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ACHIEVING QUALITY IMPROVANCE BY COMPRESSING DYNAMIC RANGE OF IMAGE AND TONE MAPPING WITH IMAGE FUSION

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Abstract— Building a mathematical model of uneven illumination and contrast is difficult, even impossible. This paper presents a novel image balancing method for different kinds of remote sensing and Smartphone captured images In this proposed algorithm we have used technique of image fusion with two other methods for tone mapping and dynamic range compression. In addition, the proposed method not only restores color information, but also retains image details. Image fusion is a process of blending the complementary as well as the common features of a set of images, to generate a resultant image with superior information content in terms of subjective as well as objective analysis point of view. The objective of this research work is to develop some novel image fusion algorithms and their applications in various fields such as crack detection, multi spectra sensor image fusion, medical image fusion and edge detection of multi-focus images etc. We address the problem of tone mapping high dynamic range (HDR) images to standard displays (CRT, LCD) and to HDR displays. With standard displays, the dynamic range of the captured HDR scene must be compressed significantly, which can induce a loss of contrast resulting in a loss of detail visibility. We have used MSR and Gamma correction techniques to improve the image quality, and result showed that our proposed algorithm can efficiently improve the information contained in image. The output image can be used in further processing like segmentation, classification etc.

Keywords-component; Discrete Wavelet Transform (DWT), Image fusion, MSR, Gamma Correction

I. INTRODUCTION

Image fusion is the technique of merging several images from multi-modal sources with respective complementary information to form a new image, which carries all the common as Well as complementary features of individual images. With the recent rapid developments in The domain of
Imaging technologies, multisensory systems have become a reality in wide Fields such as remote sensing, medical imaging, machine vision and the military applications.

Image fusion provides an effective way of reducing this increasing volume of information by Extracting all the useful information from the source images. Image fusion provides an Effective method to enable comparison and analysis of Multi-sensor data having Complementary information about the concerned region Analogous to other forms of information fusion, image fusion is usually performed at one Of the three different processing levels: signal, feature and decision. Signal level image Fusion, also known as pixel-level image fusion, represents fusion at the lowest level, where a Number of raw input image signals are combined to produce a single fused image signal. Object level image fusion, also called feature level image fusion, fuses feature and object Labels and property descriptor information that have already been extracted from individual Input images. Finally, the highest level, decision or symbol level image fusion represents Fusion of probabilistic decision information obtained by local decision makers operating on the results of feature level processing on image data produced from individual sensors. A number of pyramidal decomposition Techniques have been developed for image fusion, such as, Laplacian Pyramid, Ratio-of-low-Pass Pyramid, Morphological Pyramid, and Gradient Pyramid. Most recently, with the Evolution of wavelet based multi resolution analysis concepts, the multi-scale wavelet Decomposition has begun to take the place of pyramid decomposition for image fusion. Actually, the wavelet transform can be considered one special type of pyramid Decompositions. It retains most of the advantages for image fusion but has much more complete theoretical support.

The real Discrete Wavelet Transform (DWT) has the property of Good compression of signal energy. Perfect reconstruction is possible using short support Filters. The unique feature of DWT is the absence of redundancy and very low computation. Therefore, DWT has been used extensively for Multi Resolution Analysis (MRA) based Image fusion. By using image fusion we can combine merits of other image enhancement techniques. In this paper we will show definiteness of methods used in this research.

The figure below shows the different image fusion techniques.

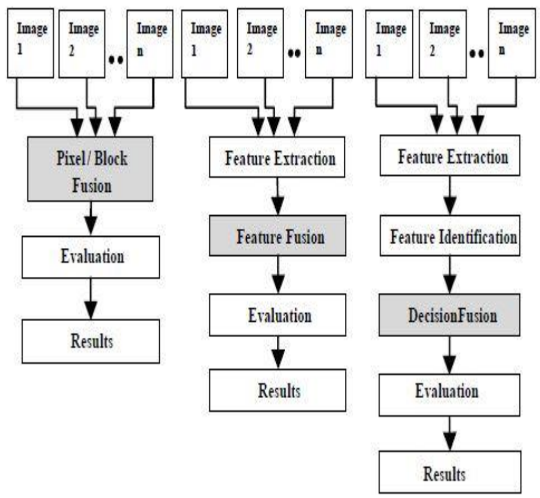


Figure 1: Different techniques of Fusion

In spatial domain fusion techniques sometimes output image may contain spatial distortion, so we have used DWT based image fusion technique.

II. MSR

The Retinex theory, developed by Edwin Land, intends to explain how the visual system extracts reliable information from the scene despite changes of illumination (Land 1964, Land and McCann 1971, Land 1977). It is based on a series of experiments carried out with one or three projectors and a flat surface made of color patches called a Mondrian [7].

The equation described below provides the basic SSR.

$$R(x,y)=\log\log I(x,y)-\log\log[F(x,y)*I(x,y)] \quad (1)$$

Here F(x,y) is Gaussian function which can be described as

$$F(x,y)= K_{exp}\left[-(x^2+y^2)/\sigma^2\right] \quad (2)$$

SSR provides good dynamic range compression, but it does not provide tonal rendition hence we use MSR for our algorithm which provides both color rendition and dynamic range compression simultaneously. MSR use three different scales and weighted coefficient to combine several SSR outputs.

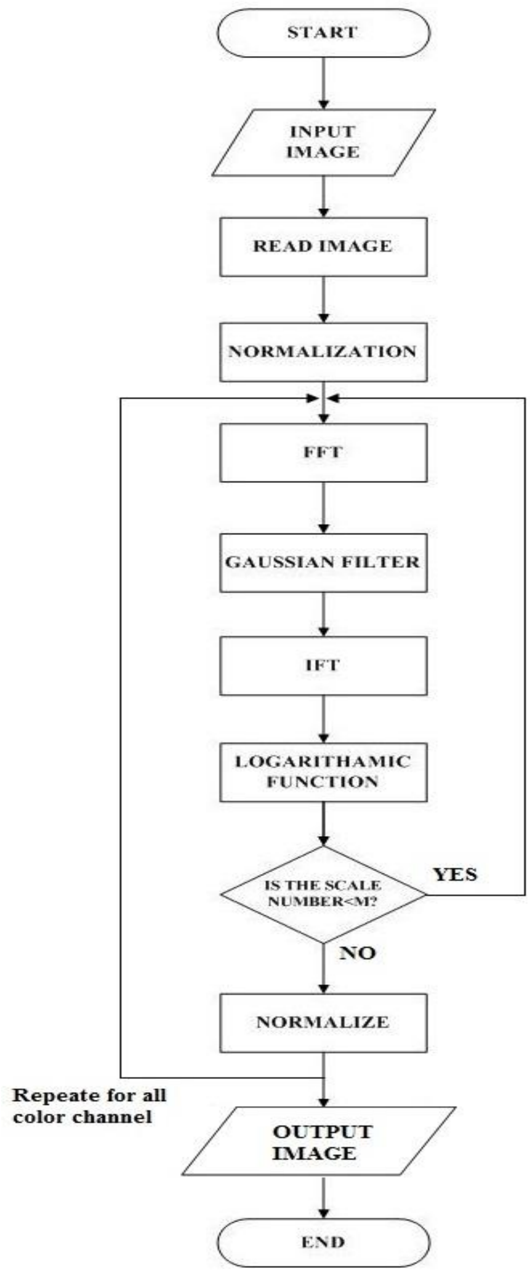


Figure 2: Flow chart of Multi scale Retinex

This flowchart describes the process of MSR, In this we have used normalization to map the values into 0-255. Then we apply FFT to transform the image into frequency domain. The next step is to apply Gaussian filter to remove illuminated image from original image.

III. GAMMA CORRECTION

In general, the enhancement techniques can be divided into two main categories: direct enhancement methods and indirect enhancement methods. In direct enhancement methods, the image contrast can be directly defined by a specific contrast term. Where in indirect enhancement methods attempt to enhance image contrast by redistributing the probability density. In this technique, without defining any specific constant image intensity can be spreaded within dynamic range. Histogram modification (HM) is the most widely used indirect enhancement techniques due to their easy and fast implementation.

Gamma correction technique which make up a family of general HM techniques obtained simply by using a varying adaptive parameter γ[12]. The simple form of the gamma correction is given by as follows.

$$T(l) = l_{\max}(l / l_{\max})^{\gamma} \qquad (3)$$

Where l_{max} is the maximum intensity of the input image. The intensity l of each pixel in the input image is transformed as T(l) after performing the above equation.

IV. PROPOSED METHOD

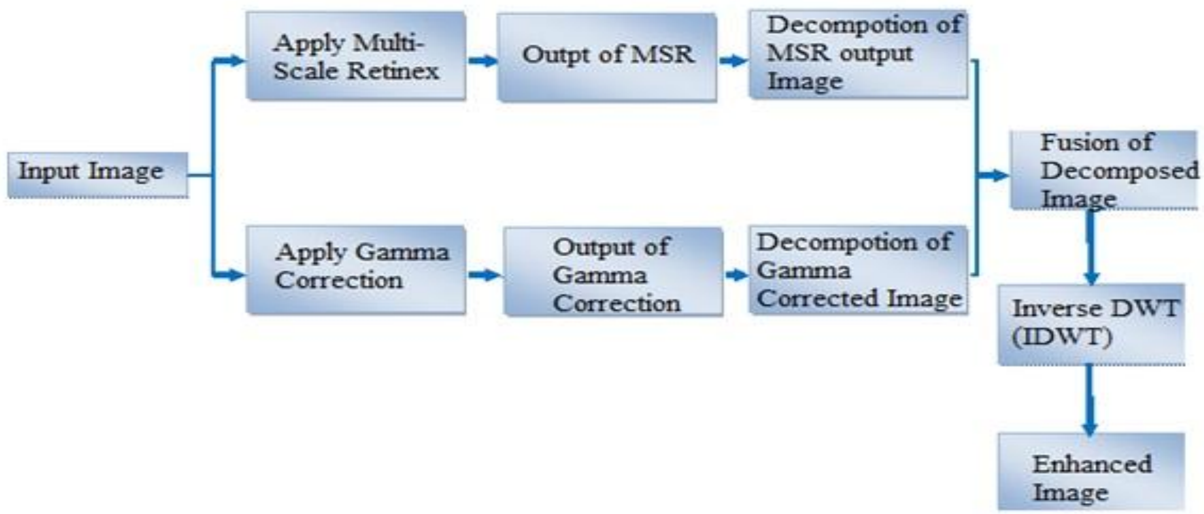


Figure 3: Block diagram of proposed method

Step that are involved in this method are as follows.

1) Perform the Multi-Scale Retinex operation and Gamma Correction on the original poor contrast image to get two different output images.

2) Perform the Discrete Wavelet Transform (DWT) decomposition on two output images of the previous operations. Input decomposition technique is used to decompose image into a set of band-limited components, named HH, HL, LH, and LL sub bands.

3) All these sub bands are fused using the fusion rules which were specified in previous section.

4) Finally, perform Inverse Discrete Wavelet Transform (IDWT) to achieve final enhanced output image.

Above points summarize the method which is proposed in this paper which can give good quality enhanced image.

V. QUALITY MATRICES

A).Peak Signal to Noise Ratio (PNSR)

The peak signal to noise ratio is given by

$$PSNR = 10 * \log_{10}\left(\frac{Peak^2}{MSE}\right) \tag{4}$$

B).Entropy

Entropy is considered as one of the vital image quality index to evaluate the information content in an image.

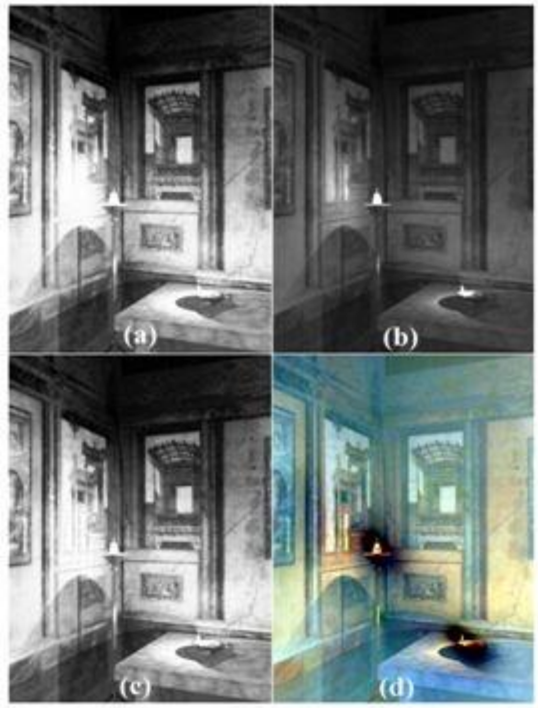
$$Entropy = -\sum_{i=0}^{N} p(x_i)\log_2\{p(x_i)\} \tag{5}$$

Where is the gray level value at pixel with corresponding probability 'p'. The entropy value is larger for images containing more the information.

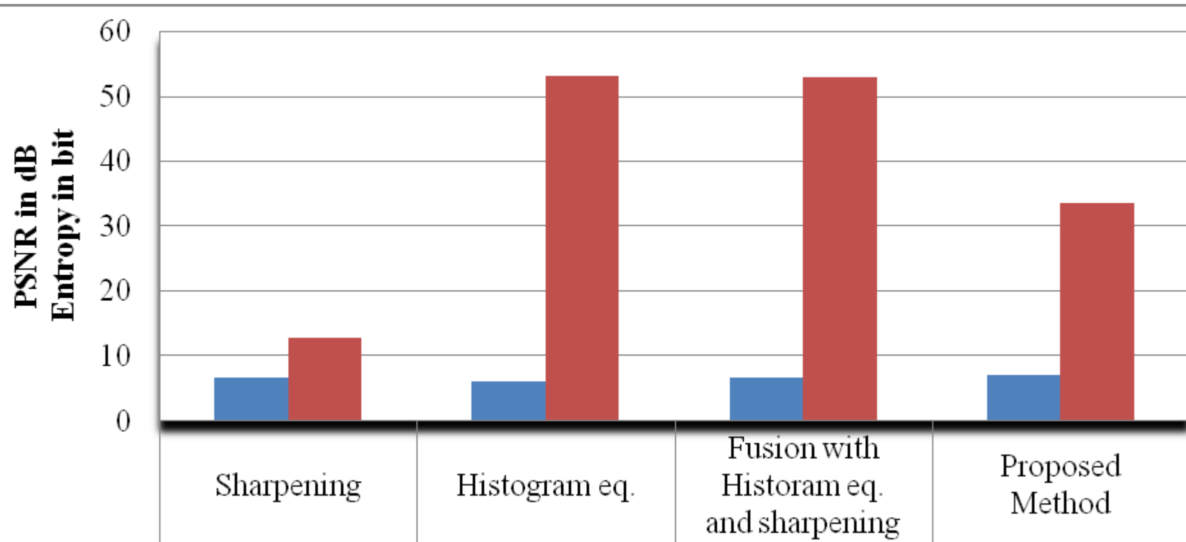
VI. ANALYSIS OF RESULT

This Section describes various results with different methods. Results show that our proposed method can efficiently improve the quality and information contained in Image.

Original Image



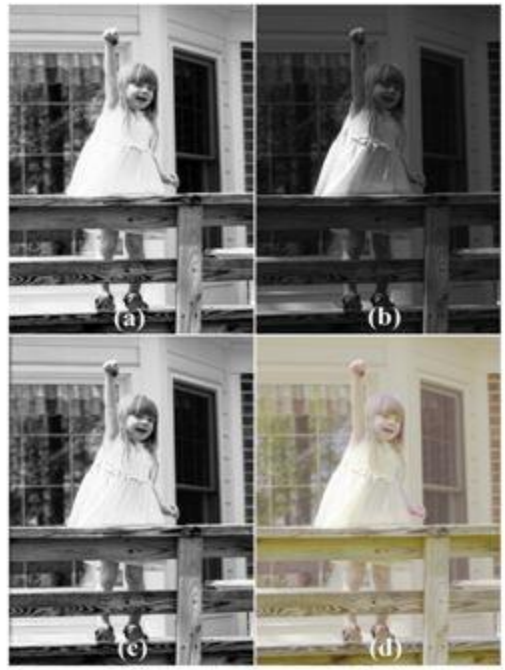
(a) Histogram eq. O/P (b) Sharpening O/P (c) Fusion of Histogram eq. and Sharpening (d) O/P of Pro. method



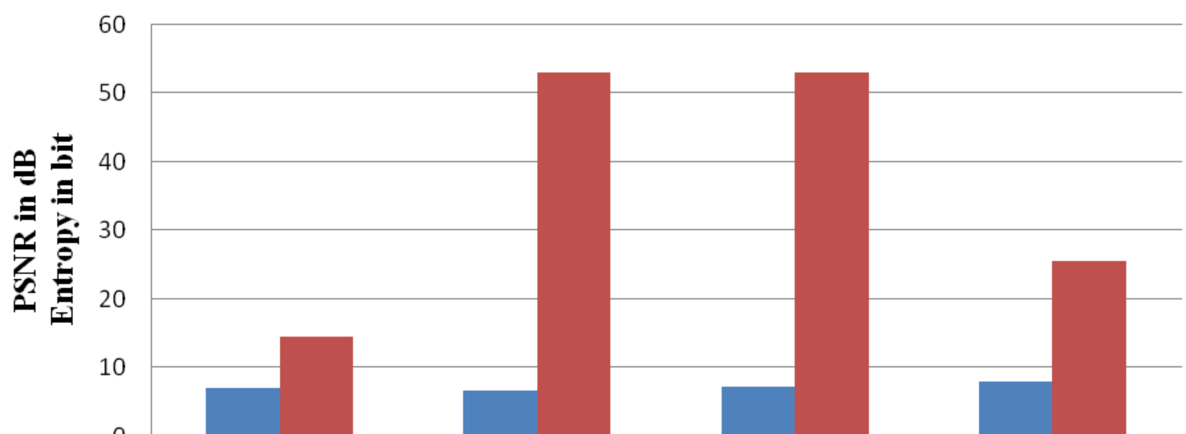
	Sharpening	Histogram eq.	Fusion with Historam eq. and sharpening	Proposed Method
Entropy	6.7979	6.1562	6.8039	7.1267
PSNR	12.8237	52.9997	52.9708	33.456

Figure 5: Analysis of different o/p images acquired by different methods

Original Image



(a) Histogram eq. O/P (b) Sharpening O/P (c) Fusion of Histogram eq. and Sharpening (d) O/P of Pro. method

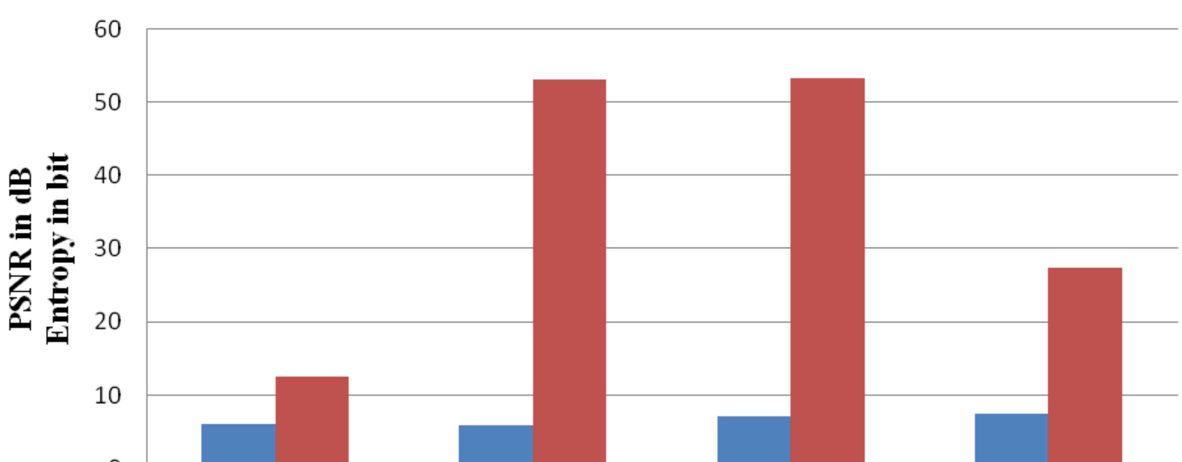


	Sharpening	Histogram eq.	Fusion with Historam eq. and sharpening	Proposed Method
Entropy	6.8564	6.5162	7.0231	7.9275
PSNR	14.3502	52.9898	52.9482	25.3412

Figure 7: Analysis of different o/p images acquired by different methods

Original Image

(a) Histogram eq. O/P (b) Sharpening O/P (c) Fusion of Histogram eq. and Sharpening (d) O/P of Pro. method



	Sharpening	Histogram eq.	Fusion with Historam eq. and sharpening	Proposed Method
Entropy	6.1833	5.8787	7.0677	7.5834
PSNR	12.6176	53.0165	53.2404	27.4512

Figure 9: Analysis of different o/p images acquired by different methods

VII. CONCLUSION

The work started with the review of several image fusion algorithms and their implementation. A novel Enhancement technique has been proposed here, which is based on two efficient tone mapping algorithms along with an efficient image fusion by means of discrete wavelet transform. The proposed fusion technique compensates all the shortcomings of MSR and Gamma correction by combining these two methods. Using only global tone mapping induces too much of a loss of contrast information either in the shadow areas or in the bright areas. This is due to the decrease in local contrast caused by the compression in dynamic range. Local tone mapping methods that increase the local contrast can be combined with a global tone mapping to avoid this loss of contrast and improve detail visibility. However, local tone mapping methods often introduce artifacts such as halos, graying-out of low contrast areas, or bad color rendition. We presented a local tone mapping method that overcomes these problems. Result show that our proposed method can efficiently enhance and improve the quality of remote sensing image, various smart phones captured images.
Future work includes enhancing and improving various medical images which can be used for further processing like segmentation.

VIII. ACKNOWLEDGMENT

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