Objectives:
The objective of this assignment is to gain familiarity with basic image processing methods. It also provides an introduction to the common image processing and analysis tasks using OpenCV. After completing this assignment, you will learn how to:

1. Open and read image files;
2. Perform simple mathematical operations on images;
3. Perform filtering using convolution masks;
4. Perform image manipulation and adjustment.

Task:
Digital art is an artistic work or practice that uses digital technologies as an essential part of the creative or presentation process, which is popularly used in computer-generated visual media with applications such as virtual reality. The goal of this assignment is to write a program that takes an input image and applies image manipulations on it to create art effects, e.g. oil painting.

Below is an original image, and the final `oil painting’ result obtained after applying a sequence of image manipulation operations.

It is recommended that you use the OpenCV library either in C++ or Python for this assignment.
Instructions:

Task 1
The colour images above are provided to you as sample input and final 'oil painting' output. You may also test on other images of your choice.
Starting with the input colour image, you should combine the three colour-bands into one band by a multiplication operation using the following equation:

\[ I = 0.299 \cdot r + 0.587 \cdot g + 0.114 \cdot b \]
You will go through the image pixel by pixel and perform this operation on each pixel. The result will be an image with only one combined band, i.e. a gray-level image.

Task 2
Once you get the combined single band image, the next task is to apply a convolution operation on the combined image to find the most frequent local pixel value in a neighbourhood (including the current pixel). To implement this, you will:

- first define a mask around the current pixel
- apply the mask on each pixel of the image
- compute the intensity histogram for the masked area
- pick the most frequent pixel value using the histogram and replace the current pixel with the most frequent local pixel value in the single band image.

Make sure you can display some meaningful intermediate results.

Task 3
Having obtained the single band image \( I \) with each pixel being the most frequent local value, you will construct the final 'oil painting effect' image. To do this, you will

- make a copy image \( A \) of the original colour image
- for each pixel \((x, y)\) in the result image \( I \), in the local neighbourhood defined by the mask in task 2 of pixel \((x, y)\),
  - find all pixels which have the same value of \( I(x, y) \)
  - get the intensities of those pixels in image \( A \)
  - calculate the average intensities of those pixels in each band
  - then replace \( A(x, y) \) with the average value in each corresponding band

Try different mask sizes in task 2 to experiment with the art effects.

Optional task: Try to improve or diversify the visual effect of the results, e.g. sharpen or smoothen the result image to create new effects.
Evaluation:

Several images will be released on the day the assignment is marked. You will take your marker through the steps showing the output of the image effect construction procedure and the final output, as well as the results you have obtained on your own data.

This assignment is worth 10% of the course total. Tasks 1, 2 and 3 are sufficient to complete the assignment and will be marked against the maximum mark achievable. The optional task, if completed, will attract a bonus mark.

Deliverables: In addition to demonstrating your work, you will also submit a two-page report both online and to your marker in hard copy on the day. This report should explain briefly the approach you have taken in Tasks 1, 2 and 3 and include some sample input sequences and the results obtained. Optionally, include details of any other effects you have implemented. Instructions for online submission of the report will appear on the course webpage before the deadline.

Deadline:

Demo and report submission on DAY of week 4 (Aug 15th, 2016), during the lab time, 5-6 PM. Venue is “brass” lab, (J17 305).

Software:

Download OpenCV and read guided tutorial: http://opencv.org/

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