CS3570 Introduction to Multimedia Technology

Homework #1

Due: 11:59pm, 3/29/2024

1. Interpolation (30%)

Write the image interpolation function to upsample the given image to 8 times the original width and height. Implement the following two different interpolation methods and show the 8X (both x and y directions) upsampled image. (You should not use any built-in function for the interpolation.)

(a) Nearest-neighbor (NN) interpolation

(b) Bilinear interpolation

(c) Compare results from (a) & (b). Discuss what you observe.

2. Photo enhancement (30%)

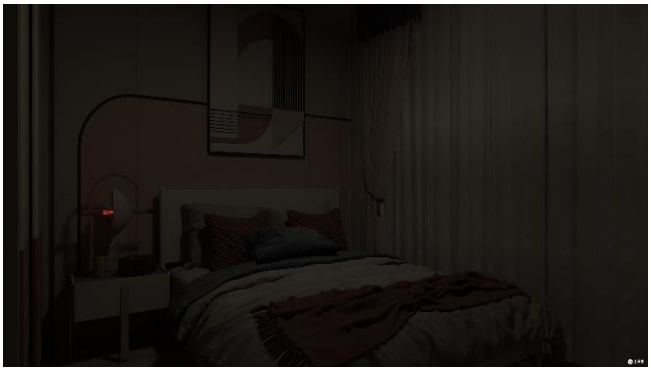
implement the following steps to correct the image “dark room”. (You cannot use any built-in functions to perform the enhancement procedure)

(a) Convert the RGB color space to YIQ, and show the image histogram of Y channel.

(b) Apply gamma transform to Y channel with a suitable gamma value.

(c) Convert the transformed image from YIQ color space back to RGB to show the result with the best gamma value. Also show the histogram of Y channel for the transformed image.

(d) Compare the image and histogram before and after your enhancement. Discuss what you observed.



3. DCT image compression

Transform the image **tokyo.jpg** from the spatial domain to the frequency domain with DCT for compression and reconstructing the compressed image using inverse DCT with reduced numbers and bits of DCT coefficients.

(a) Transform the image to YCbCr space and apply Chrominance Subsampling with 4:2:0.
(b) Show the compression rate and reconstruct the image with PSNR after Chrominance Subsampling.
(c) Apply 8x8 DCT to the image after Chrominance Subsampling and quantize according to the quantization Table.
(d) Show the ratio of non-zero elements in the image. And apply 8x8 inverse DCT to reconstruct the image with PSNR.

Reminder

- You are not allowed to use any function that directly generates the result for each step, except for those provided by us.
- Your code must display and output your results to enable us to verify its correctness.
- Please follow the instructions in the Jupyter Notebook and complete the parts marked as "TODO."
- If you encounter any problems or have questions, please post them on eeclass.

- Rename your Jupyter Notebook file to "HW1_xxxxxxxxx_ooo.ipynb", where "xxxxxxxxx" is your ID and "ooo" is your name. Ensure you upload it to eeclass before the deadline.
- Homework should be submitted before the announced due time. Scores of late homeworks will be reduced by 20% per day.