

Edge Detection & Histogram Equalization



(i)

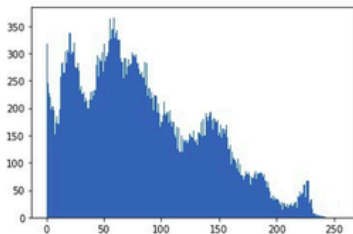


(ii)

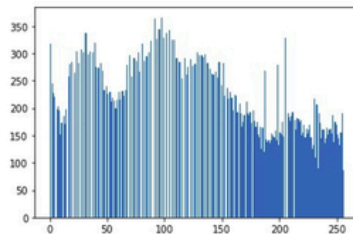


(iii)

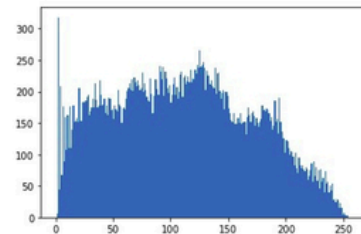
(a) Image enhancement using Histogram Equalization and CLAHE



(i)



(ii)



(iii)

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Topics

- Edge detection
- Canny Edge detection algorithm
- White Balancing
- Histogram Equalization
- CLAHE

Edge detection:

- identify and locate sharp discontinuities in an image
- discontinuities often correspond to significant changes in intensity or color

Applications:

- object recognition
- image segmentation
- feature extraction

Canny edge detection

- popular edge detection algorithm. It was developed by John F. Canny
- The algorithm is a multi-stage algorithm
- It can handle noises
- Very precise
- The quality of the output depends on the choice of threshold values
- Computationally intensive

Stages of the algorithm:

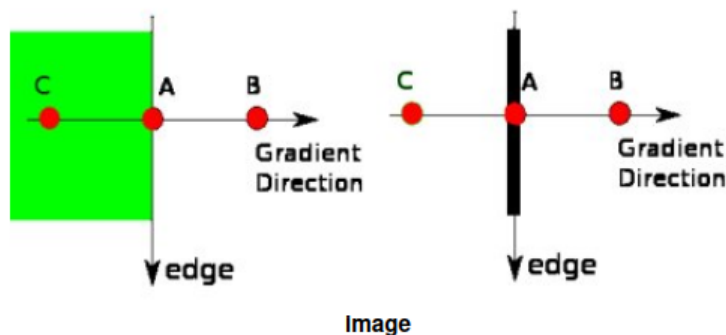
1. **Noise Reduction:** uses a 5x5 gaussian filter to remove noise

2. **Finding Intensity Gradient of the Image:**

Smoothed image is then filtered with a Sobel kernel to get first derivative in horizontal direction (G_x) and vertical direction (G_y). From these two images, we can find edge gradient and direction for each pixel as follows:

$$\text{Edge_Gradient} (G) = \sqrt{G_x^2 + G_y^2} \text{Angle} (\theta) = \tan^{-1} \left(\frac{G_y}{G_x} \right)$$

3. **Non-maximum Suppression:** a full scan of image is done to remove any unwanted pixels which may not constitute the edge.



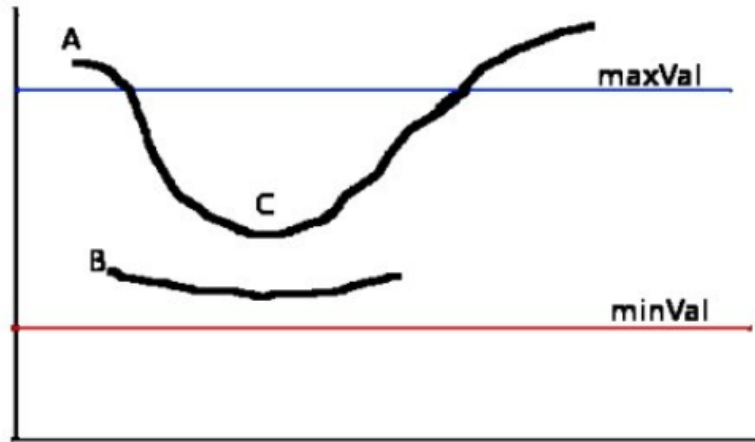
Opencv

Point A is on the edge (in vertical direction). Gradient direction is normal to the edge. Point B and C are in gradient directions. So point A is checked with point B and C to see if it forms a local maximum. If so, it is considered for next stage, otherwise, it is suppressed (put to zero).

In short, the result you get is a binary image with "thin edges".

4. Hysteresis Thresholding:

Finds actual edges using two threshold values, minVal and maxVal.



Opencv

Any edges with intensity gradient more than maxVal are sure to be edges and those below minVal are sure to be non-edges, so discarded. Those who lie between these two thresholds are classified edges or non-edges based on their connectivity. If they are connected to "sure-edge" pixels, they are considered to be part of edges. Otherwise, they are also discarded.

This stage also removes small pixels noises on the assumption that edges are long lines.

cv.Canny(src_img, lower_thresh, upper_thresh)

Don't stop here

Learn More: **Prewitt Operator, Scharr Operator ...**

White Balance



British Academy of Photography

The goal of white balance is to ensure that the colors in an image appear natural and neutral, particularly under different lighting conditions. Ideally, a white object should look white in the image, regardless of the light source.

White balance control is vital in image processing for computer vision because it ensures color accuracy, consistency, and improved performance of algorithms. By correcting for color casts introduced by different lighting conditions, we can enhance the quality of images and facilitate more effective analysis and interpretation in various applications.

Gray World Assumption

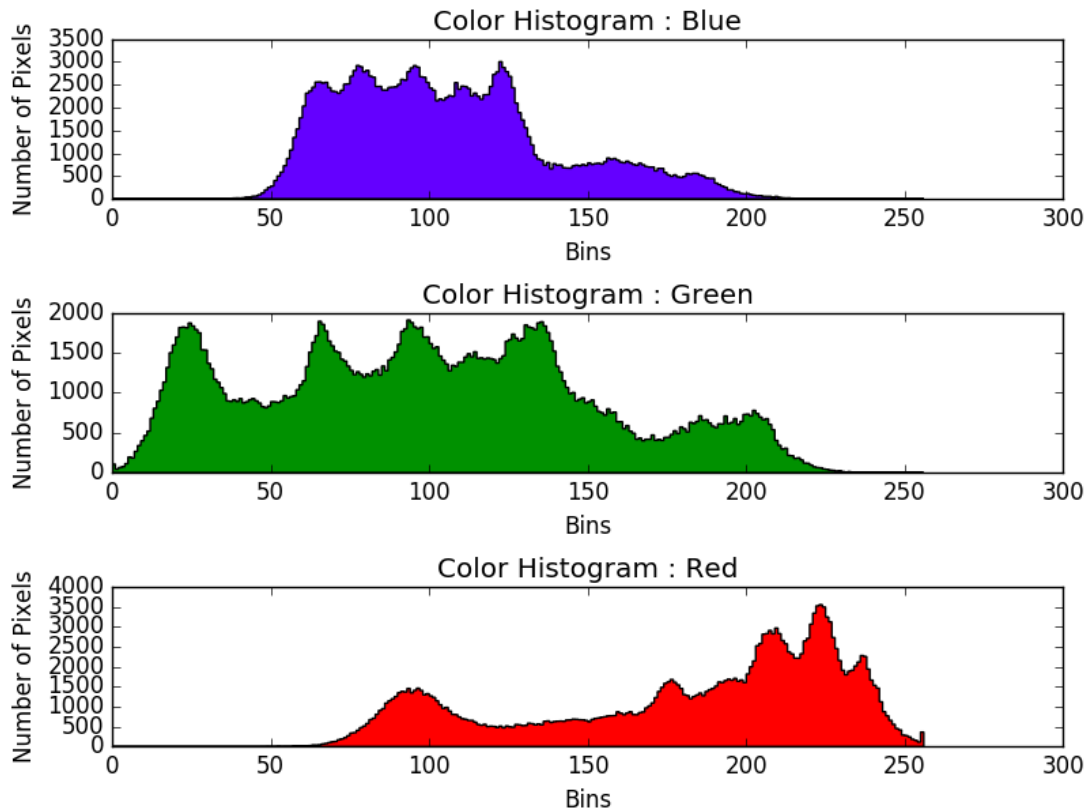
“The average color of a scene is gray”

Steps:

1. Set a scale factor
2. Get average for each channel
3. Divide the scale factor by the average value and get the scale value for each channel
4. Multiply each channel with the scale value

Learn More: **White Patch Retinex, Color Temperature Adjustment**

What is Histogram?



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Histogram: A visual representation of the distribution of quantitative data.

In image processing, **Histogram equalization** is a technique used to enhance the contrast of an image by effectively redistributing the intensity values (pixel values) across the entire range of possible values.