

TERM PROJECT—JPEG Implementation
CS 443/543 Spring 2023

Important Dates:

Due: midnight on 4/24/2023

Project Description

This project aims to implement the lossy compression part of the JPEG algorithm. Implement and apply the following simplified JPEG algorithm for two images in Project_Code_Images.zip. All of the following techniques are covered in Chapter 8 & 9.

Step I: Lossy Compression

1. Convert RGB components to YCbCr components (you can use HW2 or `rgb2ycbcr()` <https://www.mathworks.com/help/images/ref/rgb2ycbcr.html>).
2. Perform chroma subsampling 4:2:2 on color components (you can use HW2).
3. Apply 2D DCT transform ($N = M = 8$) on Y, Cb, and Cr components (refer to and use `dctTransform.m` in Project_Code_Images.zip)
4. Apply quantization using quantization tables (Table 9.1 and Table 9.2 of the Chap9 slide) for Luminance and Chrominance components, respectively. (i.e., remove AC components—check Chap. 9 slide.)
5. A Quality Scaling Factor ($qf=3, 30, 100$) should be applied to the quantization table. You must implement the scale factor algorithm from Chap. 9 lecture slides or textbook.

Step II: Decompression

1. Dequantize the DCT coefficients.
2. Implement and apply the 2D IDCT to the dequantized DCT coefficients. (use `idctTransform.m` in Project_Code_Images.zip)
3. Convert YCbCr components to RGB model (or use your HW2 or `ycbcr2rgb()`).

Step III: Outputs

- Save the outputs in .png

Step IV: GUI

You have to create a GUI that include the following functionality or GUI components:

1. Load and show the original input image
2. Add a button to execute the JPEG compression
3. Show the output after the JPEG compression
4. Add a slider for qf (Quality Scaling Factor), which allows the user to adjust the qf value from 0 to 100. If the user changes the slider, the output should be updated.

Step V: Group Report

The report should include the following information:

- Show values of the first 8x8 block of the input and output pictures (only for $qf=30$) for each stage of Step I (from 1 to 5). Importantly, you have to show how the values of the 8x8 block are changed according to different steps.
- Include input (two different input pictures from Project_Code_Images.zip) and output pictures for each stage at Step I and II. So, you need to generate your intermediate results at each stage.
- Discuss your observations of the results at each stage at Step I and II; discuss comparisons between the original image and your final output image.
- Show and discuss how the output images look different based on the qf values.
- Include your GUI screenshots.
- Lastly, your report cover (the first page) should also include a) Names of group members and also describe b) responsibilities/ contributions of each group member in a separate section.

Submission

You should submit the following materials for grading. The user should be provided an option of inputting images into your program. Include everything in a zip file, and the zip file's filename should include all team members' last names.

- Source codes
- The group report
- All output files in png (for each of the two images (pills and alu), generate six output images from the different qf values.)

output_pills_qf3.png,
 output_pills_qf30.png,
 output_pills_qf100.png
 output_alu_qf3.png,
 output_alu_qf30.png,
 output_alu_qf100.png

Group Project Policy: All team members typically receive identical project scores except for clear occasions. Report any team problems to the instructor early over email, so something can be done to remedy the situation before it is too late.