Image Capture, Digital Image Representation

1 Image Storage

The first steps in processing a digital image are input/output and simple pixel-wise manipulations. A very simple and therefore portable image file standard is the NetPBM format family. Write a program that can read both `PGM` and `PPM` files, process them as described below and produce new `PGM` or `PPM` files. Use the OpenCV library for the internal representation of the images, but not for input/output operations.

- Read a single image file, which can be either a `PGM` (grayscale) or a `PPM` (color) file. Your program should accept the filename as an argument, e.g. `myprog foo.pgm`.
- Your program should handle files with comments.
- Implement the following functionality:
  - If the input file is a grayscale image:
    1. "Invert" the image, i.e. change the gray values so that everything that was black is now white, everything that was dark gray is now light gray, everything that was white is now black. You will need to use the maximum value of the image to do this correctly.
    2. Write the updated pixel values to a new file.
  - If the input file is a color image then produce two output files:
    1. A color image where for each pixel: the red value is replaced by its blue value, the green value is replaced by its red value, the blue value is replaced by its green value.
    2. A grayscale image where the gray value of each pixel is the average of the red, green and blue values, rescaled to vary between 0 and 255.
- Make sure your output file is readable by various viewers, e.g. Gimp, Photoshop etc.
- Be careful of overflow, underflow and truncation of values.

2 Image Manipulation

In practice, you might prefer or even need a more complex image format. An important role plays compression, which makes your data collection much more space-efficient. Two important compressed image formats are `PNG` and `JPEG`.

- Explain the main difference between these two formats and which one you would choose to store your images for research.
- Use the `imread` method from OpenCV to read `PNG` and `JPEG` image files. Test it (compare to your own reader) with the `PGM` and `PPM` images as well.
- Write a version of your program that accepts two color image files.
  - Split both images into the three channels **R**, **G**, and **B**.
  - Create a new grayscale image that expresses the difference between the two images in the **R** channel. For each pixel you substract the **R** value of the second image from the **R** value of the first image.
  - Rescale the data in the difference image to vary between 0 and 255.
  - Write the difference image to a file.
  - Process the **G**, **B** channels accordingly so that in total you obtain three difference images.

All the information necessary for processing `PGM` and `PPM` files can be found at **`http://netpbm.sourceforge.net/doc/pnm.html`**.

The OpenCV documentation is available at **`http://opencv.itseez.com/`**.