CSCI-4150-programming-assignment-01

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This assignment is aimed to demonstrate how individual pixels in images can be accessed and processed.

These are all the calculations and implementations:

1) Using Python Imaging library (PIL) to create images with different contrasts, color and grayscale images because the main point was preparing images with different subjective visual quality. One way to achieve image variation is to include very low, low, medium, high, and very high contrast images. (Note: Keep all images in the collection the same size)

2) Developing an OpenCV program to read color and grayscale images. Repeating the following process for each image in the collection using a looping construct.

3) Computing probability distribution for the image and the sum of probabilities in the distribution sum to one.

4) Computing mean, variance, and the third and fourth central moments.

5) Investigation whether any relationships exist between mean, standard deviation, the third and the fourth central moments, and image variations using all the previous calculations.

Conclusions:

1) We can probably just use a simple statistical measure of the image to determine whether an image has sufficient contrast. The variance of the image would probably be a good starting point. Based on the variance calculations of images with different contrasts, if the variance is below a certain threshold (to be empirically determined) then we can consider it to be low contrast. On the other hand, an image with a high level of detail or high contrast level has high variance.

2) As we know mean value is the sum of pixel values divided by the total number of pixel values. Images with a high level of detail has its mean around L/2. As contrast increases, the pixel values shift farther toward the left or right side of the histogram. For example, in a gray color image with different contrasts, which emphasizes dark and light tones with relatively few mid-tone pixels, increasing contrast makes the distribution more bimodal. We can conclude this when we calculate and compare the mean of the color images with different details and contrasts, image variations, images with high level of contrast have smaller mean value than pictures with low level of contrast.

3) Another conclusion would be about std or standard deviation of an image. Standard deviation conveys the tendency of the values in a data set to deviate from the average value. It's interesting, though not surprising, to note that the std increases as contrast increases. The calculations for

different images show that when we add more contrast to an image, we spread out the histogram or distribution such that the overall tendency of the data set is to have greater distance between the individual pixel values and their mean.

4) In terms of digital image processing, darker and glossier surfaces tend to be more positively skewed than lighter and matte surfaces. Hence, we can use skewness in making judgements about image surfaces. This is because skewness measures how "lopsided" the distribution of pixel values. Based on this concept and third moment calculation special parts of the image with darker colors and high contrast level it would be more positively skewed, and the value would be more negative for example in my case: very high contrast image has -0.092 but very low contrast image has -0.0048. This result is similar to gray scale image too.

5) In digital image processing kurtosis values are interpreted in combination with noise and resolution measurement. High kurtosis values should go hand in hand with low noise and low resolution. Kurtosis somehow detects if distribution is flat or peaky, and later was associated to perceptual aspects of sparse coding. It is often considered as a measure a sparsity and used in early deconvolution methods. By looking at the probability distributions of the images with different contrast levels, while skewness focuses on the overall shape, kurtosis focuses on the tail shape. Based on this concept and third moment calculation special parts of the image with darker colors and high contrast level it would have more negative fourth moment value for example in my case: very high contrast image has -1.698 but very low contrast image has -0.487. This result is similar to gray scale image too.