Report on Assignment#1

(Note: the "README" file also has a detailed explanation of what the program does.)

Goal

The purpose of this assignment is to familiarize ourselves with image manipulation in Matlab and learning the basics about pixel intensity values as well as their variations under different lighting conditions.

Algorithmic Description of the Matlab program

The main program of this assignment is written in a file called "one.m". When we run the code, it does the followings in order -

1. Resize the original images (of 4000x3000 resolution) into 10 times smaller images
2. Turn the small images created above into gray scale
3. Save the gray scale images
4. Select a certain portion of the images (in particular, between 35-175x20-150 pixels) and blow them up 4 times in the figure displayed
5. Save the blown-up versions of the above images

Finally, we used a Matlab example implementation of viewing pixels ("my_pixinfotool.m") to show the intensity values of the pixels in certain regions.

Observations

Since the step 1 to 5 above are obvious and need no further explanation, we will focus our explanation on what we found in our observation of pixels using "my_pixinfotool.m".

For this experiment, we took two photos of a plush toy, the Cheshire cat. The first one is taken under normal room light, and the second one is taken when the camera flash is turned on and the room is in complete darkness. We will refer to these photos as #1 and #2 respectively in this report.

As we mentioned, these photos were converted to into gray scale and we used the third party Matlab program to inspect the intensity values. The following two screen shots (Figure 1 and 2 for photo #1 and #2, respectively) were taken from the output of the Matlab program.

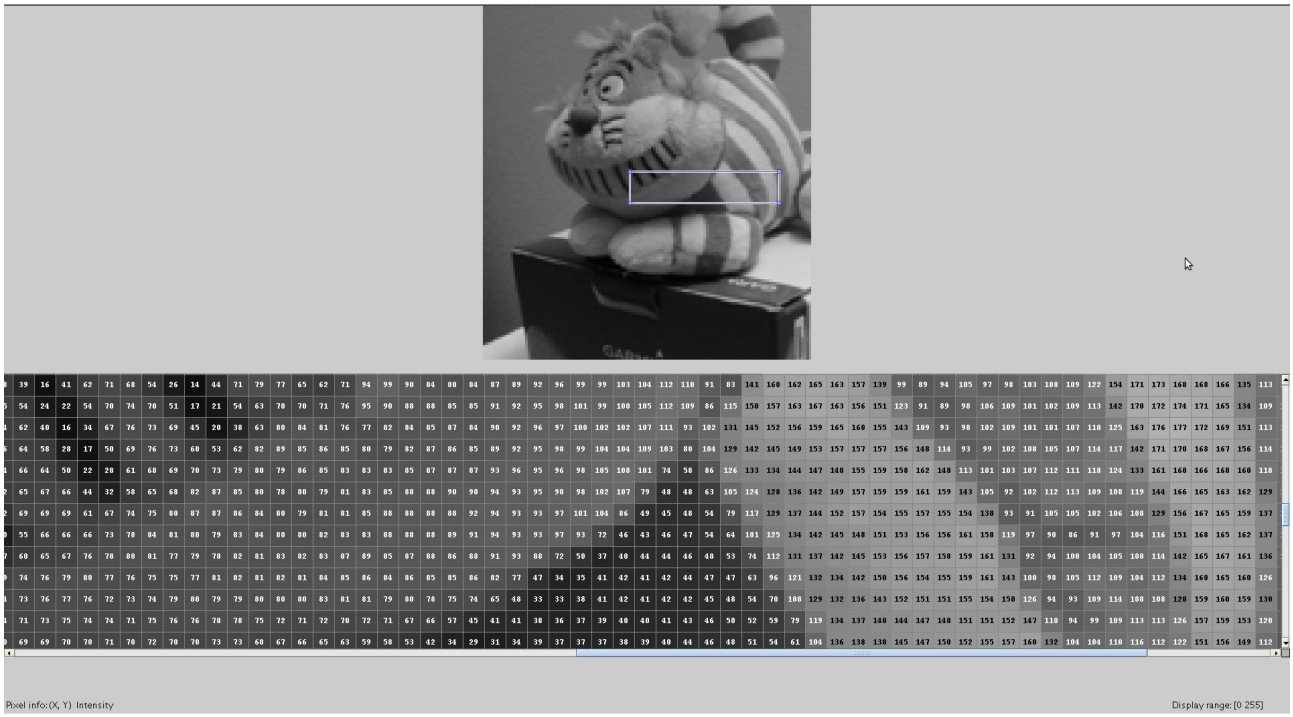

Fig. 1 Pixel intensity values around the neck and chin of cheshire cat taken under normal room light. We used a program from one of Matlab documentation examples to draw the bounding box and display the pixel intensity values within that bounding box. The bounding box can be adjusted via our Matlab program to focus on intensity values of different areas as well. Here, the bounding box is located near the cat's chin, neck and body areas.

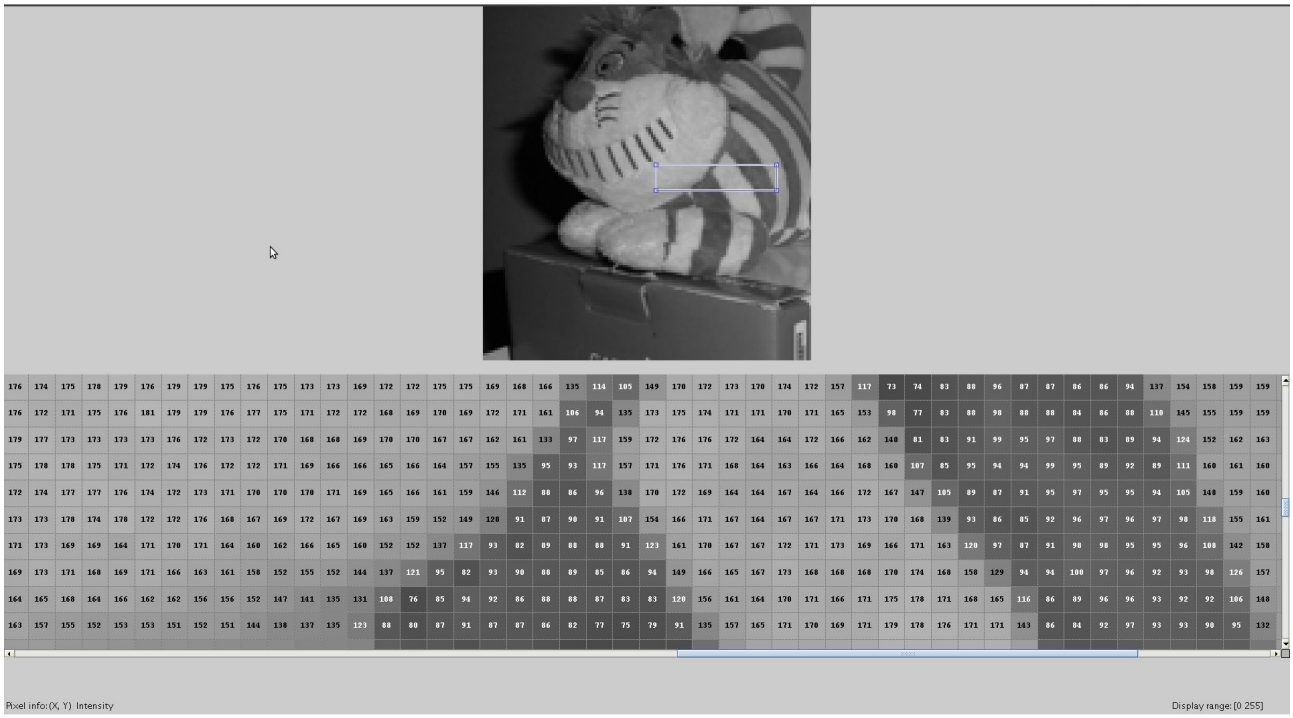

Fig. 2 Pixel intensity values around the neck and chin of cheshire cat taken using the camera flash. We can see that the intensity values are generally higher than that in Figure 1, and that even the darkest areas in the image possess higher intensity values than those in Figure 1.

Here, we put the bounding box around the chin, neck and body area of the cat. The reason is that this area has a lot of transition from dark to bright areas going on, and that it may cast shadow under the neck region when the artificial light (that is, the camera flash) is not shown.

As we can see in Figure 1, the intensity values of the focused area range from ~170 for the brightest pixels to about ~20 for the darkest pixels. However, in Figure 2, the intensity values range from ~170 for the brightest to ~80 for the darkest (please zoom in on this document if you cannot see the pixel values). In addition, the chin area (that is, the triangular region of dark pixels in the center of the pixel chart) of Figure 1 is generally darker due to the lack of artificial, directed light source whereas the same area is lighter (and therefore, hold higher intensity values on average) in Figure 2. This disproves our initial hypothesis that camera flash may cast shadow under the neck region in #2.

Although the intensity values range around 170 for the lightest areas in both screen shots, Figure 2 generally seem to have the darker pixels with values about 4 times as high as that in Figure 1 (that is, ~80 for Figure 2 vs. ~20 for Figure 1). Since Figure 2 is derived from the photo taken with the camera flash shining directly on the plush toy, it makes sense to have higher intensity values (for even the darkest areas) than Figure 1 does.

We placed bounding boxes around different areas of the images to observe their intensity values. In the teeth/mouth region of the cat, we found the similar trend that intensity values are higher in #2 (the flash image) than those in #1. However, on the right side of the photos (that is, the body and tail part of the cat), we do not see noticeable difference between intensity values. It could be explained by the fact that in #1, there is a room lamp near the right side of the cat and that it was serving as an external light source for the camera. As a result, the pixel values on the right side of #1 came out similar to those in #2 where we shone direct camera flash on the cat.

It would have been nice if we modified the program to return us the average intensity values within the bounding box. This will allow us to definitely say whether the differences in intensity values that we observed are significantly different.