

Image Practical

CS4302: Practical 3

Deadline

This practical is due 24th November 2020 at 9pm. It is worth 35% of the coursework part of the grade.

Please note that MMS is definitive for weighting and deadlines, which, occasionally have to be changed.

Summary

This practical consists of writing a Matlab program to solve image processing tasks and writing a report to describe and discuss your methods and results.

Goals

The main goal of this practical is to provide practical experience with the processing of images in the spatial and spatial frequency domain. As a secondary goal you will gain more familiarity with Matlab, a very common programming environment for image and signal processing.

Requirements

You will prepare a report that reflects your solution to the tasks described below. Please relate the task number to the solution in the document. Include all your figures in your report.

The practical requires you to screenshot or capture three of your own image files. You will need to analyse all three of these images in tasks 1 to 4. These images need to be:

- A photograph with lots of variation (which probably has a wide variety of spatial frequency content). You can use a photograph taken by you and scaled to the right size by using any raster image manipulation programs (e.g., Gimp), or download a picture free of copyright from wikimedia commons or a similar source. If the source of the image is a jpg, make sure that it is of high quality (non-observable artefacts), or that it is of very high resolution before you scale it. Make sure that your images are exactly 1024x768.
- A photograph with little variation, for example, a photograph of the desert or the sky. Same considerations as in the previous point apply.
- A rasterization of an SVG diagram created by yourself. The diagram can be created in any vector graphics program (e.g., Inkscape, Illustrator, CorelDraw, Open Office Draw), and contain at least a Bezier curve, a polygon and readable text with a word. Most vector software allows you to rasterize a vector image through some kind of "Export" command.

Tasks

You will need to solve the following problems:

1. Show the three components Red, Green, Blue (RGB) as monochrome images with a colorbar for all three image files. Label the figures so that it's clear which component you are showing. Describe what these show and why.
2. Convert the images into the YCbCr colour space and show the 3 components of this colour space as separate images. Describe what these show and why.
3. Reduce your sampling of the Cb and Cr (chromatic components) in the spatial domain by a factor of 8 in both dimensions. Create matrices which contain the reduced sample set, then create an image (of the original resolution) using the Y (intensity map) and combine with the reduced sample of the Cb and Cr components for each image (consider the new mapping you will need to do). How do the new images compare with the original images? Produce a difference image of the original image minus the changed image to show how they changed and discuss the changes in terms of visual impact.
4. What is the spatial frequency components in these (original) images? Perform a 2D Discrete Cosine Transform (DCT) on the images and then discuss what these show and why they are the way they are.

Count Mo Money Ltd needs wants to have a program which can automatically count both the number of coins and the total value of the coins (GBP sterling coins) when a customer empties their money on their white counter tops and the camera over the top takes a picture of the money. Images of money on a white counter top with various difficulties can be found in the practical directory on studres – with filenames: “money_<difficulty-level>.jpg”, with easy, medium, hard, very_hard and extreme difficulty levels [tip: start with the easy difficulty and work up, I'd not recommend starting on a hard to extreme difficulty – also note that it's not expected that you will get the “correct” answer for harder difficulty levels].

5. Write a program which can automatically count the number of coins in an image using image segmentation. In the report explain your methodology, also show output images/figures of the steps your program takes and the final output in the report and discuss what the results mean. You must show results for the images provided on studres (discussed above) and discuss these results.
6. Write a program to count the value of the coins in these images. Output the total value in pounds and pence. If you're not familiar with GBP coins then images and descriptions of the latest coins can be found here: <https://www.royalmint.com/discover/uk-coins/coin-design-and-specifications/>, note that some of the coins in the task images are not the newest. Again in the report explain your methodology, also show output images/figures of the steps your program takes and the final output in the report and discuss what the results mean. You must

show results for the images provided on Studres (discussed above) and discuss these results.

Deliverables

You will deliver through MMS the following elements, compressed in a zip with the same folder structure that you used to run them:

- A **pdf** with your answers to the tasks (include all figures in the report as well as a discussion of the method and results).
- Your Matlab Script
- The image files that you used as input
- Any additional files (code or otherwise) that you used to complete the assignment.

The standard penalty for late submission applies (Scheme B: 1 mark per 8 hour period, or part thereof): <http://info.cs.st-andrews.ac.uk/student-handbook/learning-teaching/assessment.html#lateness-penalties>

Please note that the Good Academic Practice also applies: <https://info.cs.st-andrews.ac.uk/student-handbook/academic/gap.html>

This practical accounts for 35% of the coursework marks in the module.

The marking will conform to the mark descriptors from the student handbook: http://info.cs.st-andrews.ac.uk/student-handbook/learning-teaching/feedback.html#Mark_Descriptors

General Advice

Try to relate what you are doing in the submission to the content of the model lectures. Clarity in your answers is more likely to result in higher marks. Do comment your code for readability. Make sure your figures have axis labels (which are legible in the report) and you create figure captions in your report.

Throughout the practical report make sure you explain how you did the work, why you did it that way (justifying choices made), what you found (include outputs of the steps along the way where appropriate as well as the final output), and what the result means.