Visual Recognition

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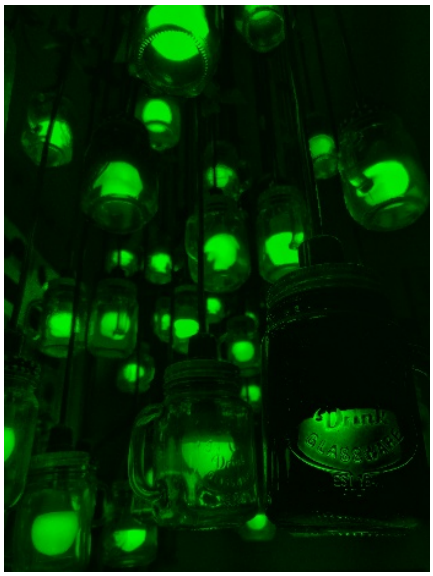
Q1. Choose an RGB image (Image1); Plot R, G, and B separately (Write clear comments and observations)

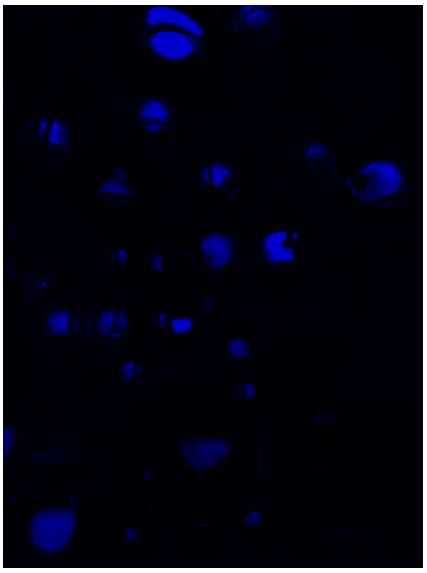
Ans.
Original Image:

Red Channel:

Green Channel:



Blue Channel:



Observation: It is an additive colorspace i.e., colors are obtained by a linear combination of Red, Green, and Blue values.
The three channels are correlated by the amount of light hitting the surface. The spots which are dark means the color value there is near to zero.

Q2. Convert Image 1 into HSL and HSV. Write the expressions for computing H, S and V/I. (Write clear comments and observations)

Ans.

Original Image:

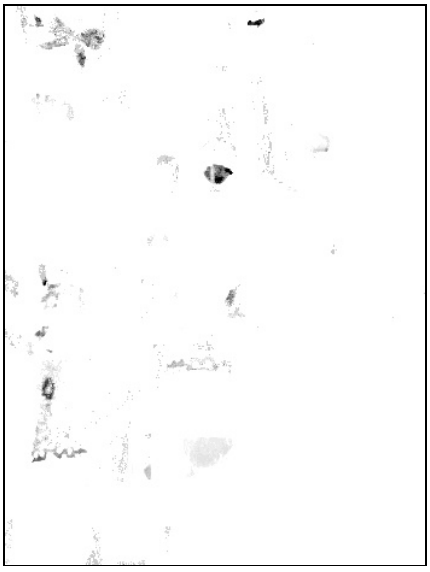
HSV Image:

HSL Image:

Hue Channel:

Saturation Channel:

Value Channel:



Observation: Only the Hue Channel is used to specify the color (Dominant wavelength), Saturation depicts the vibrance for the color and the value channel determines the brightness.

R = R'/255, G = G'/255, B = B'/255

mmax = max(R, G, B)

mmin = min(R, G, B)

Δ = mmax − mmin

H = undefined, if Δ = 0

(G−B)/Δ, if mmax = R

((B−R)/ Δ)+ 2, if mmax = G
((R−G)/Δ + 4, if mmax = B
Ho = H × scale

V = mmax
Vo = V × scale

S = 0, if V = 0
Δ/V, otherwise
So = S × scale

Q3. Convert Image 1 into L*a*b* and plot.

Ans. L*A*B* Image:

Observation:
L – Lightness (Intensity).
a – color component ranging from Green to Magenta.
b – color component ranging from Blue to Yellow.

The Lab color space is quite different from the RGB color space. In RGB color space the color information is separated into three channels but the same three channels also encode brightness information. On the other hand, in Lab color space, the L channel is independent of color information and encodes brightness only. The other two channels encode color.

Q4. Convert Image 1 into Grayscale using the default OpenCV function. Write the expressions used for the conversion.

Ans. Grayscale Image:

Observation: The OpenCV function BGR2GRAY was used. This mergers the three channels into one using some specific predefined weights.

$$Y=0.299\cdot R+0.587\cdot G+0.114\cdot B$$

Q5. Take a grayscale image (Image 3) and illustrate:
Whitening, Histogram equalization

Ans.

Grayscale Image:

Whitening:

Histogram Equalized Image:

Whitening: Whitening is a method of normalization in which tries to reduce the variance in the colors of the image.
Histogram Equalization: It is a method to process images in order to adjust the contrast of an image by modifying the intensity distribution of the histogram. The objective of this technique is to give a linear trend to the cumulative probability function associated to the image.

Q6. Take a low illumination noisy image (Image 4), and perform Gaussian smoothing at different scales. What do you observe w.r.t scale variation?

Ans.
As filter size increases more smoothening happens
Increasing sigmaX increases blur in X direction and increasing sigmaY increases blurring in Y direction.

Stack1: Increasing sigmaX:

Stack2: Increasing sigmaY:

Q7. Take an image (Image 5) and add salt-and-pepper noise. Then perform median filtering to remove this noise.

Ans.

Grayscale Image: S&P Noise Added Image: Median Filtered Image:

Median Filter: Median filtering is a nonlinear process useful in reducing impulsive, or salt-and-pepper noise. It is also useful in preserving edges in an image while reducing random noise.

Q8. Detect Road land markers.

Ans.

1. Took an image and cropped out the Region of Interest, the most intuitive shape was a triangle.
2. Used Canny Edge detection on the remaining (cropped) image data. The resulting image contained only the single pixels which were indicative of an edge.
3. Using these edges I generated a listing of lines with the help of HoughLines in opencv2.
4. Using simple algebra, I grouped the lines on each side resulting into 2 lines, one on left and the other on the right.
5. Overlayed these lines on the original image.

Q9. Classify modes: Night; Portrait; Landscape. Design features, use NN

Ans. Took 128 different images comprising of landscape, night and portrait. Then I took a histogram of 32 bins of each channel of HSV and BGR of the images and stored in a dataframe with their corresponding labels. Hence, the total number of features were 192. Used a simple KNN along with cross validation to get the optimum accuracy. I achieved an accuracy of 82% over the test set of 22 images.

Hue and Value are really important features to help us understand the lighting conditions and colors present. Individual accuracy: 73%
BGR channels help in better classification of landscapes. Individual accuracy:66%
Light channel in LAB would also be a better quantity to better classify nightscapes.