Department of Electrical & Computer Engineering

COMP ENG 4TN4

McMaster University

Image Processing

Assignment 1

Due Date: 2022/01/21

Assessment: 4% of total course mark

Instructions:

- For coding problems, please include the results as well as the screenshots of codes in the report

- Please upload source codes along with the report in Avenue (1 zip/rar file including codes, results and 1 PDF report file)

- The report MUST be written in Latex

- The codes MUST be written in Python language

- Please write comments for your codes!

Theory (50 %)

1 Phone Camera Parameters, 15 %

* NOTE : 1 paragraph explanation is enough for each part An example of a smart phone camera specifications is shown in below:

1.1

What does the camera resolution show?

1.2

As shown the size of the main camera is $2.44\mu m$ while the selfie camera sensor size is $0.8\mu m$. First define the camera sensor size and the state what is the advantage of having larger sensor size?

1.3

What does PDAF stand for? Explain shortly how it works?

1.4

What is shutter speed? What do we lose and gain when we take a photo using high shutter speed?

1.5

What does OIS stand for? Using OIS, we can use a lower shutter speed. How could this improve the quality of the taken image?

1.6

What is ISO sensitivity in cameras?

2 Gamma Correction, 10 %

Why gamma correction is useful? present the formula of gamma correction and plot the output value vs. input value (assume the images are between 0 and 255) for $\gamma = \{0.25, 0.5, 1, 1.5, 2\}$

3 Other color spaces, 15 %

What is XYZ and XYy color spaces? Explain what is chromaticity diagram and plot it.

4 Interpolation, 10 %

What is bilinear interpolation? How can it be used to upscale (upsample) an image? Consider the pixels values shown in red are known:
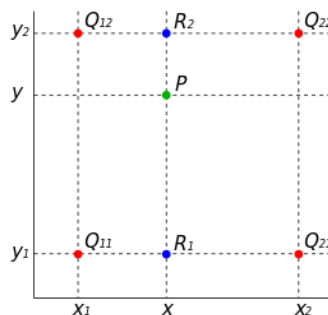
Use bilinear interpolation to derive the green pixel value. $(Q_{11} = 10, Q_{12} = 100, Q_{21} = 60, Q_{22} = 70)$

Implementation (50 %)

1   Hello OpenCV (15 %)

Write a program that takes one of the following inputs $0, 90, 180, 270$ and rotates the image regarding the given angle. Run your program for a sample image for all of the mentioned rotation angles.

2   Gamma Correction (15 %)

Implement gamma correction and apply it on "img1.png" to get a better image. Save the result.

3   Skin Detection (20 %)

Using your webcam, take a picture of your face. Then convert the image from RGB into HSV. Extract your face by thresholding the Hue channel. The threshold value should be obtained automatically. Save the final image in RGB format.

Hint: You may plot the histogram of hue channel and use the peak location of the histogram to adjust the threshold