University of Rochester
CSC 249, Machine Vision
Spring 2017

Homework 1

Nathan Conroy

January 31, 2017

1 Converting Images to Grayscale

For the first section of this assignment, I took four pictures. One pair was of a friend in two different lightings, while the other pair was of an outdoor scene during the day and at night. The images are located within the "original_images" folder.

Figure 1.1: Ankur1.png

Figure 1.2: Ankur2.png

Figure 1.3: phase1.jpg

Figure 1.4: phase2.jpg

From there, I created a method called imageToGrayscale which takes in the filename of an image and uses the rgb2gray function to convert the 3-dimensional rgb image array to a 2-dimensional grayscale image array. Note that the rgb2gray function uses Mathwork's Image Processing Toolbox, so you will need to have that installed in order to successfully run the program. If you do not have it installed, an error message will appear in the console with the link to the download during runtime. The resulting image is saved in the "grayscales" folder with the tail "_grayscale" added to the filename. The image type is preserved.

Figure 1.5: Ankur1_grayscale.png

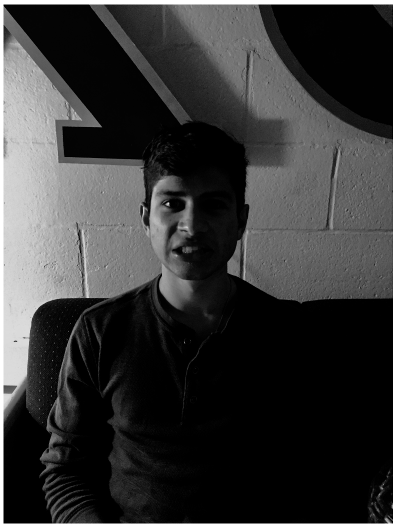

Figure 1.6: Ankur2_grayscale.png

Figure 1.7: phase1_grayscale.jpg

Figure 1.8: phase2_grayscale.jpg

2 Magnifying Patches and Creating Histograms

After the images have been converted to grayscale, the images are passed through my zoomImage method. The method takes in two parameters, a filename and a zoom level. The method uses the built-in zoom function to magnify a region of the image, and saves the result as a new image in the "zooms" folder with the tail "_zoom" added to the filename. The image type is preserved.

In order to analyze the intensity values of the image patches, I created a getHistogram function that takes in a filename and uses the imhist method to plot the data. The histograms are saved in the "histograms" folder with the tail "_histogram" added to the filename.

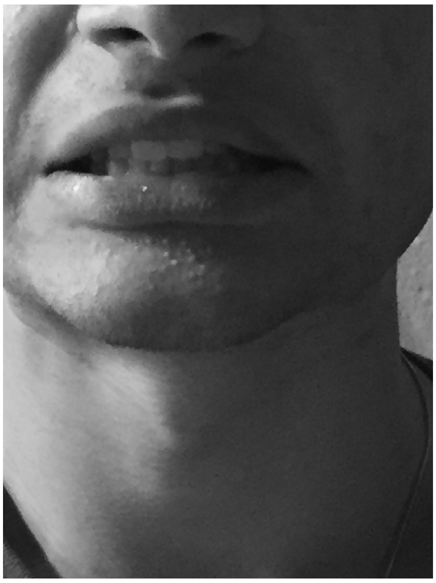

Figure 2.1: Ankur1_grayscale_zoom.png

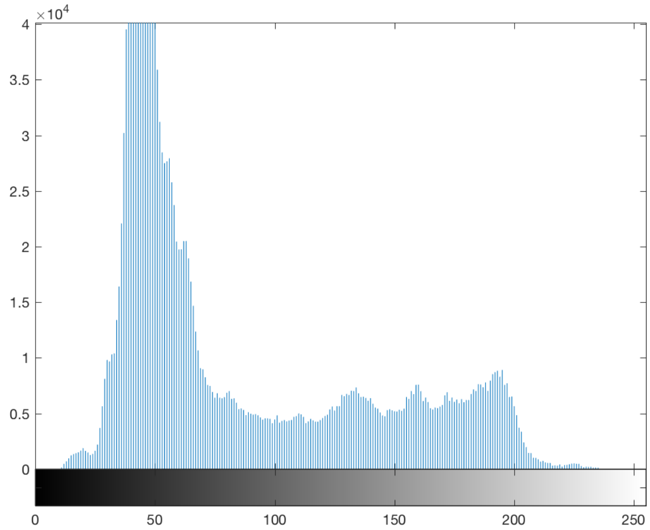

Figure 2.2: Ankur1_grayscale_zoom_histogram.png

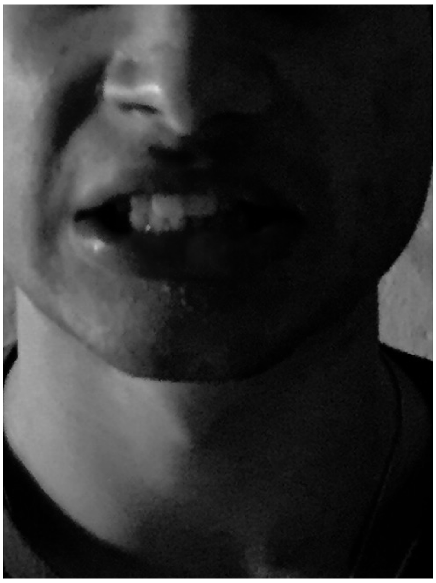

Figure 2.3: Ankur2_grayscale_zoom.png

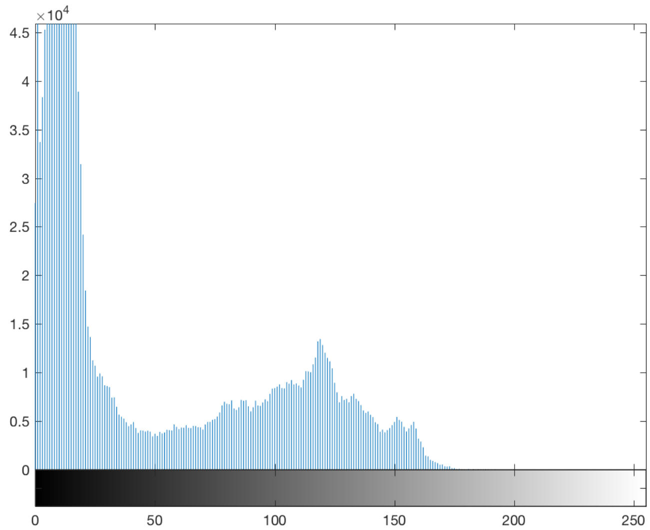

Figure 2.4: Ankur2_grayscale_zoom_histogram.png

Figure 2.5: phase1_grayscale_zoom.jpg

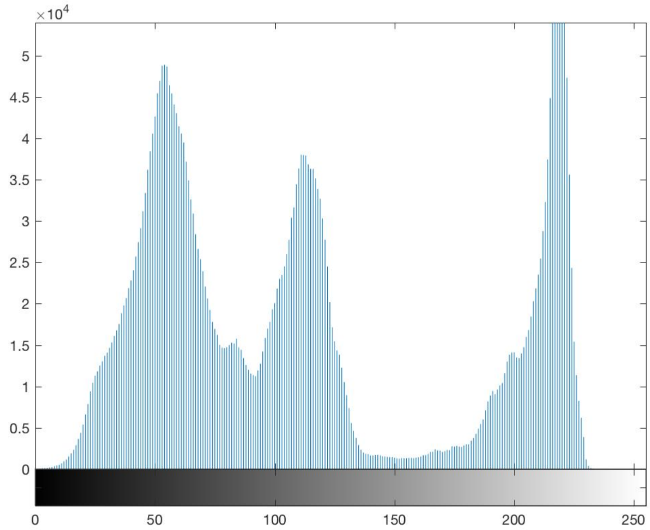

Figure 2.6: phase1_grayscale_zoom_histogram.jpg

Figure 2.7: phase2_grayscale_zoom.jpg

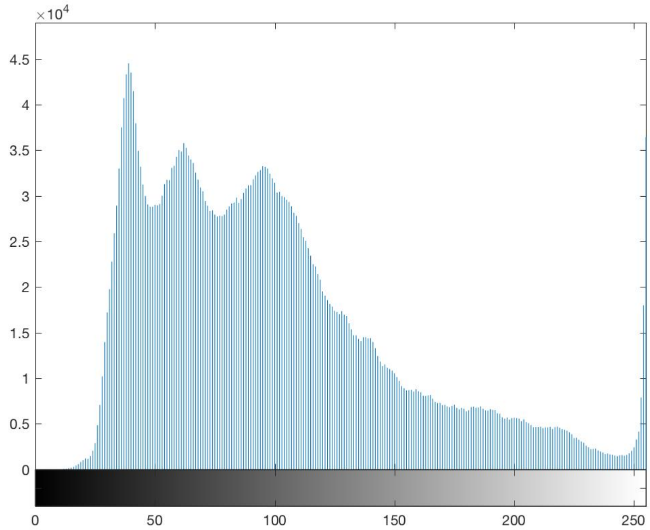

Figure 2.8: phase2_grayscale_zoom_histogram.jpg

3 Analysis

I chose to use histograms to interpret the data because they are a great way to visually display the distribution of intensities in grayscale images. The imhist function uses 256 bins, which represent a range of color values, and keeps track of how many times a pixel in that range appears in the image.

My expectation was that the shapes of the graphs corresponding to the image pairs would be similar, however the brighter image's shape would be positioned farther right along the x-axis (towards the brighter colored bins). With the first set of images, I found this to be true. Figure 2.2 shows a large peak around bin 50, which then settles back at about .5 x 10^4 pixels around bin 75, and then slightly increases at a gradual rate to about bin 200. Figure 2.4 seems to display a very similar shape, but at different bin values. Instead, the histogram has a large peak at about bin 15, which settles down to about .5 x 10^4 pixels around bin 40, and then increases at a gradual rate to about bin 120, before decreasing slightly again. Figure 2.2 has a bin range of about 10 to 230, while figure 2.4 has a bin range of about 0 to 170.

The other set of images seems to show some deviance from my initial expectation, although the graph shapes can surely be explained. Figure 2.6 shows a histogram with 3 noticeable peaks around bins 50, 110, and 220. Figure 2.8 shows a histogram with 1 major peak at about bin 40, and then a curved decline as the bin number increases. The major peak in figure 2.6 at bin 220 seems to be due to the snow, which is much more abundant in the daytime scene than in the nighttime scene. With that peak removed, the shape of the histograms seem to be much more similar. Similarly, the peak around bin 256 in figure 2.8 is due to the bright light emitted by the streetlights, which are turned off in the daytime scene.

The blurriness in the zoomed images are a result of the manipulation of the image's pixels. As the zoom level increases and the image dimensions stay the same, the size of the blocks of pixel colors increase as they are created from the value of their neighbors.

4 Extra Credit

For extra credit I chose to create the histograms to aid me in my visual analysis. Other functionalities of my code include the preservation of image type in my Matlab methods, as well as allowing the user to decide the zoom level.