Image Enhancement

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***Abstract*— There are several different processes for improving images in the realm of image enhancement. One of the most effective methods of image enhancement is known as histogram equalization. Most of the time, histogram equalization does not result in an improvement in the image's overall quality. In addition, we discovered that certain images were improved while others were deteriorated. The entropy of an image can be used to calculate how close two images are to one another. Even when histogram equalization is completed, there will be some background noise where the quality of image will be lost most of the times. We also performed Guassian specified histogram equalization on the images. Histogram matching is the process of matching a histogram with a specific histogram.**

I. Introduction

An image is a collection of pixels that holds data. A high-quality image implies conveying information in a way that is accurate, and this starts with the image's capture and concludes with its storage. Images can occasionally be captured in bright or dark areas, involving significant image improvement. Image enhancement involves improving the data for visualization and to advance image processing methods, particularly for low contrast images enhancing the image's overall quality and removing noise with filters. One of the most well-known and effective techniques is histogram equalization.

Histogram Equalization is an image processing method used to improve the histogram-based composition of an image. To put it another way, it's utilized to widen the histogram, which implies that the intensity of pixel differences gets stronger and results in larger pixels, which increase the amount of information that can be used to view an image. An image's pixel values are represented graphically by a histogram. There is just one histogram for a grayscale image, while there are three 2-D histograms for an RGB colored image, one for each color. Pixel intensity is shown on the X-axis. The frequency or quantity of pixels with a certain intensity value is shown on the histogram's Y-axis. Histogram is what we use. If a picture has low intensity values or insufficient values, equalization is utilized.

In this work, we have discussed about histogram equalization on images where we found that some images got enhanced and some got degraded with the histogram plots. The later section explained how to improve the degraded images. Further discussed Gaussian specified histogram equalization on the image. To match the histogram with a specified histogram Histogram matching is used.

II. Histogram Equalization:-

A. Demonstrating histogram equalization

Histogram Equalization[1] is a technique used in image processing to improve the contrast of an image by making use of the histogram. In other words, it is used to expand the histogram, which causes the mean intensity of pixel differences to become greater. As a result, pixels get larger, which allows for larger amounts of information that are stronger to be seen in an image. Histogram Equalization is typically applied to low-contrast images.

Fig 1:- Image before performing Histogram Equalization.

In order to perform histogram equalization, a image is taken which is a beautiful image looks like broken one. As the image is blur and has low contrast, computer vision techniques cannot extract much information from it. However, by using histogram equalization, we can mitigate this issue.

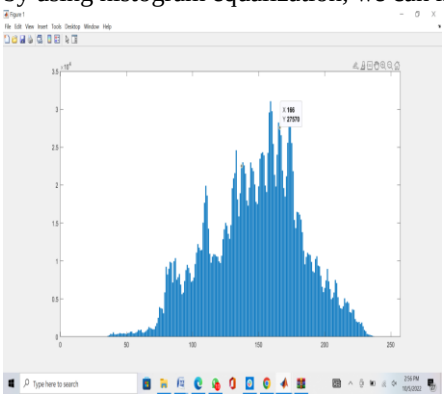

Fig 2:- The resulting histogram image formed from Fig 1.

We can observe that the distribution of pixels ranges from 100 to 150. After performing histogram equalization it spreads out

from 0 to 256.

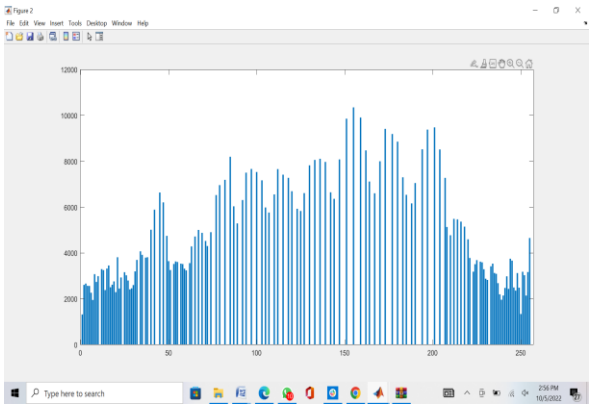

Fig 3:- Histogram image after performing histogram equalization on Fig 1

We can find the enhanced contrast values by comparing the original and enhanced images as the pixels were expanded.

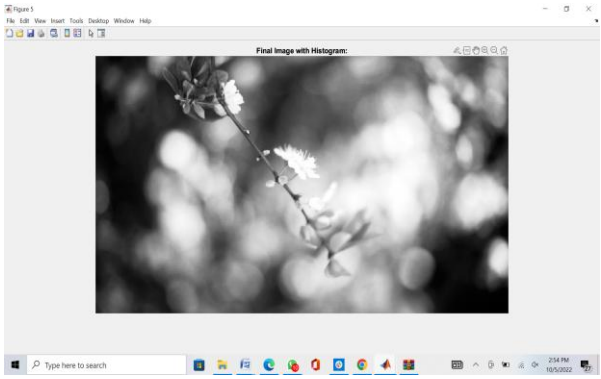

Fig 4:- Final enhanced Image after histogram equalization

The probability density function (PDF) and cumulative density function (CDF) are obtained from the input image histogram. We use the two functions PDF and CDF to replace the gray levels in the input image with the new gray levels, and then we generate the processed image and histogram for the resultant image. When we compare the input image histogram to the processed image histogram, we discover that the gray level intensities are systematically stretched and depressed. As a result, the histogram of the output image is systematically distributed. However, this results in image enhancement above the actual gray scale span. During the histogram equalization approach, the processed image's mean brightness is always the middle gray level, regardless of the input mean.

B. Histogram Equalization Degraded image

Fig 5:- Image before performing Histogram Equalization

When the image intensity values are brightened in one location, Histogram Equalization may not perform well.So taken a photo with low contrast.

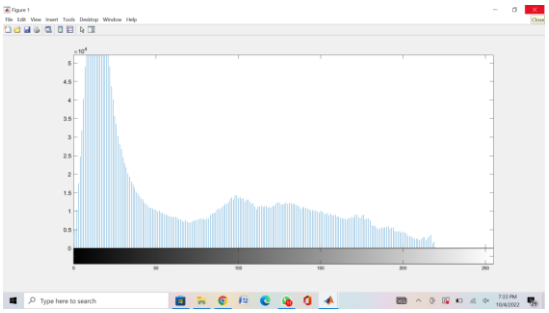

Fig 6:- The resulting histogram image formed from Fig 5

When we find a histogram on this image, the pixel values range from 0 to 256.

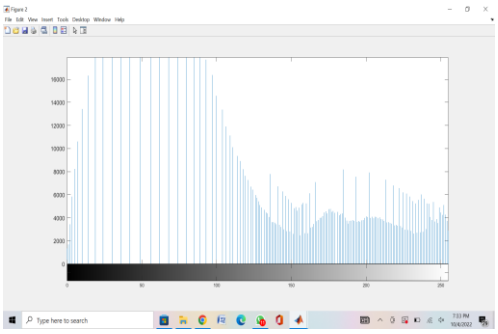

Fig 7:- Histogram image after performing histogram equalization on Fig 5

The histogram's intensity levels appear to spread out more after histogram equalization, but the image did not improve after histogram equalization.

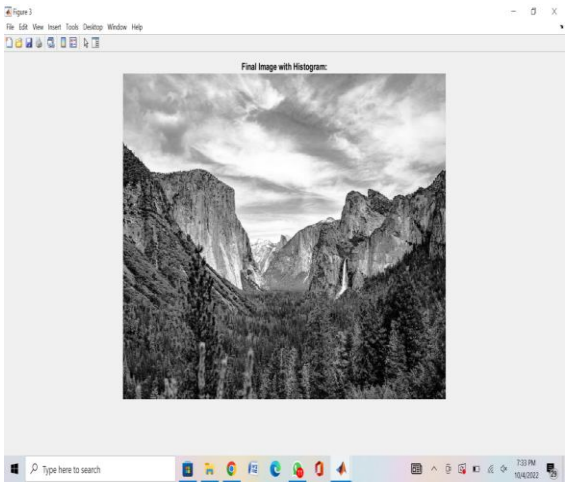

Fig 8:- Image before performing Histogram Equalization

This procedure is inconvenient to implement in consumer electronics such as television because it introduces irrelevant visual deterioration such as the concentration effect. The specific solution to this problem is to keep the mean brightness of the input image indoors the output image.

A. *To measure closeness of image*

Entropy, in general, measures how unpredictable a random variable is[1]. Entropy is a distribution of the probability isotropy function.

Entropy maximization and histogram maximization both aim to maximize information. Since ME seeks to achieve uniform standard distribution, maintaining identical frequency values in the same bucket effectively maximizes the entropy (ME) of the column of frequencies. The probability of each value is determined by dividing its frequency by the total number of attribute values, and the entropy of the probability distribution of the values inside that bucket.

III. METHODS TO IMPROVE THE DEGRADED IMAGE:-

By determining the gray value of each pixel based on the correlation between pixels/image patches in the original image, spatial domain approaches seek to eliminate noise. Spatial domain filtering and variational denoising techniques fall into the two broad groups of spatial domain procedures.

A. *Image Enhancement*

Please One of the simplest and most appealing aspects of digital image processing is image enhancement. The basic idea behind enhancement techniques is to either emphasize specific features of interest in an image or reveal obscured detail. when we boost an image's contrast and apply a filter to eliminate noise, "it appears better." It's crucial to remember that the field of image processing known as enhancement is quite subjective. By applying enhancement techniques, the quality of these deteriorated photos can be improved.

B. *Adaptive Histogram Equalization method[2-4]*

This is a development of the conventional Histogram Equalization method. By changing the values in intensity image , it improves the contrast of the photographs. It works with small data sections (tiles), not the complete image, unlike HISTEQ. The contrast of each tile is raised so that the output region's histogram closely resembles the desired histogram. Then, in order to remove artificially produced boundaries, the adjoining tiles are joined using bilinear interpolation. Limiting the contrast can prevent the image's potential noise from being amplified, especially in homogeneous areas.

C. *Dualistic sub-image histogram equalization method*

Using The original image is divided into two equal area sub-images based on the histogram's gray level probability density function in this innovative histogram equalization technique. The two sub-images are then each equalized. After the processed sub-images are combined into a single image, we finally receive the outcome. In reality, the method may effectively improve the visual information in the image while simultaneously preventing a significant shift in the average luminance of the original image. Because of this, one can immediately use a video system.

D. *Dynamic histogram equalization for image contrast enhancement:*

If you do not have a The input histogram is divided into several sub-histograms using a partitioning procedure so that none of them contain a dominant component. After passing through HE, each sub-histogram is then permitted to fill a specific gray level range in the improved output image. DHE achieves a superior overall contrast enhancement by controlling the dynamic range of gray levels and removing the risk of compressing the low histogram components, which could give some parts of the image a washed-out appearance.
if possible.

IV. GAUSSIAN SPECIFIED HISTOGRAM EQUALIZATION:-

The contrast can be raised during image processing using the Histogram Equalization approach[6-8]. The where gray scaled facial images still have a low contrast level. The Histogram Equalization method of grayscale image processing helps boost the contrast in the image. But after Histogram Equalization processing, the image still has noise.

Image filtering using Gaussian Filtering was used to reduce the noise present in the image. The combination of Gaussian filtering and histogram equalization can enhance the quality of the image.

Matlab software was used for the digital image processing, and a technique based on an image matrix was utilized to examine differences between the original and filtered images. The picture used in this work was a kind of digital image data as it has a relatively small size for a data type and can provide a lot of information. Initially work started by provide image input. That image was converted from color format (RGB) to grayscale.

Histogram Equalization was used to make the transformation to the image. To perform this equalization, we first calculated the histogram of the transformed image. Now the images that had completed the histogram equalization started to enter the Gaussian noise filtering process. The main aim of this procedure is to reduce the noise contained in the image. The results of the images resulted in this process were resized.

The field of digital image processing was profoundly impacted by the noise-reduction technique. If we want our data to be reliable and reflective of reality, we must first eliminate distracting background noise, so that the next step can make use of the best possible image processing results.

Fig 9:- Image before performing Guassian specified Histogram Equalization

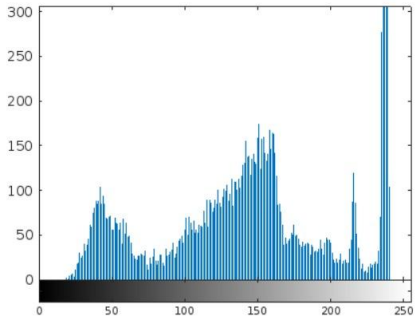

Fig 10:- This is the low contrast image graph which represents the histogram values are evenly spread of fig 9

Fig 11:- Image after performing guassian specified histogram equalization of fig 9

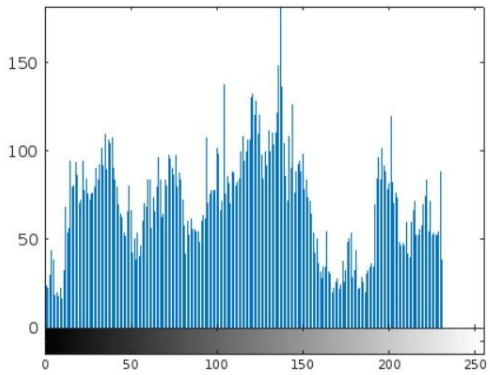

Fig 12:- This is the high contrast image graph of fig 9 which represents the histogram values are distributed on entire graph and this graph is called as flat profile.

V. HISTOGRAM MATCHING:-

Histogram equalization uses a transformation function to create an output image with a uniform histogram. If we use automated enhancement, we get good outcomes, predictable outcomes, and a straightforward method. It is not a wise course of action to execute base augmentation on a uniform histogram. To get a processed image, we may need to specify the histogram shape. Histogram matching is the process of creating a processed image with a specific histogram. Most of the time, histogram equalization does not increase the quality of an image. Most often, the cumulative distribution function is used for equivalence.

When we wish to make photographs with better contrast, histogram processing is helpful. Here, we change the image's histogram to a normal distribution.
In this work we have taken 2 distinct photos that we have taken to perform histogram matching.

Fig 13:- Input image

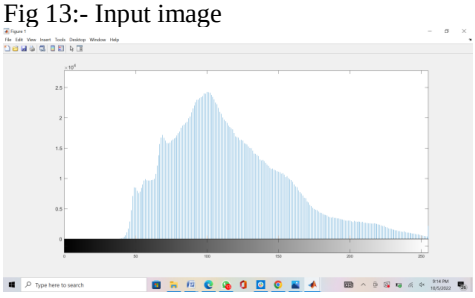

Fig 14:- Histogram of input image

Fig 15:- Target image

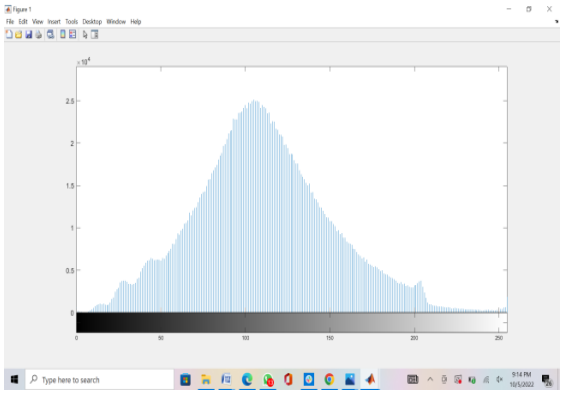

Fig 7:- Histogram of Target image

So in order to match this both images we first make equalization of images .And then we need to map the pixel of each image. So here we consider the first image has input image and the second one has target image. We have to calculate histogram of two images and then equalization.

Fig 16:- Image after performing Histogram Matching

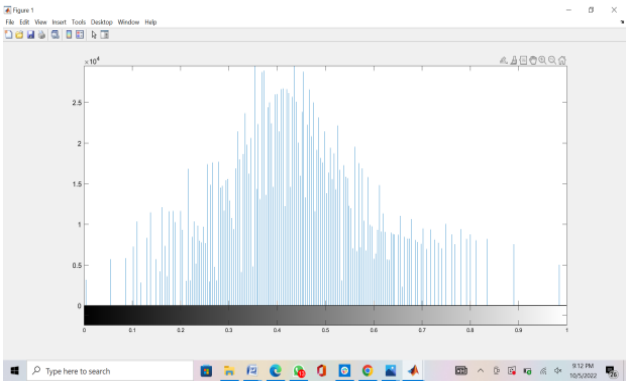

Fig 17:- Histogram of matched Image

In the fig(a) the image shown is with red color and want to modify the second image has the better one so converting the first image to contrast of first image. Hence the image has been improved.

VI. Conclusion

In this case, we have collected some image and calculated image histogram and equalization is performed on the generated histogram, equalization is performed on the generated histogram. In most cases, after histogram equalization has been performed, there remains some noise; hence, guassian is performed to remove the noise. In order to adjust the image so that the contrast in the image can be improved, we will be perdominantly matching the histogram.

References

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