

<b>LP-VI Image Processing (2023-24)</b> <b>Experiment 2:</b> Read any image. Display the histogram, Equalized histogram, and image with equalized histogram.	
<b>Student Name:</b>	<b>Roll No. :</b>
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**Title:** Display the histogram, Equalized histogram, and image with equalized histogram.

**Aim:** Implementation of Histogram Equalization on an image.

**Prerequisites:** Histogram, Histogram Equalization.

**Theory:**

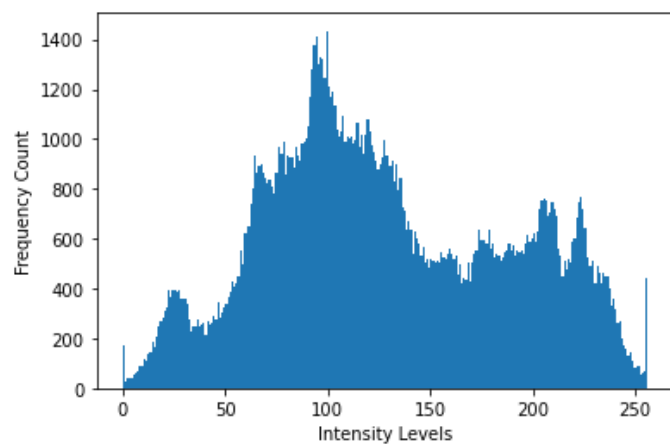
**Histogram:**

In digital image processing, the histogram is used for graphical representation of a digital image. A graph is a plot by the number of pixels for each tonal value. Nowadays, image histogram is present in digital cameras. Photographers use them to see the distribution of tones captured.

In a graph, the horizontal axis of the graph is used to represent tonal variations whereas the vertical axis is used to represent the number of pixels in that particular pixel. Black and dark areas are represented in the left side of the horizontal axis, medium grey color is represented in the middle, and the vertical axis represents the size of the area.

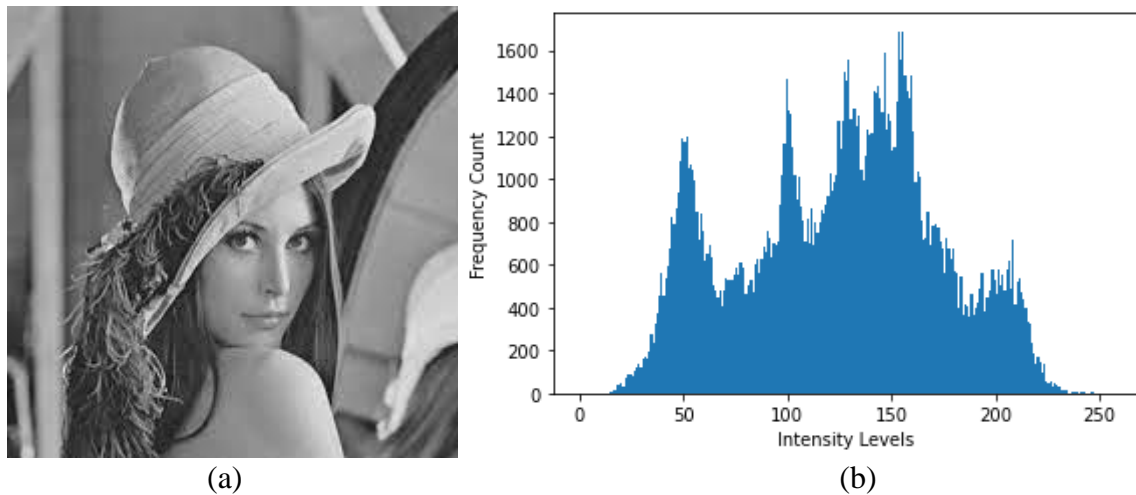


(a)



(b)

**Figure 1: Histogram (a) Original Input Color Image, (b) Histogram of Input Image**



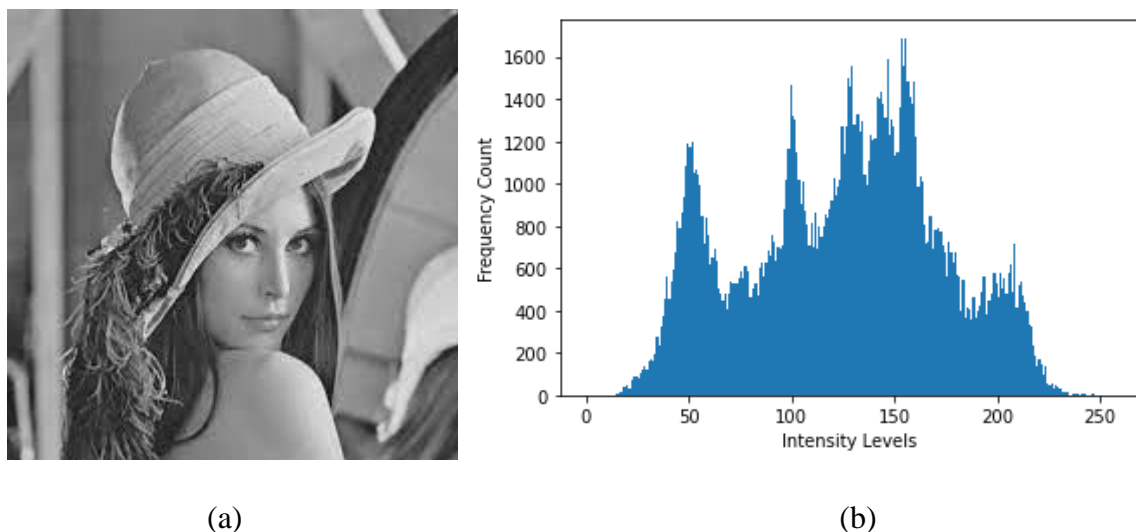
**Figure 2: Histogram (a) Original Input Grayscale Image, (b) Histogram of Input Image**

The histogram of a digital image with gray levels in the range  $[0, L-1]$  is a discrete function.

- Histogram of an image provides a global description of the appearance of an image.
- Information obtained from histogram is very large in quality.
- Histogram of an image represents the relative frequency of occurrence of various gray levels in an image

### **Histogram Equalization:**

Histogram equalization is used to enhance contrast. It is not necessary that contrast will always be increase in this. There may be some cases were histogram equalization can be worse. In that cases the contrast is decreased. Let's start histogram equalization by taking this image below as a simple image.



**Figure 3: Histogram (a) Original Input Grayscale Image, (b) Histogram of Input Image**

### PMF (Probability Mass Function)

First we have to calculate the PMF (probability mass function) of all the pixels in this image. If you donot know how to calculate PMF, please visit our tutorial of PMF calculation.

### CDF (Cumulative Distributive Function)

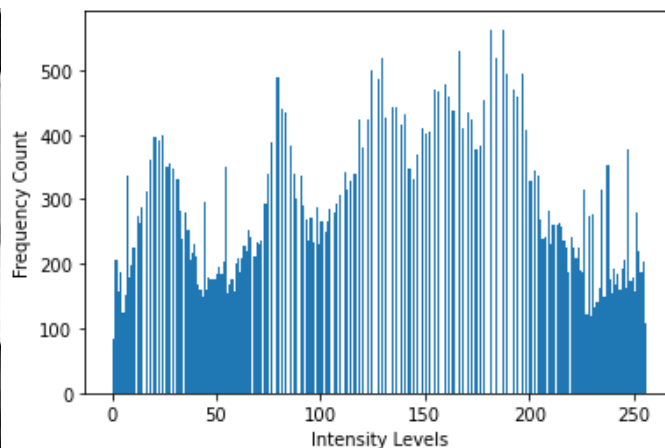
Our next step involves calculation of CDF (cumulative distributive function). Again if you donot know how to calculate CDF , please visit our tutorial of CDF calculation.

The histogram of a digital image, with intensity levels between 0 and (L-1), is a function  $h(r_k) = n_k$ , where  $r_k$  is the kth intensity level and  $n_k$  is the number of pixels in the image having that intensity level. We can also normalize the histogram by dividing it by the total number of pixels in the image. For an N x N image, we have the following definition of a Equalized histogram function:

$$h(v) = \text{round} \left( \frac{cdf(v) - cdf_{min}}{(M \times N) - cdf_{min}} \times (L - 1) \right)$$



(a)



(b)

**Figure 3: Histogram (a) Equalized Histogram Image, (b) Equalized Histogram**

**Conclusion:** We have performed histogram equalization on an image.

### Questions:

1. What is Histogram?
2. What is Histogram Equalization?

3. Explain CDF?
4. Explain hist() function?
5. What is equaliseHist() function in openCV?