are combined and the level of the contrast improvement is adjustable by changing the weighting coefficients. This method has been implemented on four different images to check experimental results.

AMBE and Entropy is then calculated to measure the performance of the proposed algorithm. Experimented results that the proposed method not only achieve contrast enhancement enhances the visual quality of the image but also preserves the brightness level. On the basis of outcomes it show that the proposed algorithm has good performance on enhancing contrast and visibility for a majority of images.

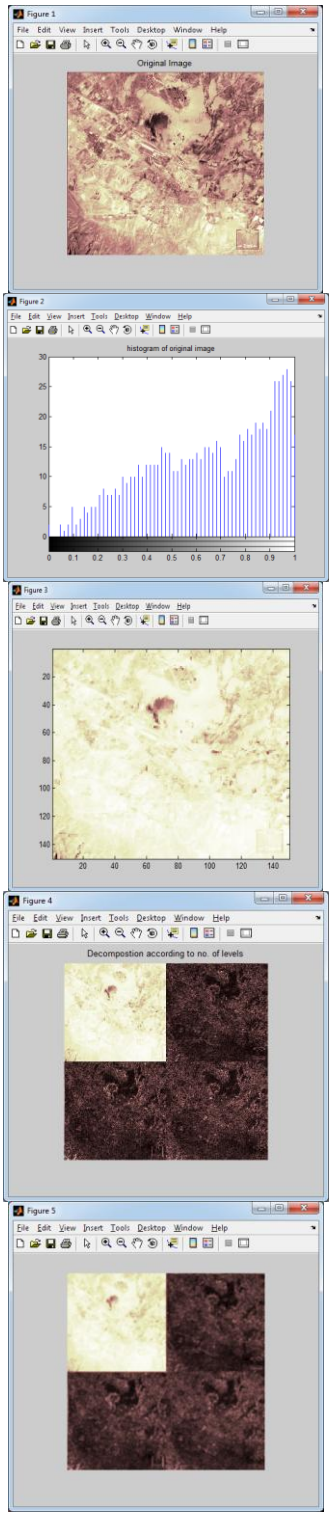
In [13] Eunsung lee proposes “Contrast Enhancement using Dominant Brightness Level Analysis and Adaptive Intensity Transformation for Remote Sensing Images” (DBAIT) especially for Images taken from satellite. This method uses dominant brightness level of Image for decomposing the Image in different three layers and then these layers are used for calculation of adaptive intensity transfer function. This estimated adaptive intensity transfer function is used for image contrast enhancement then these layers are fused to get enhanced image. This method gives the better result in comparison of all above mentioned techniques.

III. PROPOSED METHODOLOGY

1. Take satellite image as an input image.
2. Apply DWT transformation on the input image.
3. Analysis of the Dominant brightness level of the LL band of the DWT is process out.
4. Image Decomposition of the image on the basis of dominant brightness level is carried out.
5. Apply Adaptive intensity transfer function on different intensity levels of the decomposed image and then smoothened out.
6. The smoothen image is passed to the canny edge detection techniques which is then integrated with the Contrast enhancement techniques and is fused out.
7. The inverse DWT is then applied on the fusion image and HH, HL, LH bands to get the contrasted image.

IV. RESULT ANALYSIS

As shown in the below figure is the different images when the existing algorithm is applied on the input sample of the satellite image. The algorithm includes adaptive intensity function, contrast enhancement, DWT,, Smoothing and Fusion of the image.



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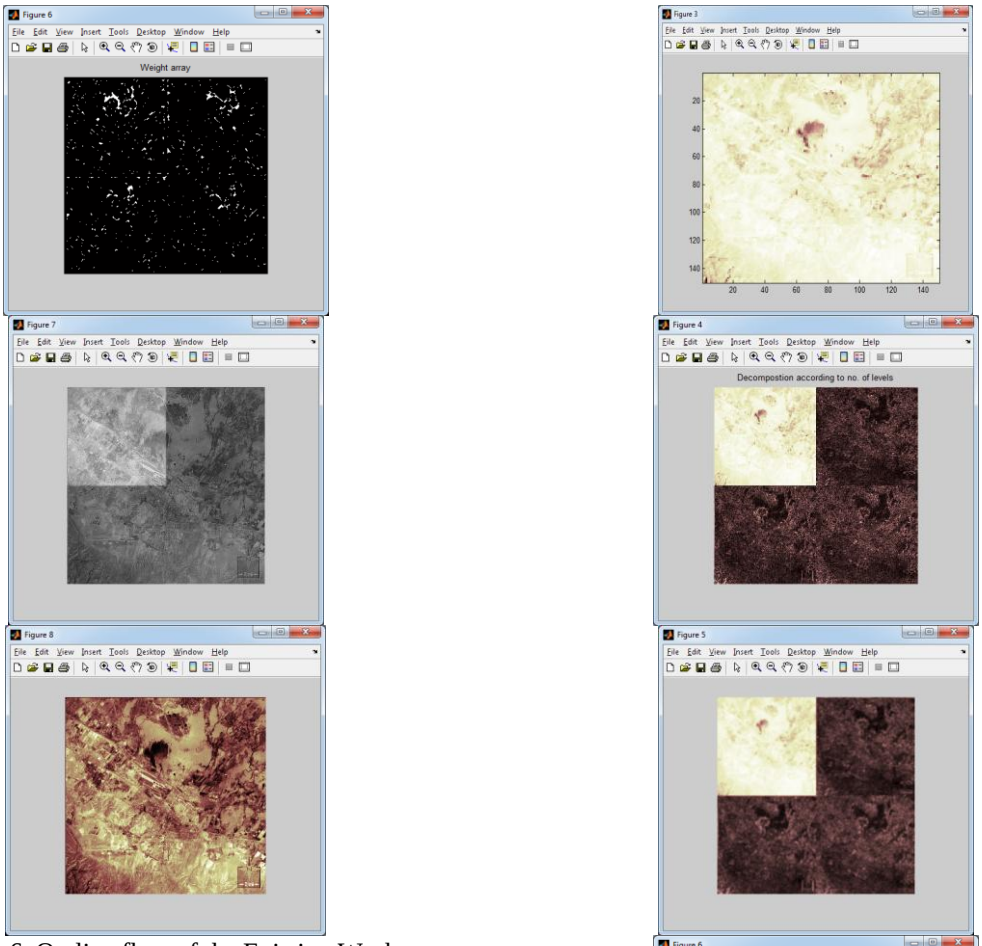

Figure 6. Outline flow of the Existing Work

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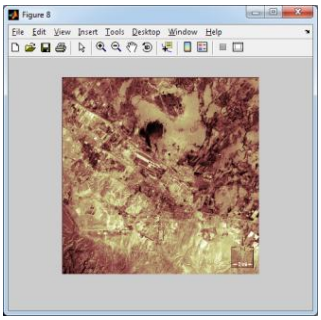


Figure 7. Outline flow of the Proposed Work

As shown in the below figure is the result analysis of existing work. The different parameters of contrast enhancement are taken for the analysis of the degree of enhancement of image.

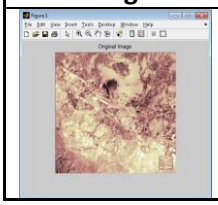
Image	MSE	PSNR	NCC	NAE	EME
	1.2618e+004	7.1209	0.3258	0.6970	0.6865

Table 1. Result Analysis of Existing Work

As shown in the below figure is the result analysis of Proposed work. The different parameters of contrast enhancement are taken for the analysis of the degree of enhancement of image.

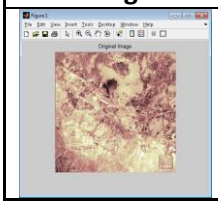
Image	MSE	PSNR	NCC	NAE	EME
	4.0827e+003	12.0213	0.6886	0.4130	0.8963

Table 2. Result Analysis of Proposed Work

V. CONCLUSION

The methodology adopted here for the contrast enhancement of satellite images using the hybrid combinatorial method of transformation and adaptive intensity function and the fusion of the result of the two images will give the resultant contrast enhanced image. The result analysis shows the performance of the proposed methodology. The proposed methodology implemented here provides high measure of Enhancement and also the error rate between the input image and the resultant image is less and has high PSNR.

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