**IIVS Module #4 Laboratory**

**Digital Image Processing**

The following should be written as a simple experiment summary – **no need for a formal lab report.** Begin by downloading the following 6 images from mycourses Module 4 content onto your local machine.

**4. Lena.tif - grayscale**

**4. Dock.tif - grayscale**

**4. NYC.tif - grayscale**

**4. Boy.tif – color**

**4. UglyBoy.tif - color**

**4. Elevator.tif - color**

**Exercise #1 – Histograms**

Follow in the lecture notes as we look at histogram definitions. You will use Photoshop with these images to keep up with the discussion.

Questions:

1. Describe how histogram shape and image contrast are related.

If the there is a reasonable distribution of values on the histogram, the image has high contrast because there the values are not skewed towards a certain color. A histogram shape that involves values leaning towards the left or right side, the image has a low contrast because most code value counts are similarly related.

1. Fill in the following table for the mean code values in the **4. Boy.tif** image.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **R** | **G** | **B** |
| **Entire Image** | 103.38 | 110.03 | 91.65 |
| **Face Only** | 113.38 | 103.05 | 79.46 |
| **Hair Only** | 64.08 | 55.77 | 42.92 |
| **Yellow Flower** | 239.76 | 215.15 | 15.59 |

1. What is the general color balance of the overall image based on your answers above?

The overall image has a nice color balance because the mean values of all three colors are relatively similar. Looking at the image, there are areas of brightness, like the chair and the face, just as often as the areas of darkness, like the hair and background.

1. A) How many instances of a red pixel value of 45 are there in this image? B) What percentage of blue pixels are there in the image with code value greater than 200? C) Are there more pixels overall with a color above code value 128 or below?
2. 5022
3. 11.81%
4. Below - there is a higher number of pixels with code value less than 128.

**Exercise #2 – Photoshop Levels**

Using **4. Boy.tif**, open Image->Adjustments->Levels and begin experimenting with Preview On. Make sure you can see your image histogram and make note of how it changes as you adjust the different settings on the Levels GUI (Photoshop CC shows you the original histogram and your adjusted histogram together when you Preview the operation – very handy!)

1. How do the image and the histogram change when you slide the black input level to the right?

As the white and black triangles are moved towards the center, the histogram begins to level out in pixel count and the shape appears to be relatively smooth. \*\*think mathematically\*\*. The image changes in brightness as the white and black triangle move.

1. How do they both change when you slide the white input level to the left?

The image brightens as the white triangle slides to the left and the histogram shows higher pixel counts for the higher code values. This means the overall appearing of the image is brighter as the input level changes so the colors are leaning more towards higher code values.

1. How do the image and histogram change with the gray input slider?

When the gray input slider moves to the left, the darker areas get crushed whereas when it moves to the right, the appearance is brighter and the lighter areas get clipped. This

1. Why does your histogram occasionally get gaps in it as you manipulate the settings?

If the output level remains the same, from 0 to 255, and the white and black input levels are changed, the input levels will not be enough to fill every output level given. The values are integers, so if there are less input values than output values, not every output value will be assigned an input value and therefore, gaps appear in the histogram to show those empty areas in output values.

1. Which digital imaging artifact best describes these gaps?

Next, open **4. Ugly Boy.tif** in Photoshop. This image is screwed up for contrast, brightness and color balance and we need to fix it.

1. Check out the histograms for the red, green, and blue channel individually – you’ll notice the green channel is squished in from the left (blacks), the blue channel is squished in from the right (whites), and the red channel is squished in from both sides.
2. Using Photoshop Levels, adjust the input sliders on R, G, and B channels **independently** until all 3 of the histograms are once again nicely distributed across the full range (be sure you are looking at individual color channel histograms and levels as you do your manipulation previews!)
3. Comment on the quality of the match to the original **4. Boy.tif – copy and paste the original 4. Boy and the fixed 4. Ugly Boy into this word document**

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**Exercise #3 – Photoshop Curves**

We will again be using the **4. Boy.tif** image. Using Image->Adjustments->Curves, play with the interface to get the hang of the tool. Keep Preview ‘on’ so you can see how your image will be impacted by the adjustments you are making. Once you are comfortable proceed with the 3 exercises below.

1. From the original starting image, produce a curve that basically looks like the following. Apply your curve to the image and save it as a new jpeg file.
2. Start again from the original image and create a curve that looks like this. Again, apply and save your image as a jpeg.
3. And one last time, recreate the curve here and save the altered image.
4. **Paste copies of the 3 image files into this document** and comment on tonescale consequences (use tonescale-appropriate vocabulary – shadows, highlights, midtones, contrast, etc. – speak about changes from the original to each of the 3 new states)

**Exercise #4 – Photoshop Image Size**

We will again be using the **4. Boy.tif** image. Using Image-> Image Size, resize up the image from an original size of 768x512 to 1920x1280. Use Nearest Neighbor, Bilinear and Bicubic (best for smooth gradients) interpolation.

Comment on the differences you see with each method. Which method in your opinion produces the best results and why do you think that is the case?

**There is no need to copy and paste the images from this exercise into the document**

**Exercise #5 – Convolution**

Begin by downloading the image **4. Elevator.tif**. Next, open the image in Photoshop and navigate to Filter->Other->Custom. You will be applying different filters one at a time and saving the resulting images as jpegs (you also need to save the original unaltered image as jpeg). Also start formulating some observations as you create each image. **Remember to always start with the original image before applying the next filter or your results will be cumulative!**

\*Note: Photoshop provides you a 5x5 grid but most of the filters we will experiment with are only 3x3 – you can type your filter into the middle 9 squares and leave the outer squares blank.

1. Blur filters

|  |  |  |
| --- | --- | --- |
| 1 | 1 | 1 |
| 1 | 1 | 1 |
| 1 | 1 | 1 |

Scale=9, Offset=0

Vs.

|  |  |  |
| --- | --- | --- |
| 1 | 2 | 1 |
| 2 | 4 | 2 |
| 1 | 2 | 1 |

Scale=16, Offset=0

Using the 2nd filter, what happens to the images as you change the scale value?

Explain mathematically, the difference in the amount of blurring each filter

provides.

1. Sharpening Filters

|  |  |  |
| --- | --- | --- |
| 0 | -1 | 0 |
| -1 | 5 | -1 |
| 0 | -1 | 0 |

Scale=1, Offset=0

Vs.

|  |  |  |
| --- | --- | --- |
| -1 | -1 | -1 |
| -1 | 9 | -1 |
| -1 | -1 | -1 |

Scale=1, Offset=0

Using the 2nd filter, what happens to the image as you change the offset value both positive and negative?

Explain mathematically, the difference in the amount of sharpening each filter

provides.

1. Edge Detection Filters

|  |  |  |
| --- | --- | --- |
| 0 | -2 | 0 |
| -2 | 8 | -2 |
| 0 | -2 | 0 |

Scale=1, Offset=128

Vs.

|  |  |  |
| --- | --- | --- |
| -1 | -1 | -1 |
| 0 | 0 | 0 |
| 1 | 1 | 1 |

Scale=1, Offset=128

Vs.

|  |  |  |
| --- | --- | --- |
| -1 | 0 | 1 |
| -1 | 0 | 1 |
| -1 | 0 | 1 |

Scale=1, Offset=128

Any obvious trends noted in comparing these 3 filters? Can you justify it

mathematically? (Hint: these are edge detection filters so look at image edges!)

**Copy and paste all of the images from the blur, sharpen and edge filtering exercises into this Word document**