COMPUTER VISION
LECTURE 6 ASSIGNMENT
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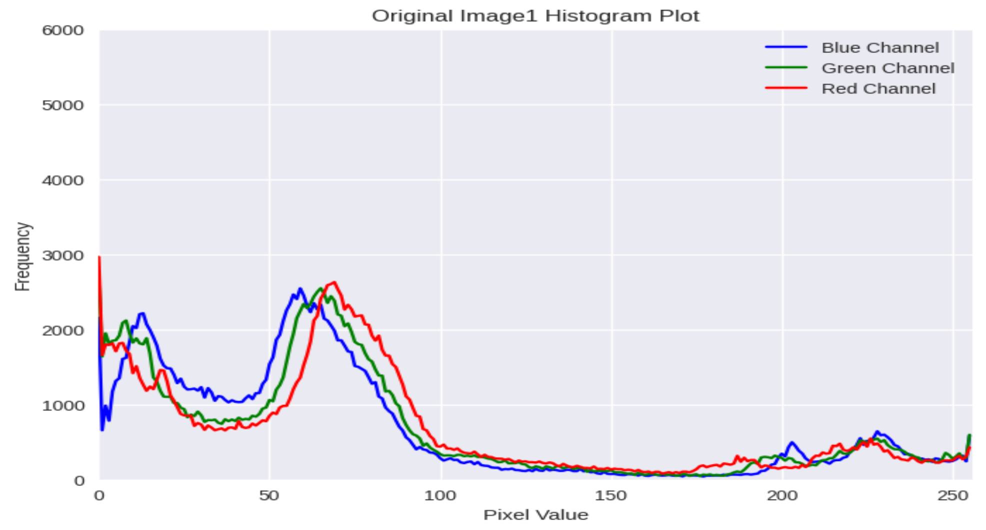
1.Implement a contrast stretching algorithm

Percentile based contrast stretching

Original Image



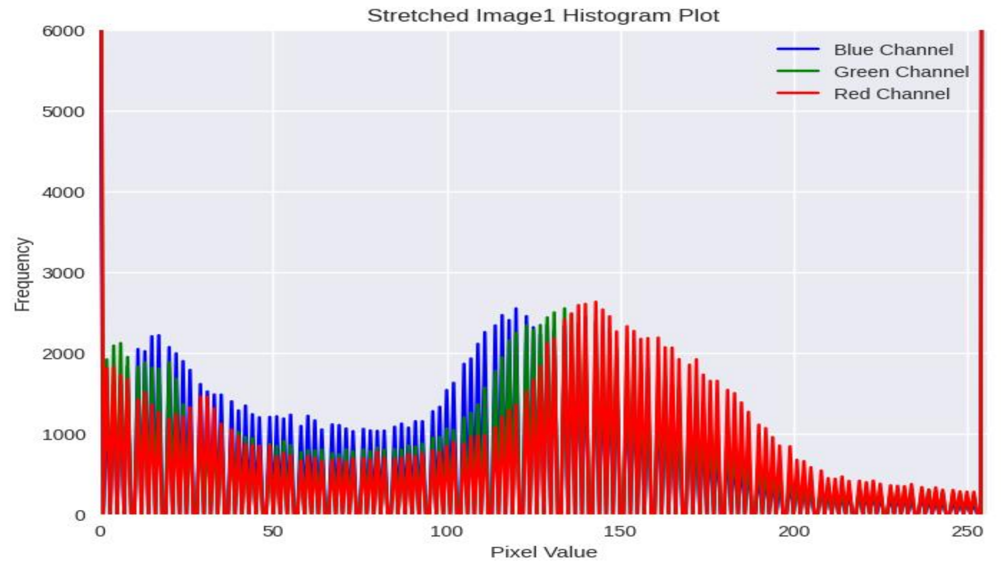
Mean Values for RGB

[73.20,75.94, 79.59]

Var[4265.47]

Percentile based Image

percentile min =5, percentile max =83



Mean Values for RGB

[120.98, 126.69, 135.22]

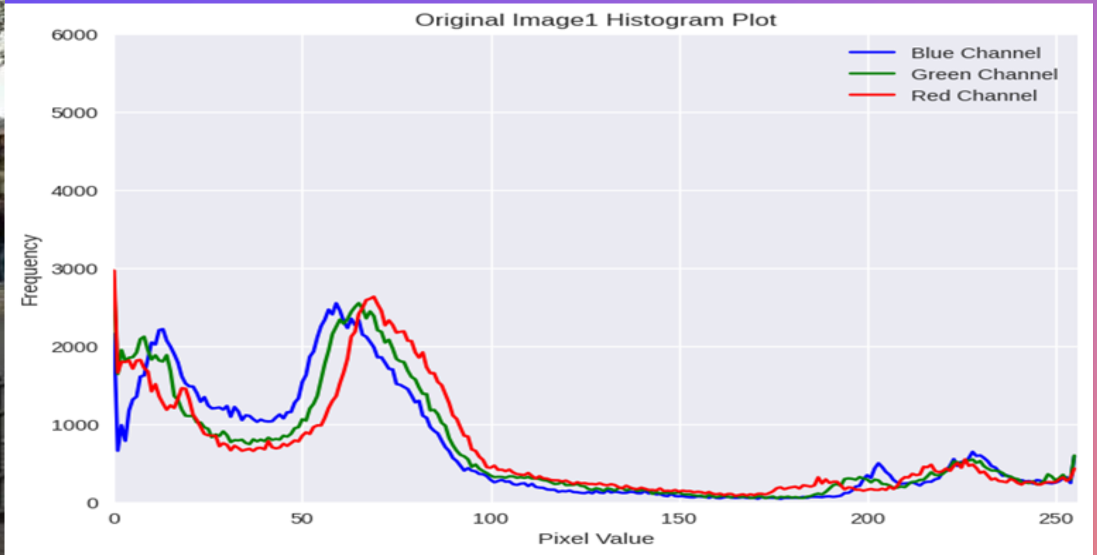
Var[6961.69]

The resultant image is after normalizing the percentile-based image by multiplying 255

2. Spatial processing for image enhancement

(2.1) Implement a function for histogram equalization

Original Image

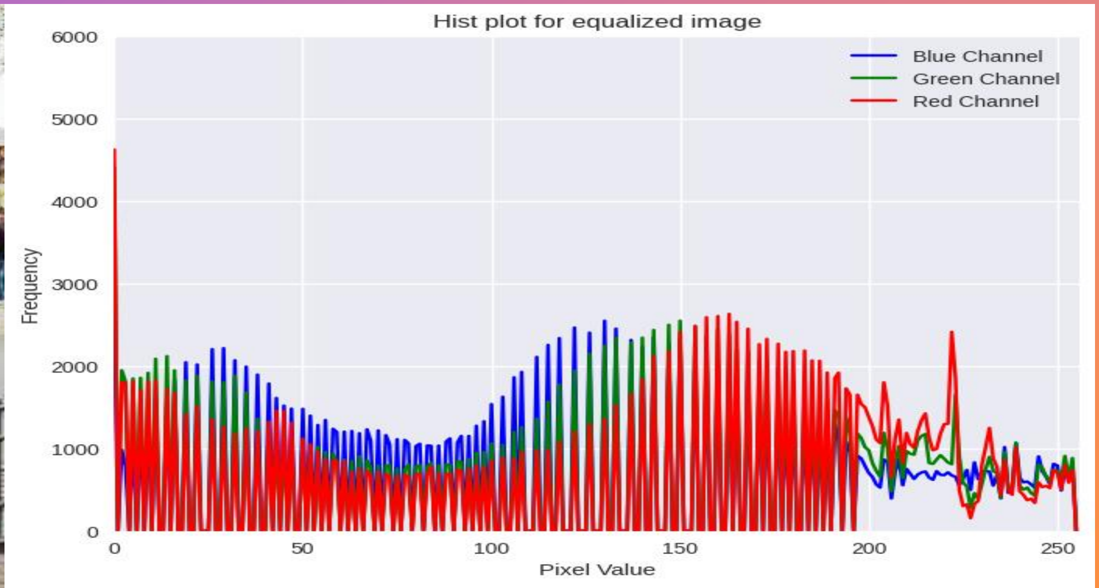


Mean Values for RGB

[73.20,75.94, 79.59]

Var[4265.46]

Histogram equalization image enhancement



1.Calc Hist
2.Calc CDF
3.Normalize CDF
4.Map Image with Normalized CDF

Var[5853.28]

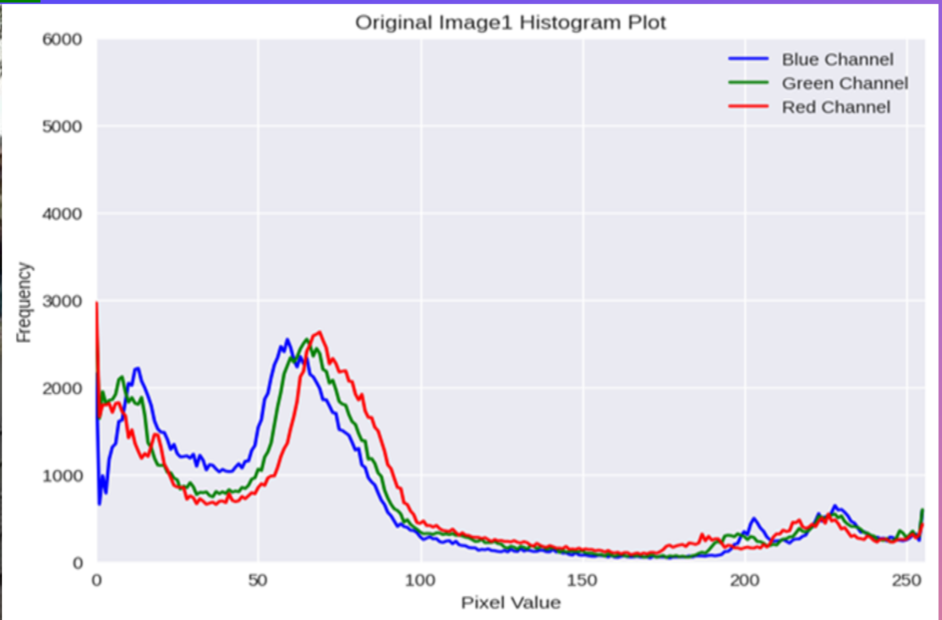
Mean Values for RGB

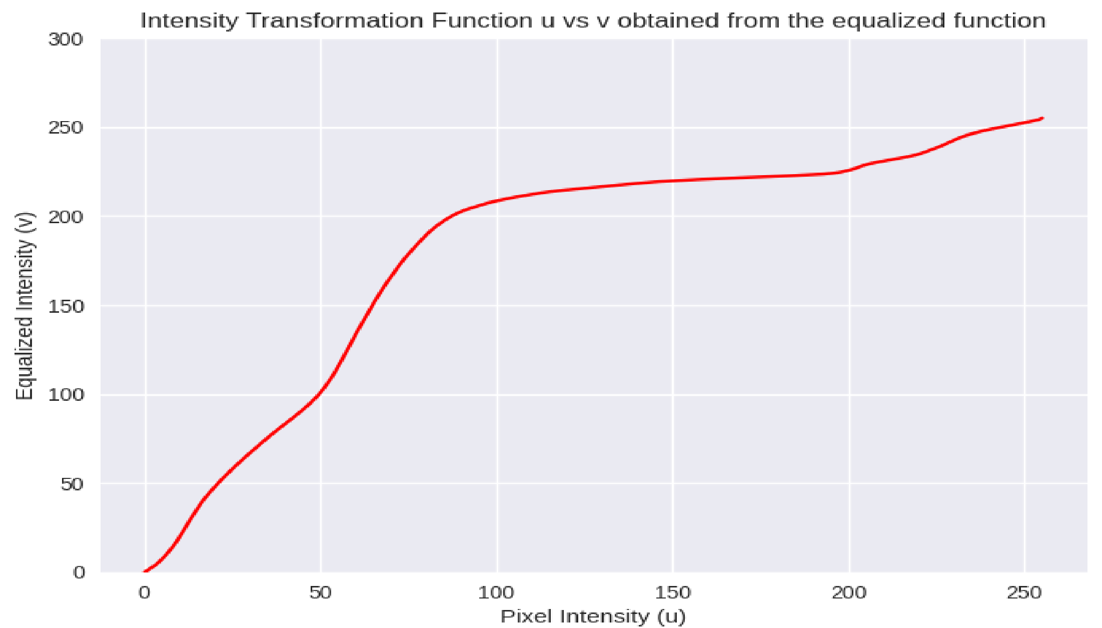
[126.45, 131.66, 139.87]

2. Spatial processing for image enhancement

(2.1.1) Include your source code and the equalized image. Plot the intensity transformation function u vs. v obtained from the equalization function

```
def histogram_equalization(image):
    # Calculate the histogram
    hist = cv2.calcHist([image], [0], None, [256], [0, 256])

    # Calculate the CDF
    cdf = hist.cumsum()

    # Normalize the CDF
    nor_cdf = ((cdf - cdf.min()) * 255) / (cdf.max() - cdf.min())

    # Map the image using normalized CDF
    equalized = nor_cdf[image]

    # Convert the equalized image to uint8 data type
    equalized_image = equalized.astype(np.uint8)

    return equalized_image, nor_cdf
```



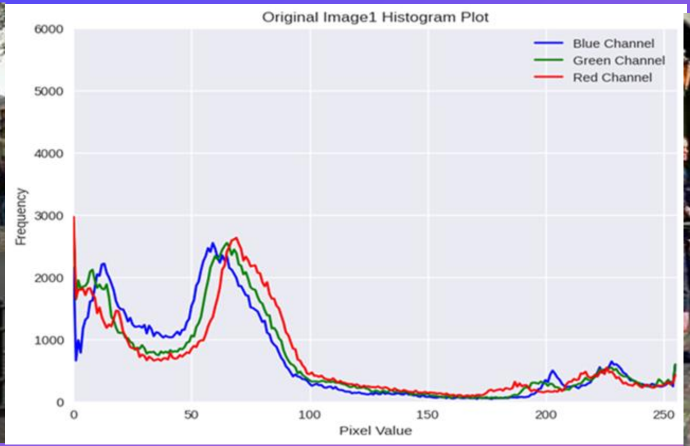


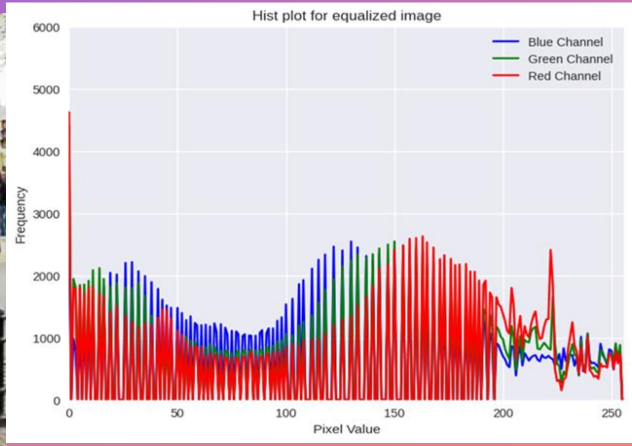
2.1.2

Experiment with contrast stretching with MATLAB or in an image editing software's comment on the outcome in comparison with (2.1.1).

Original Image

Equalized Image Hist

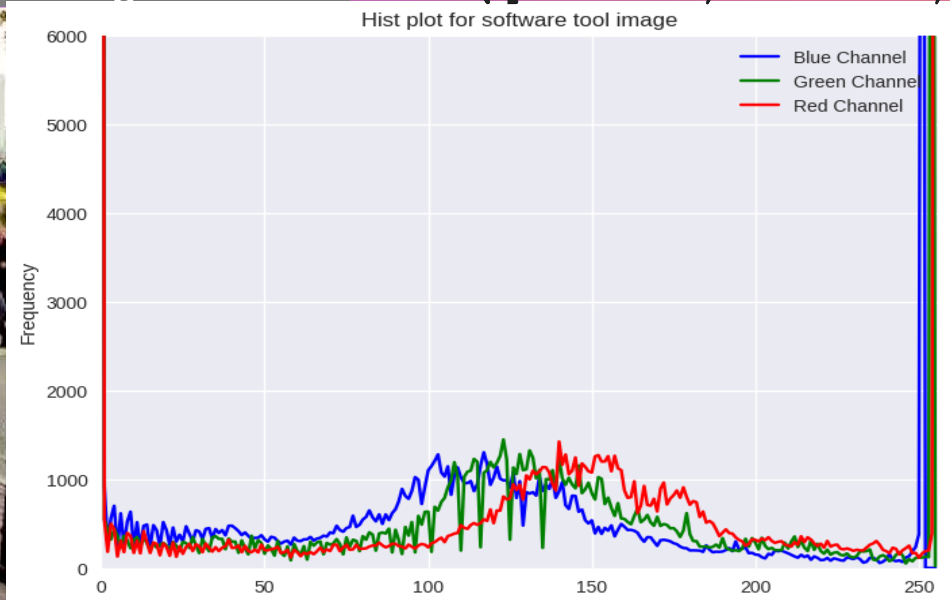


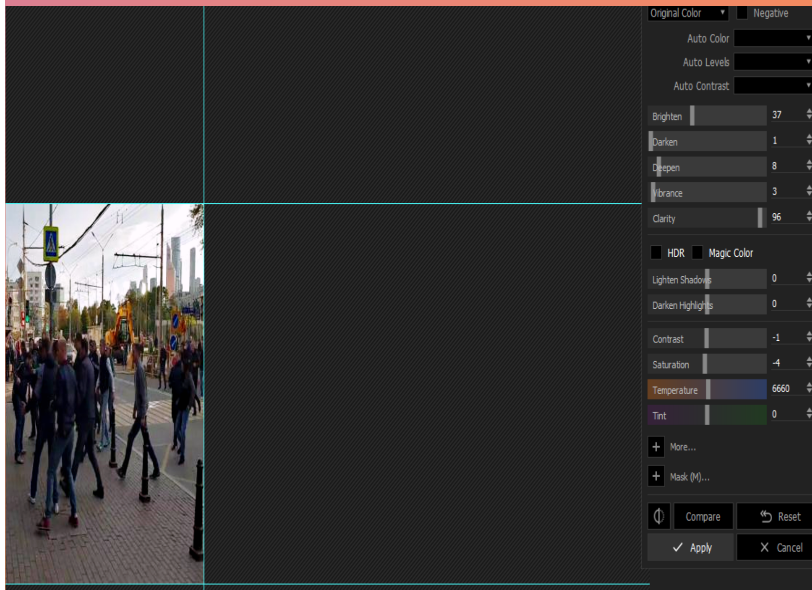


The software used for this process is PhotoSpaceX editor where the image1 was uploaded and changes were made accordingly. The values for brightness was 53, clarity was 100, contrast was 0 and saturation was 11

Mean for software image
([102.51, 113.38, 126.25]) Var[7352.76]

Image processed with editing software





Comparison between 2.1.1(function for Hist equalization) and 2.1.2(editing software image

Hist image

Software image

[126.45,131.66,139.86] [5853.28]

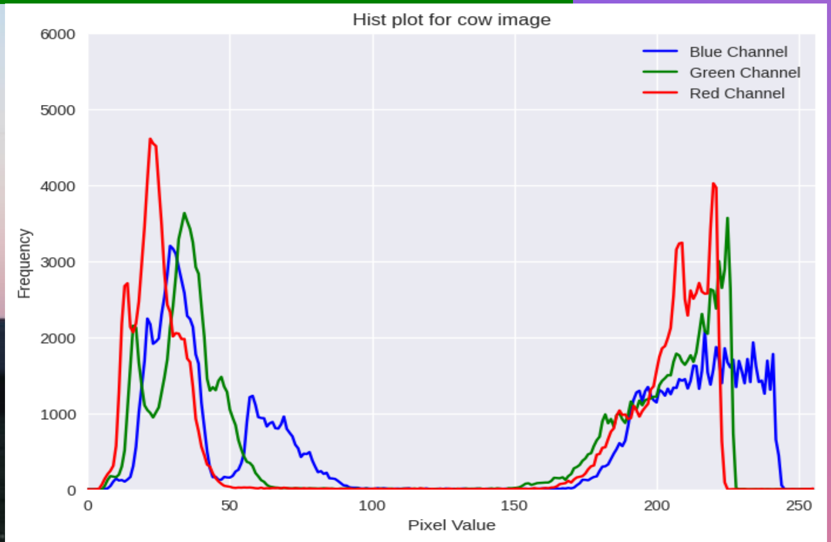
[102.51,113.38,126.25] [7352.76]

The image from histogram equalization seems to have high mean and low variance whereas editor software image has high variance and low mean in comparison to histogram equalized image. Since, the histogram equalized image is the result of the calculation of hist values and CDF which is constant whereas the software image is the result of manipulating the different parameters like brightness, contrast, clarity and so on, I believe we can achieve better image from editor software as we can changes various values to get the best image as per our requirement.

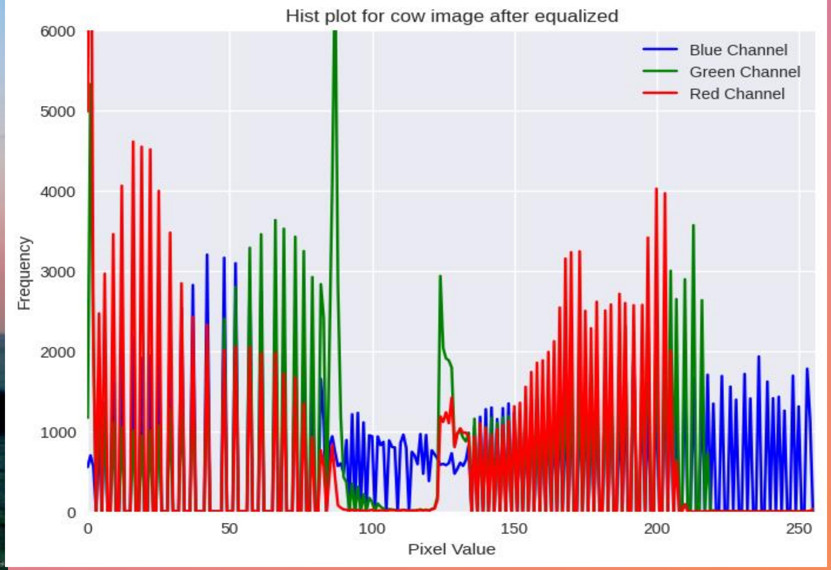
2.3Take an image (photo you took, medical image, or images from the web) and enhance it with spatial processing.

Submit the "before" and "after" (as in 2.2), discuss the steps and why it looks better

Original Image **Mean[129.89,121.92,117.47] Var[7975.36]**



After equalized **Mean[128.28,115.14,100.34] Var[5202.40]**



The image after equalized looks better as it has enhanced image with bright and more clear details.

We applied the same steps as in question number 2.1 by using histogram equalized method as the question says to use spatial processing where histogram is also a part of it.

1. Calculate Hist value
2. Calculate CDF
3. Normalized the CDF
4. Map the original image with N.CDF

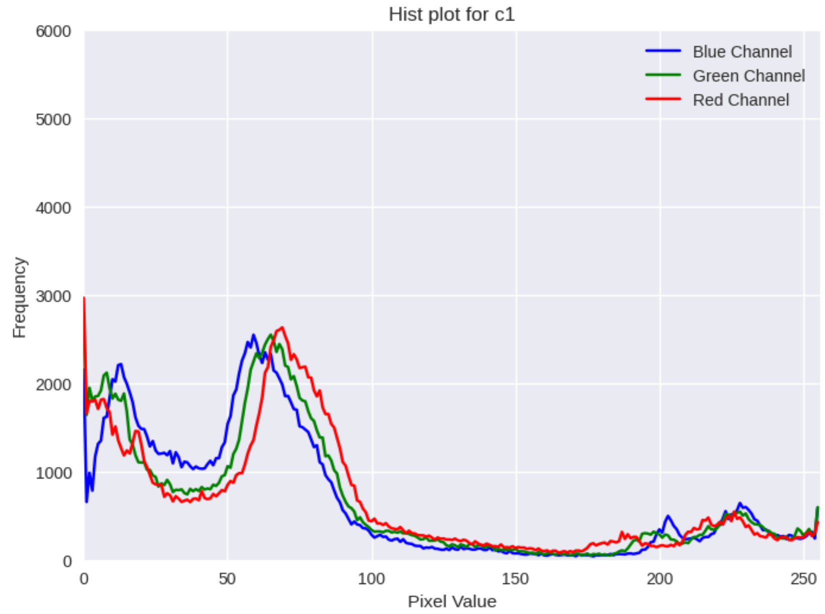
(3) Write an **M-function that**

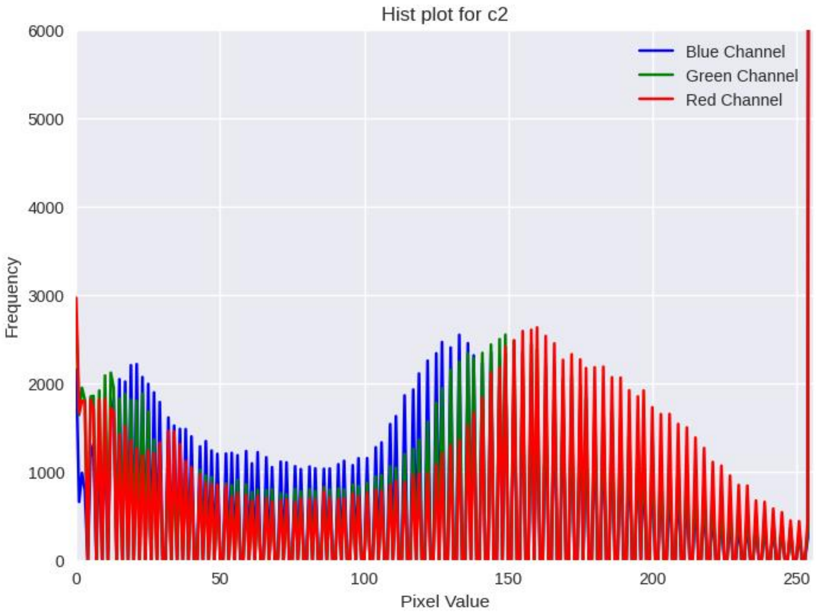
Apply a gamma correction algorithm on image f and produces image g

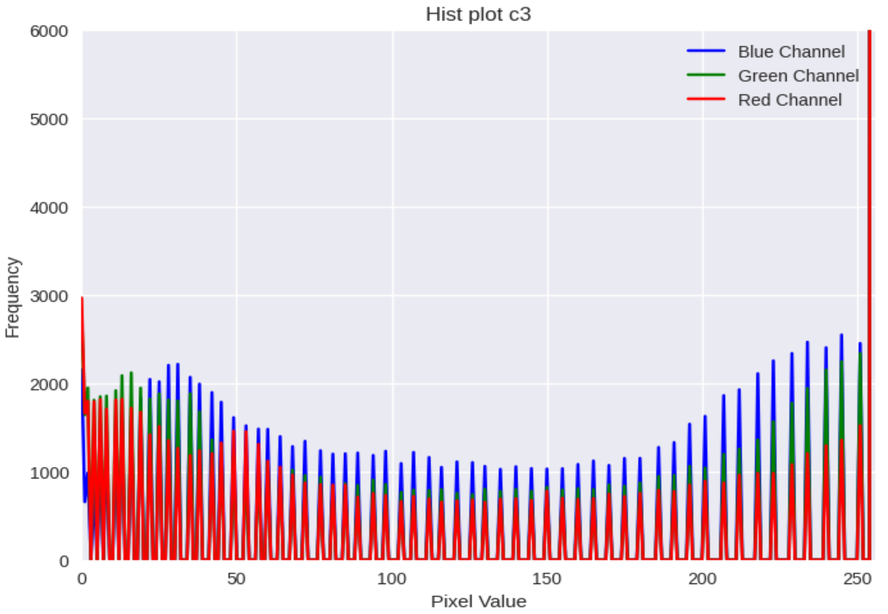
Here we use f(x) and apply gama function to produce g(x) where gamma is the power function.

S= z^(gamma) or s= c(z+a)^(gamma) where c and a are positive constant gray level expansion and 0<gamma| < gray level

Original image or gamma= 1 gamma=1.2 gamma=1.35







S = (Z)^y where y>0 is gamma value

Input image output image

Mean[73.20,75.94,79.59]
Var[4265.47

The first image is the original where gamma is set to 1 which does not show any changes in pixels.

[130.76,137.27 ,146.90]
Var[7439.52

The second image is gamma correction image with gamma value 1.2 where the
Images has high mean and high variance
With high contrast and brightness

[179.34,183.16,190.38]
Var[9124.94]

The third image is another gamma correction where gamma value is 1.35. The image is much brighter and more colorful than other images.

Concludes that gamma function is very helpful technique for image enhancement, but the value of gamma must be chosen carefully for better result

(4) Apply the retinex image enhancement method. See the next slide 5 for help

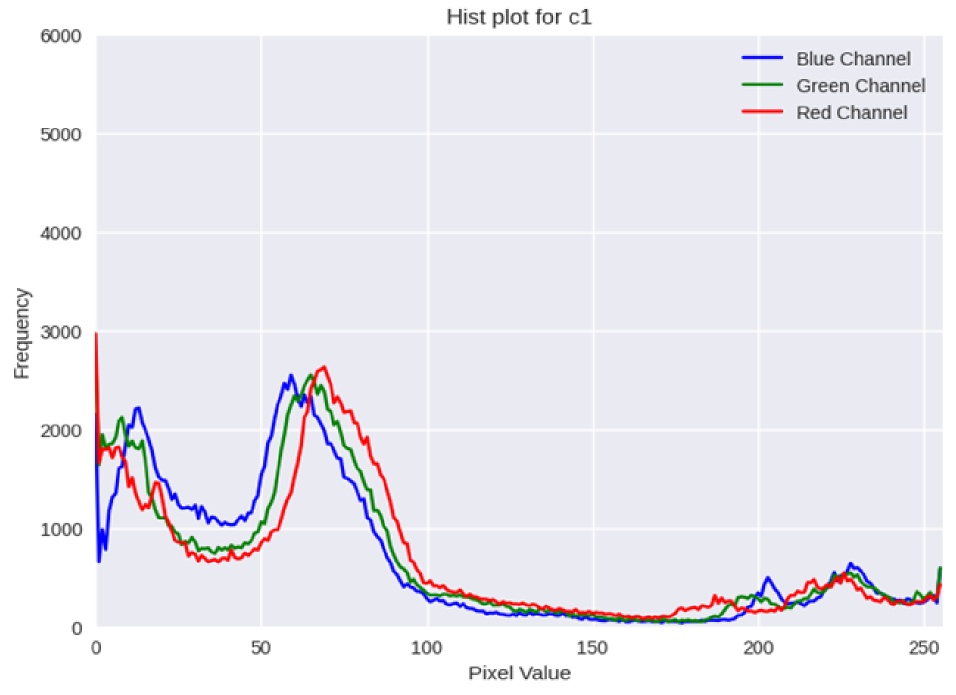
Original Image

illumination

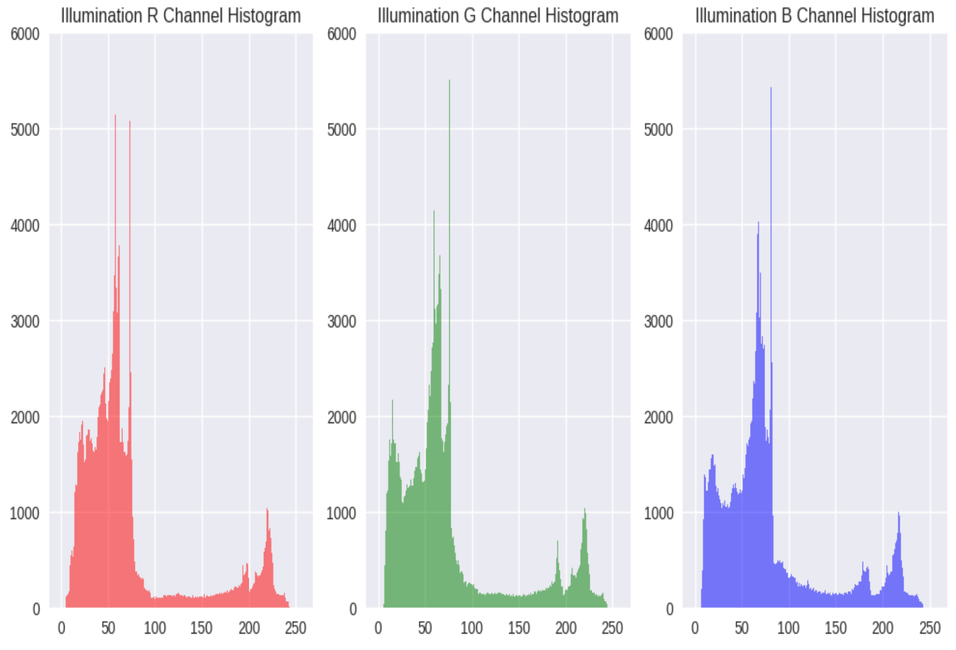
Mean[129.89,121.92,117.47]
Var[7975.36

Sigma=10

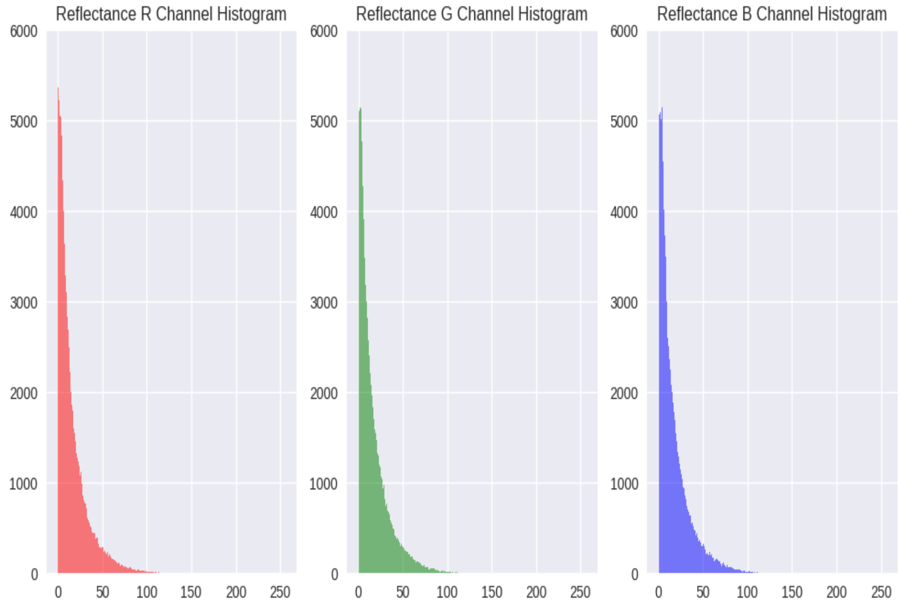
Mean[73.17,75.91,79.57]
Var[3353.59



Tried with different value of sigma where final retinex image after normalized was getting better but the illumination and reflectance were getting worse, so chosed sigma=10 as sample value



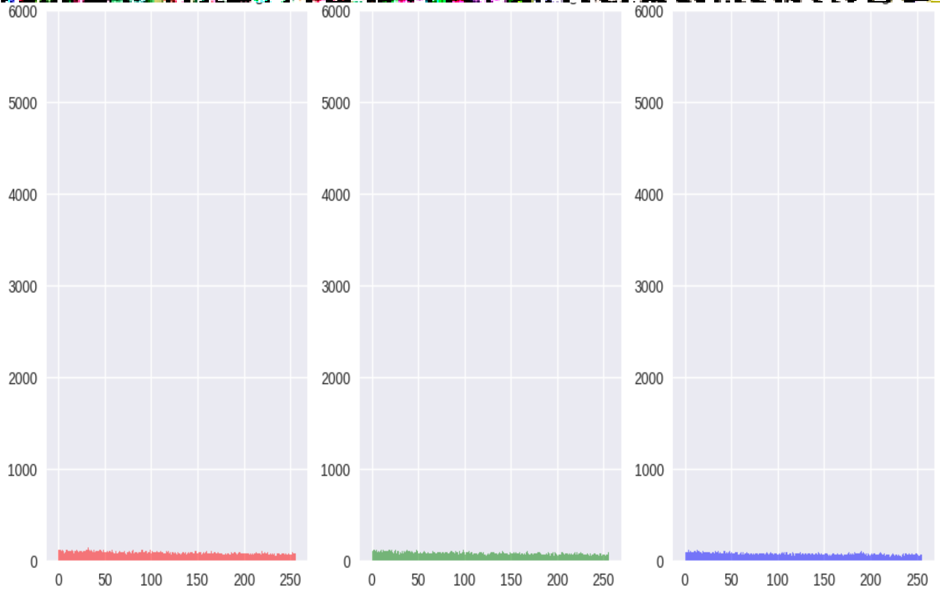
Reflectance image



Mean[0.025, 0.028,0.030]
Var[657.01]

Combined retinex image

Mean[133.73,128.03,127.12]
Var[10356422.91]



The combined retinex image which is the product of reflectance and illumination seems to be getting better with more sharpness and contrast but needs an appropriate value for a better image. The problem could also be that the image is not a suitable for retinal enhancement as it is already somewhat enhanced.

Sigma=100

Some sample with various sigma values and normalized image

Retinex combined

Retinex Normalized

Sigma=500

Application for the project

Histogram equalization seems to the best option for my project as it balances all the RGB values by calculating Hist and CDF, where we do not have to adjust values like gamma and sigma for other methods such as gamma enhancement and retinex.

Before

After

THE END