Project 1

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Image & Video Processing

1- Color Spaces

For this task two different image one with bright colors, and one with pale colors were chosen :

Figure 1-1 :BGR of bright color

Figure 1-2 :BGR of pale color

1.1 In task 1, two different types of images ask to present RGB and HSV for two distinguished images.

The RGB model is an additive color model.RGB is the amount of three primary colors of light red , green and blue in the image in the range of (O,255) . The whole idea here is that all visible colors can be made of these three primary colors.

The HSV model contan three component:

Hue: hue is the color portion of the model which is in the range of (0,360)

Saturation: Saturation is the amount of gray from 0 to 100 percent in the particular color.

Value (or Brightness): Value is the amount of brightness of the color from 0 to 100 percent.

You can see in the bright cimage since the intensity of the image is high when we transfer it to the HSV (figure 1-4) you can see most of the image is green except the center which make sense because the intensity of the center of image is low (It's mostly bright).For Image with pale colors you can see most part of image is red and it is because of the low intensity of the pic especially at the top of the image.

Figure 1-3 : RGB of bright color image

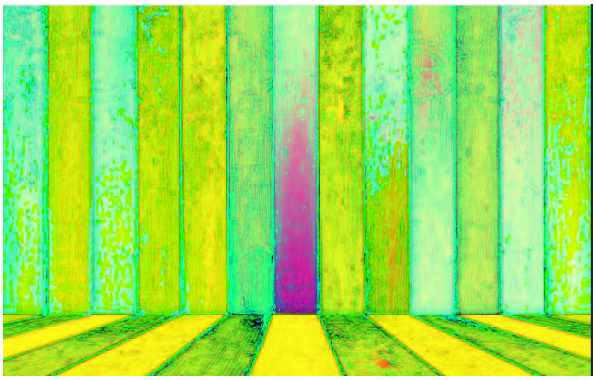


Figure 1-4 : HSV of color image

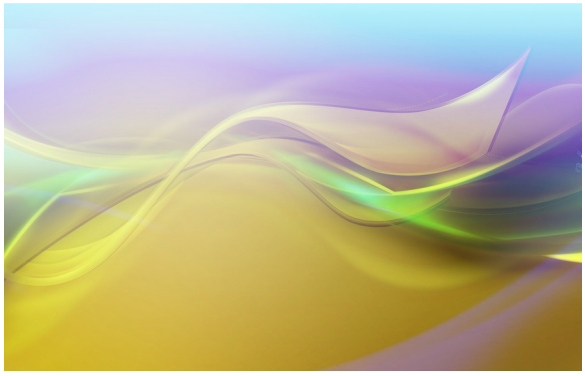


Figure 1-4 : RGB of pale color image

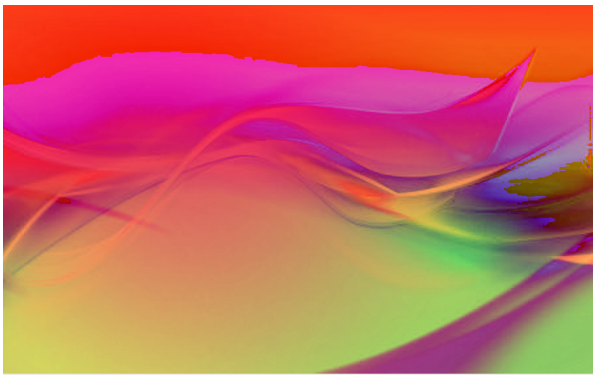


Figure 1-5 : HSV of pale color image

1.2 In task 2,Two parameters Value (in HSV) and intensity (in HSI) were asked to calculate.

Value is the amount of which the color is mixed with black from 0 to 100 percent.So in the code The maximum value of Red,Green and red in the has been considered. (in RGB 0 is for black and 255 is for white).As in figure 1-6 you can see the amount of Red is 249 in the orange pixel.The V in here is going to be 249 which is almost white since we are taking the maximum number of RGB. So we can expect to see white in the orange area in V image (figure 1-7)

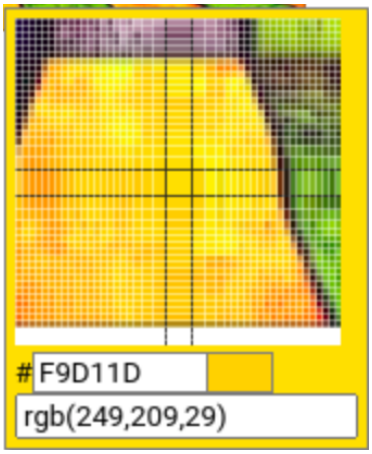


Figure 1-6 : RGB of orange

Figure 1-7 : Value image of color pic

Intensity range is between [0,1] and 0 means black, 1 means white and it is the average of R,G and B values. Intensity represents the brightness of the color.The most observable thing in here that can be mentioned is the center of color image which is white and it remains white in Value image (figure 1-8).It can said that since the amount of biritness in Red and Blue and Green component are high , so the average value of these three component it must be high and near 255. Another observation that we can mention here is the difference between figure 1-7 and figure 1-8 as you can see figure 1-7 (value) is brighter than figure 1-8 (Intensity) which is reasonable since for value we are using the maximum hence in intensity we use average amount of primary colors.

Figure 1-8 :Intensity of pale color image.

The value and intensity of the pale image are shown in figure 1-9 and figure 1-10 respectively.As the conclusion for this image we can say as this picture has the moderate colors i.e. the amount of brightness in the Red , green and blue component are also the same, the average and maximum value of this value are not that different so that's why there is no difference between these two images.

Figure 1-9 : Value image of pale pic

Figure 1-10 : intensity image of pale pic

2- Pointwise transforms, Histogram Equalization

Two grayscale images, one with high contrast and one with low contrast were chosen,shown in figure 2-1 and figure 2-2 respectively

Figure 2-1 : Image with high contrast

Figure 2-2 :Image with low contrast

2.1 in task one histogram plot of two pictures were taken by using inbuilt function plt.hist() from library matplotlib.X axis represent the gray level of of each pixel (0 , 255) and Y axis represent the number of the pixel in that specific gray level.figure 2-3 represent histogram plot of a picture with high contrast which also you can see it in the graph , as you can see the number of the pixel with value 0 are around 700,000 which can be said is the half of the picture has the black color i.e 0 amount of bightnes.

While in figure 2-4 as it is obvious the vast majority of the pixels have the value between 100 and 200 which tell us that most of the pictures have the moderate gray level and also 0 number of black and white pixels.

Figure 2-3 :Histogram high contrast image

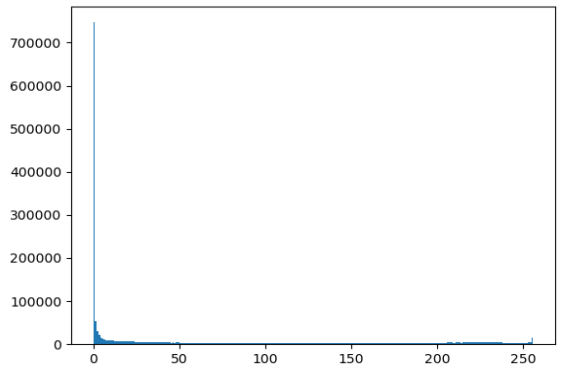
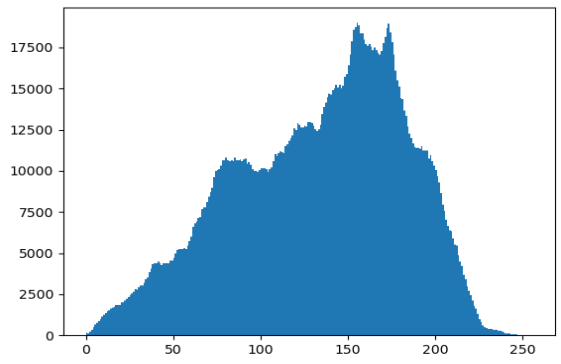


Figure 2-4 :histogram low contrast image



2.2 in task two images transformed to their own Negative pointwise.So each pixel has the gray level value from (0 , 255), When we try to negatively transform an image, the brightest areas are transformed into the darkest and the darkest areas are transformed into the brightest and it is equal to the subtraction of the maximum value of gray level(255) and the current value of the pixel. Figure 2-5 and figure 2-6 you can see the result of the image after the negative transform applied on it. The observation is reasonable since all of the black areas convert to white and vice versa.

Figure 2-5 :Image negative transform high contrast image

Figure 2-6 :Image negative transform low contrast image

2.3 In task Three the histogram of negative transform images were presented. Based on the discussion on part 2.2 It is known to us the negative transform, reverses the gray level of the image. So it is expected that the histogram of the negative image should be exactly the opposite of the original histogram. For example, for images with high contrast we have a large number of 0 values (blak) while in figure 2-7 we are faced with the large number of values 255 (white)

which is observable from the negative image ,figure 2-5. Additionally figure 2-8 presents a histogram of negative transform which also can conclude the same result for this plot as well.

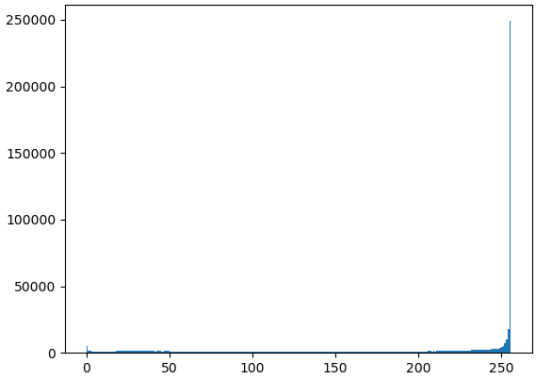


Figure 2-7 :Histogram negative high contrast image

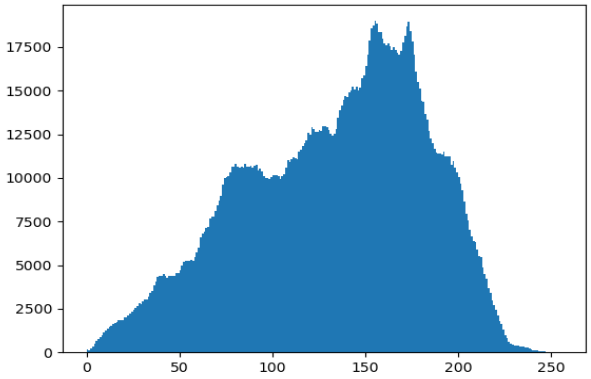


Figure 2-8 :histogram negative low contrast image

2.4 In task four a power pointwise transform applied base on the $s = r^n$ and different values of n were examined (above or below 1) to convert high contrast images to low contrast and vice versa.As you can see in figure 2-9 for n = 2 we can observe that image still has high contrast while when n reduced to 0.5 the contrast of image was decreased a. While for an image with low contrast when n decreases from 2 to 0.5 the image is no contrast at all and it is totally white figure 2-12.

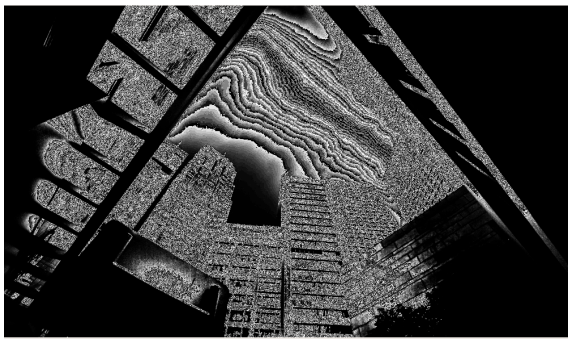


Figure 2-9 :power High contrast n = 2

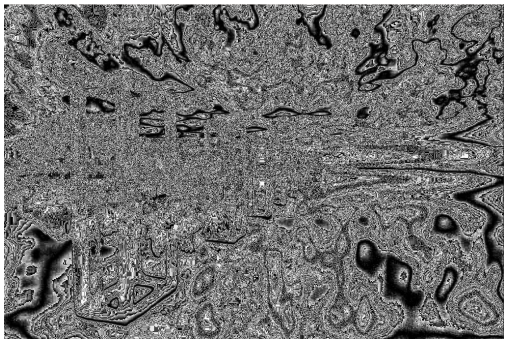


Figure 2-10 :power low contrast n = 2

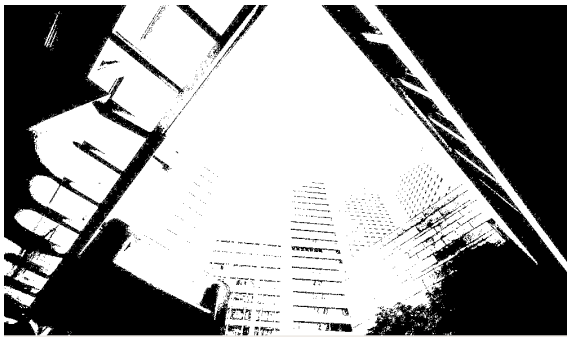


Figure 2-11 :power High contrast n = 0.5

Figure 2-12 :power low contrast n = 0.5

3-Special Effects

For this task two different image one with strong circular, and one with straight features were chosen :

Figure 3-1 :Image with straight feature

Figure 3-1 : Image with strong circula.

3-1 In the task image was converted to the polar coordinate. In the figure 3-1 and 3-2 you can see the result for these two images, X axis is the radius and Y axis is angel. For example in figure 3-2 it is more observable since polar coordinates divide the image into angles and the flower is already a circle so can be divided nicely.

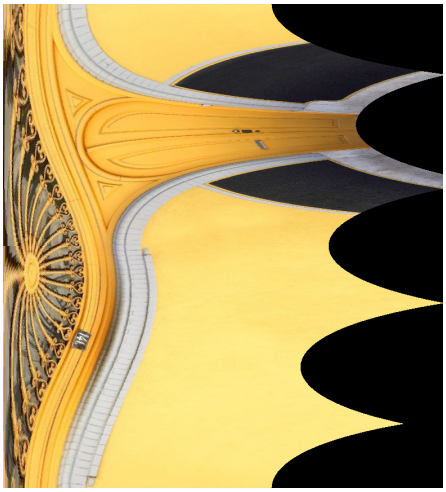


Figure 3-1 :Polar coordinate transform straight feature

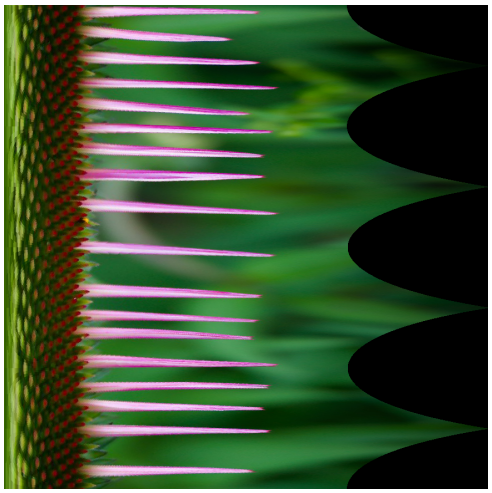


Figure 3-2 : IPolar coordinate transform strong circle.

3-2 This task is about cartonifying the image for this purpose first some filtering add to image to remove noise from the image secondly by using laplace transformation edges were found (based on thresholding) so far we have the image for unifying the color , by using K-means algorithm the updated color were calculated. Lastly, reverse the color.

Figure 3-1 cartoonify straight feature

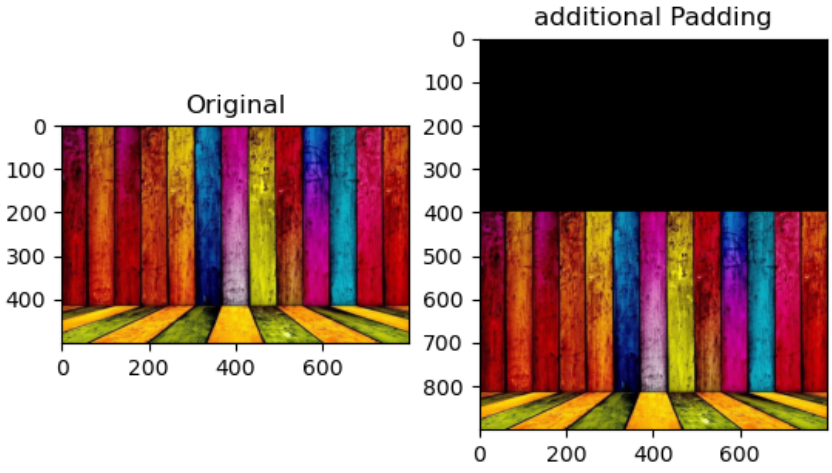
Figure 3-2 : cartoonify strong circle

4-Frequency domain properties

For the fourth exercise, following image was chosen:

Figure 4-1

Add padding to the image with numpy library. Figure 4-2



By adding padding we are adding to the size of the image as you can see the plots are almost the same except we can see some vertical stretch and we can relate it to the fact that in here top padding was added.

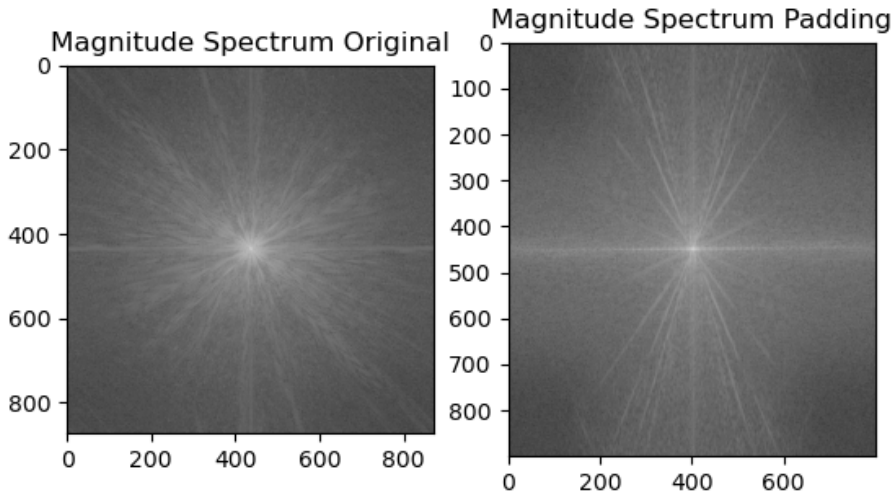


Figure 4-3

5- Periodic noise removal

For the fourth exercise, following image was chosen:

Figure 5-1

5-1 This task is adding noise to the image. Which is applied by adding periodical noise while using sin (figure 5-2)

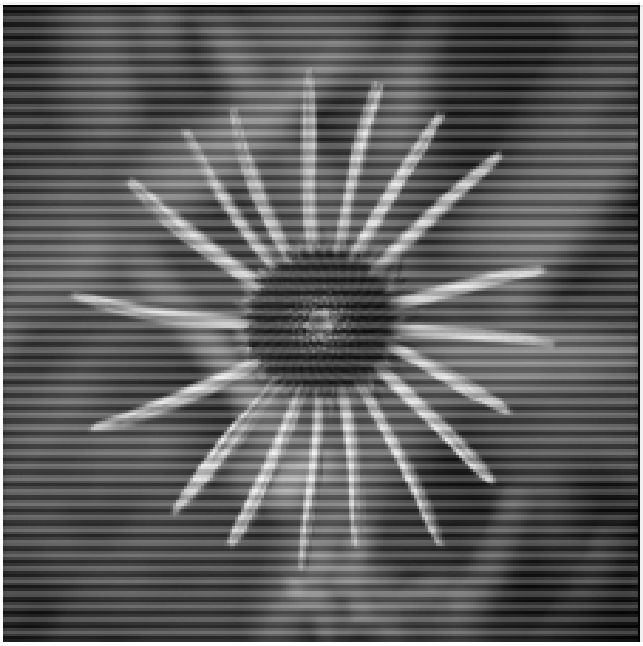


Figure 5-2

5-2 1D,2D,3D

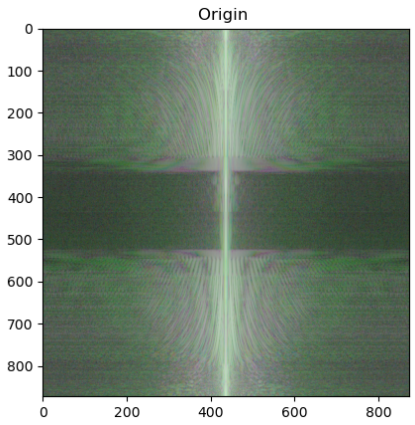


Figure 5-3: 2D power spectrum original image

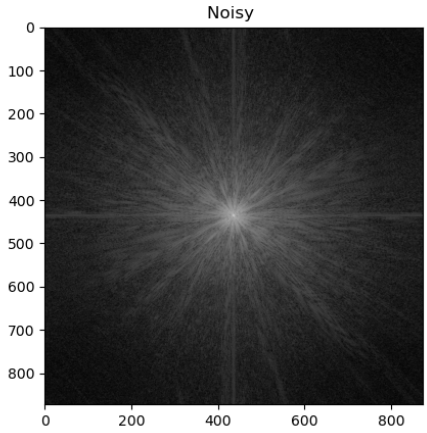


Figure 5-4: 2D power spectrum noisy image

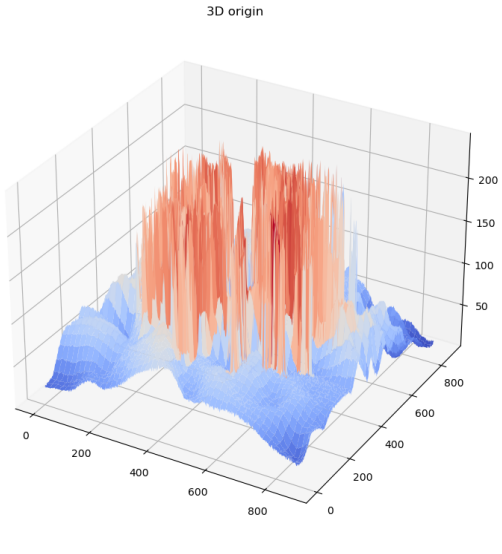


Figure 5-3: 3D power spectrum original image

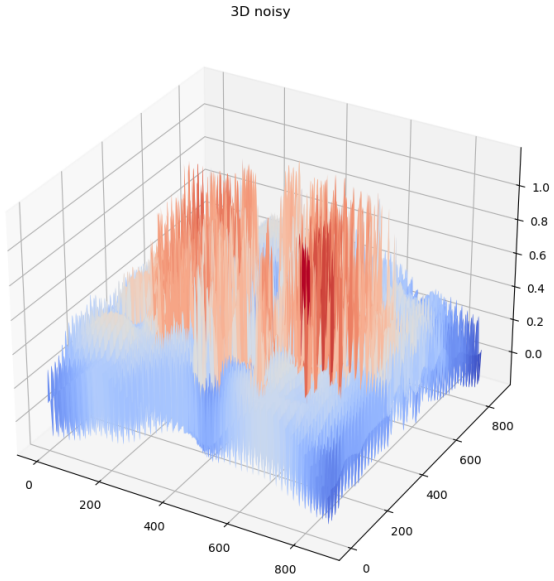
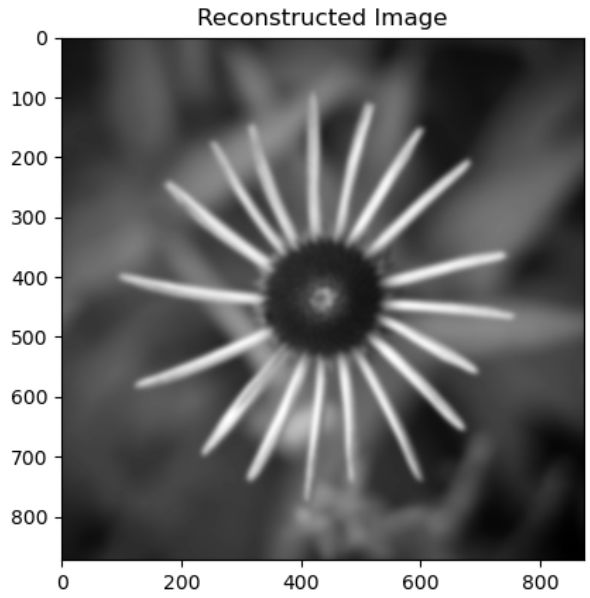


Figure 5-4: 3D power spectrum noisy image

5-3 In this task gaussian filter and FFT applied to get the denois image.



References

https://medium.com/nerd-for-tech/cartoonize-images-with-python-10e2a466b5fb

https://scipy-lectures.org/intro/scipy/auto_examples/solutions/plot_fft_image_denoise.html