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Image Enhancement using Guided Filter for under Exposed Images

Jasveer Singh[1] and Harpreet Kaur[2]
[1]Student, Department of Computer Science & Engineering, Bahra Group of Institution, INDIA
[2]Assistant Professor, Department of Computer Science & Engineering, Bahra Group of Institution, INDIA

[1]Corresponding author: shweta.angel90@gmail.com

ABSTRACT

Image enhancement becomes an important step to improve the quality of image and change in the appearance of the image in such a way that either a human or a machine can fetch certain information from the image after a change. Due to low contrast images it becomes very difficult to get any information out of it. In today's digital world of imaging image enhancement is a very useful in various applications ranging from electronics printing to recognition. For highly underexposed region, intensity bin are present in darken region that's by such images lacks in saturation and suffers from low intensity. Power law transformation provides solution to this problem. It enhances the brightness so as image at least becomes visible. To modify the intensity level histogram equalization can be used. In this we can apply cumulative density function and probabilistic density function so as to divide the image into sub images.

In proposed approach to provide betterment in results guided filter has been applied to images after equalization so that we can get better Entropy rate and Coefficient of correlation can be improved with previously available techniques. The guided filter is derived from local linear model. The guided filter computes the filtering output by considering the content of guidance image, which can be the image itself or other targeted image.

***Keywords*--** Image Histogram Equalization, GFSIHE, ESIHE

I. INTRODUCTION

Image enhancement becomes an important step to improve the quality of image and change in the appearance of the image in such a way that either a human or a machine can fetch certain information from the image after a change. Due to low contrast images it becomes very difficult to get any information out of it. In today's digital world of imaging image enhancement is a very useful in various applications ranging from electronics printing to recognition. There are various methods to available in the literature that help to enhance the quality of the image. There are many parameters that can be used to enhance the quality of the image. Below are the algorithms that enhance the quality of image

Exposure: It is defined as the measure of amount of grey levels. Exposure is the amount of light per unit area (the image plane luminance times the exposure time) reaching a photographic film or electronic image sensor, as determined by shutter speed, lens aperture and scene luminance.

Histogram Equalization is Mapping the intensity to enhance the images. it is a method in image processing of contrast adjustment using the image's histogram The image guided filter function performs edge-preserving smoothing on an image, using the content of a second image, called a guidance image, to influence the filtering. The guidance image can be the image itself, a different version of the image, or a completely different image. Edges are significant local changes of intensity in an image. Edges occur on the boundary between two different regions of an image. Edge detection is a fundamental tool in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction, which aim at identifying points in a digital image at which the image brightness changes sharply or more formally has discontinuities [24].

The steps of Edge detection are:

Smoothening: Without destroying the true edges it suppress as much noise as possible.

Enhancement: Filter is applied to enhance the quality of the edges in the image (sharpening)[5].

Detection: The edge pixels are determined, which should be discarded as noise and which should be retained (usually, threshold provides the criterion used for detection).

Localization: Determine the exact location of an edge (sub-pixel resolution might be required for some applications, that is, estimate the location of an edge to better than the spacing between pixels). Edge thinning and linking are usually required in this steps [1].

II. LITERATURE REVIEW

Nitish Vig et. Al[1], The author has proposed a GFSIHE (Guided filter Based Sub Image Histogram Equalization) which is used to improve contrast enhancement, brightness preservation, hue preservation, better entropy. The exposure function is used to estimate the underexposed and highly underexposed image. Histogram matching is used to improve the brightness of

the image .The existing technique Exposure Based Sub Image Histogram Equalization (ESIHE) is used to increase the visual quality which is followed by the Guided filter. This proposed approach had better contrast enhancement, Brightness Preservation, Hue preservation, better entropy.

K. Yoshinari et.al [5] said that accurate formulas for the color transformation between RGB and the proposed HSI color model which is named the improved HSI (I-HSI) color model. Furthermore, a simple enhancement method of color images based on the gamma transformation has been shown. In experiments, the validity of the I-HSI color model under the comparison with the conventional HSI color model has been compared.

K. Murahira et. al [2] has given a new enhancement scheme that enables one to apply a class of grey scale image enhancement methods to color images with free from gamut problem since color images are processed within RGB color space. The proposed processing framework guarantees the preserving hue while increasing saturation of enhancement results. The grey scale histogram equalization is applied to our generic framework in order to realize 3-D histogram equalization.

C.Y.Wonget.al [8] The author proposed a pipelined approach including color channel stretching, histogram averaging and re-mapping is developed. By using stretching, color information from a scene is restored. Averaging against a uniform distribution enables the output image to recover the information lost. Furthermore, histogram re-mapping reduces artifacts that often arise from the equalization procedure. The technique also employs a search process to find optimal algorithmic parameters, such that the mean brightness difference between the input and output images is minimized. The effectiveness of the proposed method was tested with a set of images captured in adverse environments and compared against available methods. High performing qualitative and quantitative results were obtained.

G.Jiang et. al[18] showed an approach proposed to specify a proper histogram profile such that image intensity values are adjusted accordingly and the output brightness is maintained close to the input image. Specifically, the equalization profile is shaped by finding a balancing control threshold through carrying out an integration of rectangular and triangular sections. Experiments are conducted using a large number of natural color images and compared to other available histogram based image enhancement methods. Results have shown that the proposed approach is able to accomplish a wide set of performance goals including information content, sharpness and color quality.

Independently and finally all sub images are integrated into one complete image for analysis. The simulation results show that ESIHE outperforms other conventional Histogram Equalization (HE) methods in terms of image visual quality, entropy preservation and better contrast enhancement.

III. PROBLEM FORMULATION

For highly underexposed region, intensity bin are present in darken region that's by such images lacks in saturation and suffers from low intensity. Power law transformation provides solution to this problem. It enhances the brightness so as image at least becomes visible. If we give an increase in the intensity then saturation will automatically increases. To modify the intensity level histogram equalization can be used. Further if the histogram equalization is applied to more specific areas it will provide better results. For that purpose histogram equalization can be applied to sub images. In this we can apply cumulative density function and probabilistic density function so as to divide the image into sub images. In proposed approach to provide betterment in results guided filter has been applied to images after equalization so that we can get better Entropy rate and Coefficient of correlation can be improved with previously available techniques.

In this work exposure has been used to divide the image between underexposed and overexposed images, which will be enhanced using MHE and Power law respectively. Proposed approach uses a histogram matching to improve the brightness of the images, while ESIHE works on enhancing the contrast. In this exposure based sub histogram correction technique has been combined with guided filter. The guided filter provides the edge smoothing and pleasing visual content.

The guided filter is derived from local linear model. The guided filter computes the filtering output by considering the content of guidance image, which can be the image itself or other targeted image. The padding array is implemented to produces edges and then window size is varied to observe change in images. It improving the brightness of images and improvement in Entropy and Correlation Coefficient and maintaining hue error so that we can meet the hue preserving condition and it improves edge smoothing and pleasing visual content and better contrast enhancement .

IV. RESEARCH METHODOLOGY

Guided filter based sub image histogram equalization helps in smoothening of edges enhances the color contrast and visual quality of images. Framework of methodology to be implemented is as follows:

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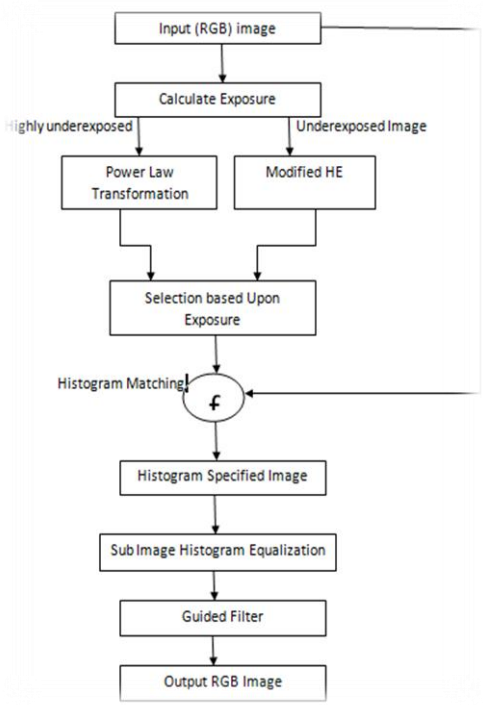

The following parameters are used to show the better contrast enhancement, Brightness preservation while at the same time preserving the Hue. The Parameters are: Entropy, Correlation coefficient and Hue error.

The Proposed approach has been tested on 4 images and perform a GFSIHE (Guided Filter Based Sub Image Histogram Equalization) approach and got the better contrast enhancement, brightness preservation, and maintaining the hue error. The Proposed approach is compare with the original image and existing techniques like ESIHE (Exposure Based Sub Image Histogram Equalization) and obtained a better result with the existing techniques.

Figure: Original Image

In fig it is original image. It shows the image is under the exposed category.

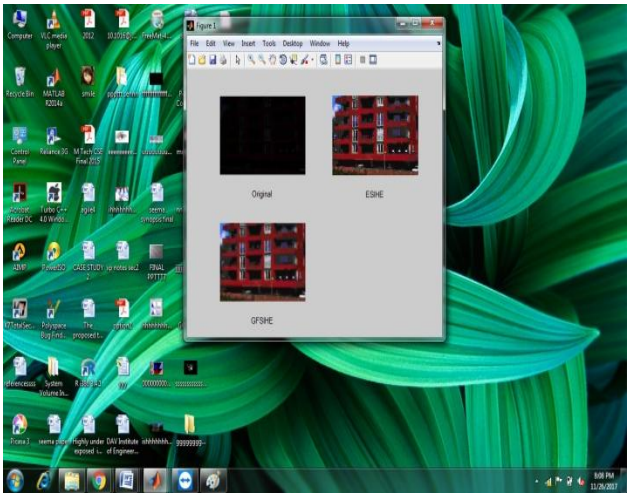

Figure: Comparison the existing approach with new approach

V. ENTROPY AND CORRELATION COEFFICIENTFOR DIFFERENT METHODS

Table 5.1: Guided filter Window size for Building image in GFSIHE Technique

Parameters	WindowSize-3	Window size-5	WindowSize-10	WindowSize-15
Entropy	7.0099	7.0097	6.9891	6.9622
(CC)	0.6695	0.6240	0.6265	0.6285
Hue Error	0.0999	0.0885	0.0888	0.0892

In Table 5.1 the proposed approach has been tested on Fig 5.1 and got different values of Entropy, Correlation Coefficient ,Hue Error. In proposed work a different window Size 3 ,5 10, 15 and Size-3 is considered to compare results among existing techniques Because As size increase there is slight decrease in these parameters and the image become blurrier.

Entropy and Correlation Coefficient For Proposed Approach

Image 2	**Values**
Entropy	6.9891
Correlation coefficient	0.6265
Hue Error	0.0888

VI. CONCLUSION AND FUTURE SCOPE

In this approach we had introduced a new Hue-preserving method based on histogram equalization. Proposed approach is better in both terms of space complexity as well as time complexity. From the result section it could be clearly seen that proposed approach gives better contrast enhancement, preserve the brightness of the image and also maintains the error.

It has been compared in terms of Entropy, correlation coefficient and Hue error. In proposed work different window sizes has been used. Result section reveals that least the window size better will be the results.

In future this approach could be enhanced to have better contrast and can be worked with edge preservation also. It could enhance the quality of image. The proposed approach can be combined with 2-d filters that could give less Mean square error and can provide large Peak signal to noise ration

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