Performance analysis of Local window Histogram equalization using Gaussian filter in image enhancement

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Abstract - Image enhancement is a technique by which a given image can be made better in quality than the original image. Image enhancement can be done by various methods and most popular of them is Histogram Equalization. Histogram Equalization is widely used in various image enhancement methods but it has some drawbacks like it sometimes over enhances the image and make it look unnatural. Here we are using a method known as "local window histogram equalization with Gaussian filter" which allows us to adjust the contrast of the image by specifying the size of the window and on the other hand using Gaussian filter to remove the noise from the image.

Key Words: *image processing, image enhancement, Gaussian filter, histogram equalization, local window HE, contrast enhancement*

1. INTRODUCTION

Image processing is a technique to enhance the images that are captured through cameras, sensors that are placed on satellites, day to day taken pictures etc. The purpose of image processing is to produce an improved version of the input image by performing various operations on it. Images are widely used in various applications like medical field, remote sensing, transmission and encoding, pattern recognition, video processing etc. In these areas image processing plays an important role.

So in these applications the quality of image is important. Various variations of the Histogram Equalization have been proposed till date but every method has some or the other drawbacks like Adaptive Histogram Equalization over amplifies the noise and its variation Contrast-limited Adaptive Histogram Equalization performs over-enhancement which steals the naturalness of the image and Brightness preserving dynamic Fuzzy histogram Equalization fail to extract the detail information if the image and some other techniques also does not give better results. Some over amplifies the noise whereas some does not do proper contrasting. Contrast is a very important factor for the subjective quality of the image and to improve the contrast as well as to improve the quality of the image in digital image processing a method image enhancement is used. Image enhancement is performed by various methods in which Histogram Equalization is most popular and widely used.

2. Related work

As discussed in the previous sections Histogram Equalization is the common method to enhance the image. Histogram Equalization can be performed in two ways Local Histogram Equalization (LHE) and Global Histogram Equalization (GHE) [2].

In the Global Histogram Equalization the histogram function enhances the contrast of the whole image and gives the image an unnatural view and the high frequency components are stretched and low frequency components are compressed.

This makes the view of the image sometimes unnatural. This HE cannot enhance the image locally so to overcome this problem Local Histogram Equalization was proposed. Local Histogram Equalization enhances the image locally so that the image is contrasted in a proportionate way. Further generalizations of these techniques have been proposed that we will discuss here.

Adaptive histogram equalization (AHE) is an image processing technique used to improve contrast in images. Adaptive histogram equalization works by taking small regions and based on their local cumulative density function performs contrast enhancement of those small regions.

Quadrant Dynamic Histogram Equalization (QDHE) is a contrast enhancement method in image processing using traditional Histogram Equalization (HE) but it performs image contrast enhancement using mean filtering technique [5].

In Exposure based Sub image Histogram Equalization (ESIHE) the images are partitioned into sub-images.

If the AHE contains small intensity values then the noise can get enhanced in those regions so to prevent such situations Contrast limited Adaptive Histogram Equalization (CLAHE) is used.

2.1 Which technique is best?

We have discussed so many techniques related to image enhancement but every method has some advantages as well as some disadvantages. Here we are proposing a method that enhances the image in such a way that it proportionally enhances the image and removes the noise as well. We have combined local window histogram equalization as well as Gaussian filter to enhance the image.

Figure 1. Various Histogram Equalizations

Various histogram equalizations are shown in the figure. These are used to enhance the image. Here in the images we can observe that HE produces an enhanced image as it produced in the which gives a natural look to the image in this image as comparing with the original image whereas AHE is increasing the brightness as well as making the image contrasted at one point and less contrasted at other points of the image, CLAHE is not enhancing the the image in an appropriate way and other algorithms like BPDFHE are giving better results but clarity is being compromised in these images ESIHE is increasing brightness in the image.

LWHE-G is providing a balanced image but it is not showing much better as compared to the previous images but it is contrasting with balance at various points and giving the image a natural look as well as it is making the image look clearer.

3. Proposed method

Image enhancement is a technique by which a given image can be made better in quality than the original image. To enhance the given image we use various image enhancement methods like enhancement by point processing, spatial filtering, pseudo color image processing etc.

Our objective is to increase the contrast in the image and reduce the amount of noise in the image and improve the quality of the image more than that was being done by previous traditional methods and to enhance the image using

local information and to show that image is enhanced with greater detail and lower noise compared to the several existing methods that were previously used.

So here we are using local window histogram equalization (LWHE) method for image enhancement using Gaussian model. LWHE is a method that is based on histogram equalization method that is used to enhance the image. Here we have used a parametric model, Gaussian filter that enhances the image with lower noise and better quality as compared to various existing methods. Here we are using a technique local window histogram equalization that is based on traditional histogram equalization with varying window size and a parametric model, noise is an unwanted element that destroys the quality of an image so we use Gaussian filter that improves the quality of image by removing noise to a great extent.

The image is given as input to the LWHE algorithm and we can see the difference in its histogram. Simple image contains various peaks in its histogram whereas the image that was enhanced using LWHE contains uniform distribution.
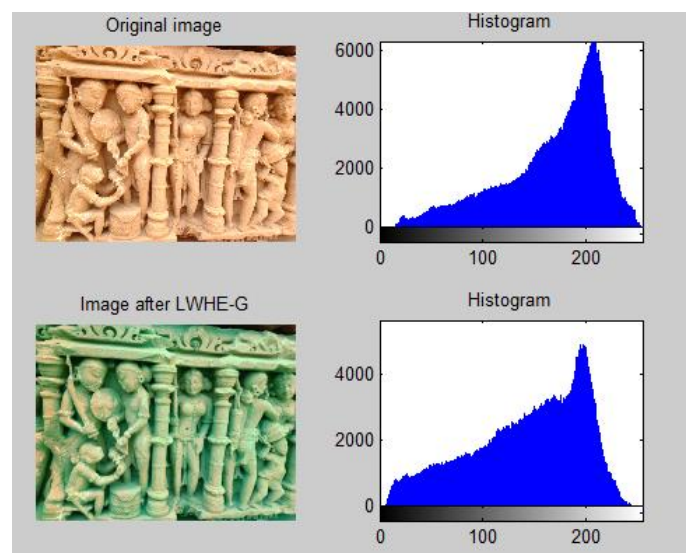

Figure-2 Image and LWHE-G

Here in the local window histogram equalization using Gaussian filter we can see that noise is reduced as the peaks are not shown much in the second histogram whereas the peaks are so much shown in the origina image as well the image has become much clearer.

4. Conclusion

When the simulation results were performed using various evaluation parameters it was found that the noise is reduced to a great extent and the entropy is increased of the image. So we can say that LWHE-G is a comparatively better method that was used before.

Technique	Entropy	Psnr	GradMag
HE	6.94	13.86	11.9
AHE	7.74	16.43	10.0
LWHE-G	**7.67**	**19.2**	**5.60**
ESIHE	7.67	32.29	6.92
BPDFHE	7.57	46.33	6.68
CLAHE	7.58	15.03	10.3
QDHE	7.71	29.64	7.28

Table-1 comparative analysis of various methods

Here in the table-1 we can see that entropy of LWHE-G is better than various other methods and psnr is also comparatively good and Gradient Magnitude is less.

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