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Lab. 1 – Image Filtering
CS4800 – Digital Image Processing
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Submitted on: 07/15/14

IMAGE FILTERING

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Description

For this assignment was required the implementation of two filters in a colored and grayscale image. The original image was took on class and the original format was .JPG, but for the project purpose, it was converted to .PPM. Always when is mentioned "Original" in this report, is referring to the **.PPM** file.

LAPLACIAN CONTRAST

The two filters applied were based in a 3 x 3 mask, as follow:

Mask 1:

$$\lambda_1 = \begin{matrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{matrix}$$

Mask 2:

$$\lambda_2 = \begin{matrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{matrix}$$

Implementation

LANGUAGE

The programming languages used in this project were C and C++.

SOFTWARE USED

The main software used was Microsoft Visual Studio 2013, for the development and debugging of the code. It was also used MatLab, Photoshop and GIMP, to the preprocessing of the image files.

SOURCE CODE

The complete source code is attached and also available on GitHub:
https://github.com/inessadl/image-filtering

Original and Grayscale

The original image was cropped, resized and converted to .PPM format. The grayscale and all the applications of filters on “color image” were based on this picture.

ORIGINAL

Picture 1 – Original Image

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GRAYSCALE

The Formula used for the conversion of a RGB image to a grayscale image was:

$y = 0.299R + 0.59G + 0.11B$

and it was extracted from the class book. My first solution to the conversion was the average method, after that, I tried the luminosity method (with 0.21 R + 0.72 G + 0.07 B), until I got the right formula.

All the filters to "grayscale" were applied in this image.

Picture 2 – Grayscale Image

Filter 1

The initial challenge for the application of the filters was deal with the boundary values. The values of the "contour" of the image require special attention because if the base convolution formula is applied, they will receive the wrong value.

One of my first errors was in the boundary of the right column, were I was trying to access values outside the array, therefore, wrong positions of memory, which my compiler didn't accepted.

I also had some mistakes in the convolution formula which were fixed with the help of the professor.

FILTER1 ON COLORED IMAGE

Picture 3 – Filter 1 on colored image

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FILTER1 ON GRAYSCALE IMAGE

Picture 4 – Filter 1 grayscale image

Filter 2

One of the main problems in the representation of the filter 2 was the size of the image. The result was clearer in smaller images. So after the application of the filter, the original image was resized and the filter applied again. Once the original image was resized, all the others (including the grayscale) images with the mask 2 presented a better result.

FILTER2 ON COLORED IMAGE

Picture 5 – Filter 2 on colored image

FILTER2 ON GRAYSCALE IMAGE

Picture 6 – Filter 2 on grayscale image

Comparison

For purpose of easy comparison, the images are represented side by side:

ORIGINAL X GRAYSCALE

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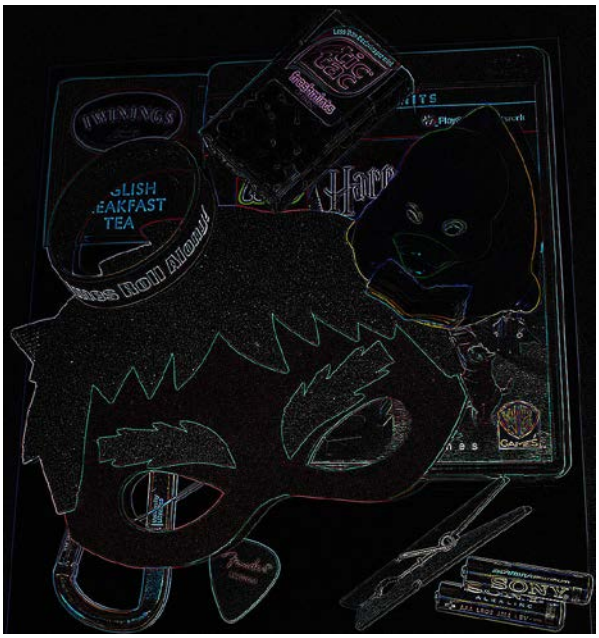
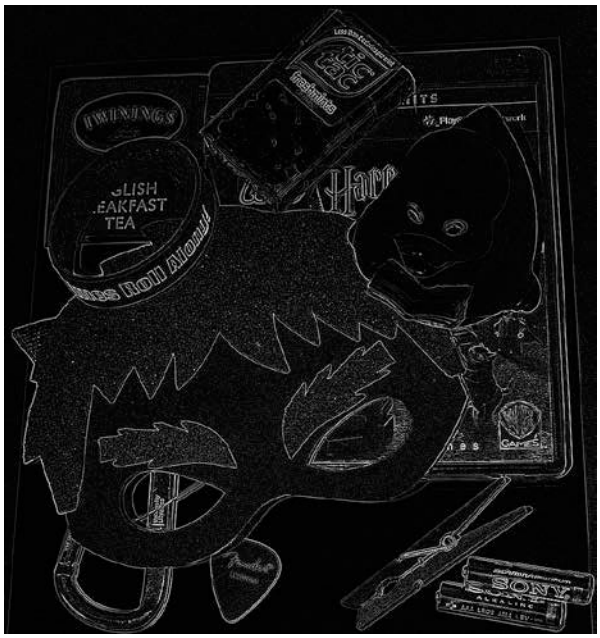
FILTER 1: COLOR X GRAYSCALE

FILTER 2: COLOR X GRAYSCALE





Discussion

This project was a worthy introduction to digital image processing techniques and certainly stimulating for future works. The template provided by the professor was essential to the beginning of the project.