Automatic Contrast Enhancement and Equalization of Gray Images using Gaussian Mixture Modeling

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Abstract:-In this proposed work image equalization method is shown which enlarges the contrast in an inserted picture. The method utilized the Gaussian mixture model to model (GMM) the image gray-level dissemination and the crossing point of the Gaussian elements in the model are utilized to separate the range of the image into inserted gray-level intermissions. The contrast same picture is created by converting the pixels' gray levels in every inserted intermission in the suitable output gray-level intermission depending upon the ruling Gaussian element of the inserted intermission. With respect of the experiment that the same kind of areas in the picture displays the same kind of silences in the image histogram, the Gaussian elements with little variations are weighted with little values as compared to the Gaussian elements with high variations, and the gray-level dissemination is also utilized to weight the elements of the inserted intermissions to the resultant intermission. The final results display the proposed method generates better image than the enlarged image. On the other hand the given method is free of the variable changes for a proposed range of the enlarged picture and can be allocated to a various range of images.

Keywords:-Contrast enhancement, Image equalization, Gaussian mixture modeling.

I. INTRODUCTION

In this paper, we propose an image enhancement method which is utilized to find out invisible picture information's or to enlarge the contrast of the picture with a low range [1]. Such a method creates a final image that comparatively looks better as compared to the real picture by enlarging the gray-level diffusion (i.e., the contrast) among targets and settings. There are a number of enhancement methods that have been presented and these can be distinguished into three groups:

1) Capabilities to dissolve an image into high frequency and low-frequency signals for utilization [2], [3].

2) Transform-based techniques [4].

3) Histogram modification techniques [5]-[8].

In this report, the proposed work is about the image equalization method that is productive in terms of upgrading the display status of distinct ways of input images. The aforesaid techniques may cause complications when increasing a sequence of images, or when a natural-looking improved image is needed. Images with low contrast, are automatically upgraded in terms of an enlarge image in the range. Images with enough high contrast are also improved, but comparatively low.

The algorithm further enhances the color quality of the input images in terms of color stability, higher contrast between foreground and background objects, larger range and more information's in image specifications. The suggested algorithm is free from variable setting. In place of that, the pixel values of an inserted picture are modeled utilizing the (GMM).

II. PREVIOUS WORK

Image enlargement is needed, usually for good modification or rendering of the image to support our visual recognition. There are various causes, why a fresh image data needs to be organized before showing. The scope of the actual image may be very huge to be adjusted by the fewest number of bit-planes of a present implement.

The issue gets more complex when the radiance of the site widely changes in the area occupied on the enlargement of gray-level images in the spatial domain. It can like this be also, the scope of the strength values may be less because of the existence of strong framework radiance, furthermore because of the inadequate lighting.

III. IMAGE CONTRAST

Contrast is the dissimilarities in radiance or color that produces a material (or it denotes in an inserted image or display) differentiable. In display, interpretation of the actual sphere, contrast is calculated by the dissimilarities in the color and radiance of the material and some of the other materials in the identity space of user observation. The human display system is largely sensitive to contrast as compared to the actual radiance; we can recognize the world in the same manner in spite of the vast conversions in radiation over the day or from location to location. The peak of a contrast of an inserted image is the contrast ratio or its range [4].

Fig.3.1 Changes in the quantity of contrast

IV. IMAGE ENHANCEMENT

Image enhancement operation composed of a group of capabilities that pursue to enhance the display aspect of an inserted image or to change the image to produce the best suited for examination by a human observer or a device. The main motive of image enhancement methods is to generate an image so that the output is more appropriate as compared to the original inserted image for a specific application. More often it is utilized to improve the contrast in images that is significantly dark or light. Image enhancement requires operations that enhance the aspect to a human observer, or techniques to change an image to an arrangement that is best appropriate for device operations.

This method refers to those image methods that enhance the standard of inserting image so that it control the defects of the user display structure. Image enhancement methods can be denoted into three categories:

- Spatial domain methods.
- Frequency domain methods (DFT).
- Fuzzy domain.

V. GAUSSIAN MIXTURE MODELING

In image contrast method the equal contrast picture is caused by converting the pixels' gray level in every inserted intermission with the suitable result gray-level intermission as stated into the ruling Gaussian element of the inserted intermission. An image enlargement algorithm using GMM by itself enlarges the contrast in an inserted image.

It utilizes the GMM to model the picture gray-level dissemination and the crossing point of its elements in the model is utilized to separate the range of the image to its inserted gray-level intermissions. With respect to the similar areas in the images shows a similar piece of the image histogram, the Gaussian elements with few differences are holed with little values as compared to the Gaussian elements with huge differences are utilized to hold the elements of the inserted intermission to the produced intermission.

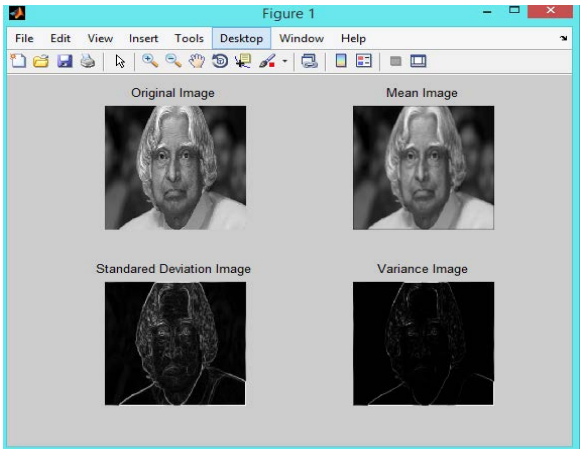

Fig.5.1 Original, mean, standard deviation, variance of image

VI. IMPLEMENTATION OF PROJECT

In this paper, we propose an image enhancement method is used to find out invisible picture information's or to enlarge the contrast of the picture with a low range. Such a method produces a final picture that comparatively looks good than the original picture by enlarging the gray-level diffusions (i.e., the contrast) among targets and settings.

Here, we have taken gray images of image size 256×256 in which we have enhanced it by using Gaussian mixture modeling .Proposed method is compared with two methods, namely Histogram equalization (HE) [5]-[8], Contrast stretching [4]. The proposed work incorporated with the global and local information about each image. The local information includes the mean, standard deviation and variance where the local information includes the window size of 3*3. The global information is used to smoothen the image which is nothing but to eliminate the noise. The flow of whole algorithm stated below:

Mean:

μ(i,j) is the local mean of the (i,j)th pixels of the input image over a n*n window , expression for local mean is denoted as:

$$\mu(i,j) = \frac{1}{nxn}\sum_{x=0}^{n-1}\sum_{y=0}^{n-1} f(x,y)$$

Standard deviation:

$\sigma(i,j)$is the standard deviation of (i,j)th pixel of the input image over a n*n window, in our proposed work we take 3*3 window size; which is defined as:

$$\sigma(i,j) = \sqrt{\frac{1}{n \times n}\sum_{x=o}^{n}\sum_{y=0}^{n}(f(x,y) - \mu(i,j))^2}$$

Gaussian mixture modeling:

GMM (i,j) is the Gaussian mixture model of (i,j)th pixel of the input image over a n*n window, in our proposed work , GMM is defined as:

$$GMM(i,j) = \frac{1}{\sigma(i,j)\sqrt{2x}} e^{-\frac{\{img(i,j) - \mu(i,j)\}\text{^}2}{\sigma(i,j)\text{^}2}}$$

Where, $\mu(i,j), \sigma(i,j)$ is mentioned above.

Enhancement method:

In this paper we have been using the image of (i,j)th pixel of the input image over a n*n window, in our proposed work, Enhanced image is defined as:

Enhanced image=image(i.j)+S*smooth image(i,j)+GMM(i,j)

Where, S→scaling factor [0, 1], GMM is mentioned above.

VII. EXPERIMENTAL RESULTS

In this proposed work the original image are enhanced by using Gaussian mixture modeling. Later, on this GMM based enhanced image is compared with the other two enhancement techniques, namely, Histogram equalization (HE) and Contrast stretching.The proposed work incorporated with the global and local information about each image. The local information includes the mean, standard deviation and variance where the local information includes the window size of 3*3. The global information is used to smoothen the image which is nothing but to eliminate the noise.

Firstly, mean (μ), standard deviation (σ) and variance ($\sigma 2$) has been calculated by the formula mentioned above. Then, the obtained values are put in GMM algorithm to find out the GMM of the image having the window size of 3*3. This obtained GMM is then used to find out the enhanced image in the motioned formula:

img_new (i,j) = img(i,j) + 0.3 * im_smooth(i,j) + Gaussian_mixture(i,j)

Where 0.3is the scaling factor lies between 0 and 1.

If we apply the value in above formula we will get an enhanced image. The coding will go through the following steps to enhance the image as well as to find out its histogram:

-->> Image Read

-->> Image Normalization

-->> Size Normalization

-->> Smooth Image Generated

-->> Mean Image Generated

-->> Standard Deviation Image Generated

-->> Variance Image Generated

-->> Gaussian Mixture Image Generated

-->> Enhancement Image Generated

-->> Image is going to plot

Fig.7.1 Contrast enhancement results for the image Cameraman: (a)original image; (b) GMM based image; (c) HE; (d) Contrast stretching.

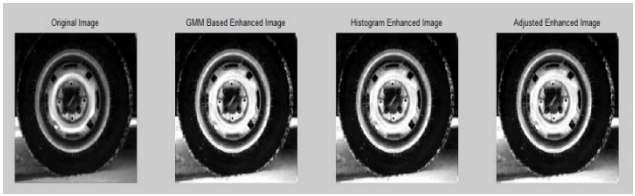

Fig.7.2 Contrast enhancement results for the image tire: (a) original image; (b) GMM based image; (c) HE; (d) Contrast stretching.

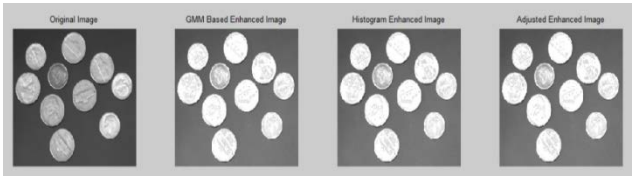

Fig.7.3 Contrast enhancement results for the image Coins: (a) original image; (b) GMM based image; (c) HE; (d) Contrast stretching.

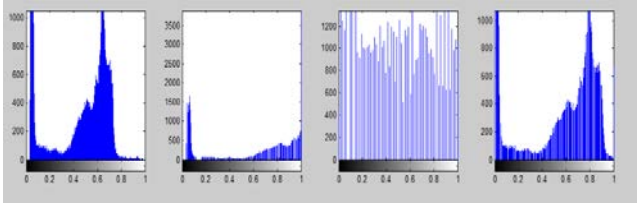

Fig.7.4 Histograms of original and enhanced image Cameraman: (a) original image; (b) GM based image; (c) HE; (d) Contrast stretching.

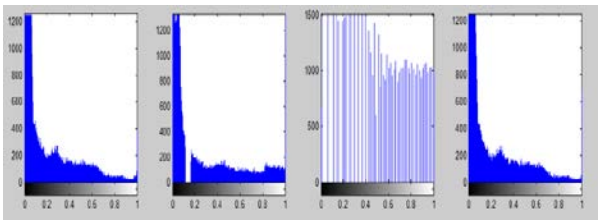

Fig.7.5 Histograms of original and enhanced image tire: (a) original image; (b) GM based image; (c) HE; (d) Contrast stretching.

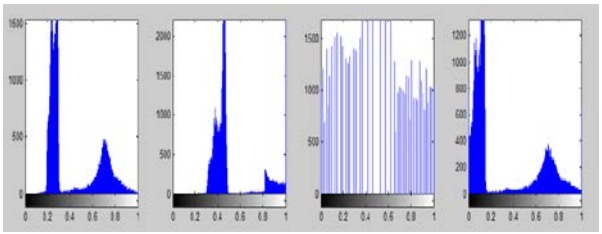

Fig.7.6 Histograms of original and enhanced image Coins: (a) original image; (b) GM based image; (c) HE; (d) Contrast stretching.

VIII.CONCLUSION AND FUTURE SCOPE

In this paper, we have proposed an automatic image enhancement method that uses Gaussian mixture modeling of an inserted image to produce an enhanced image and the histogram of the enhanced image. The proposed method can attain image equalization that is better even under various radiance situations. It does not divert the complete material of an inserted image with respect to the high contrast. Later on it upgrades the brightness and contrast of an input image by its own. The comparison of GMM based enhanced image with the HE image and the contrast stretching image shows that the result of the GMM based enhanced images are better in terms of brightness preservation and contrast improvement under the 99% confidence level.

The current work is focused only on getting better enhancement by using the GMM method as compared to the other two techniques. Thus, as a future work this can be extended by finding out the values of mean, standard deviation and variance by putting different values in formula, after this we will calculate GMM and enhanced image. These results are compared with other more methods for comparing the enhanced quality.

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