Computer Vision
Fall 2018
Problem Set #1

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1a: Interesting Images

Image 1 - ps1-1-a-1.png

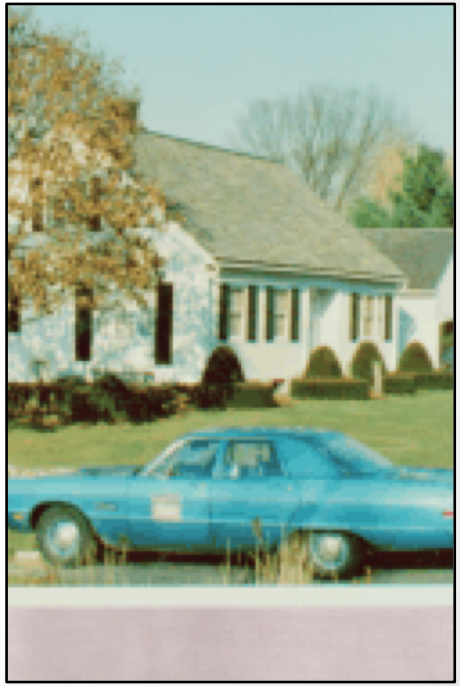


Image 2 - ps1-1-a-2.png

2a: Swapped Green and Blue

ps1-2-a-1.png

2b: Monochrome Green

Img1_green - ps1-2-b-1.png

2c: Monochrome Red

Img1_red - ps1-2-c-1.png

3a: Replacement of Pixels

ps1-3-a-1.png

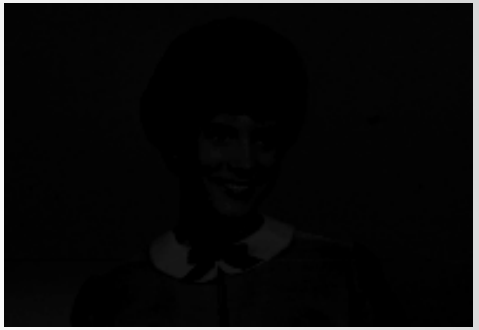
4a: Image Stats

- Min, max, mean, and standard deviation

```
('The min pixel value of img1_green is', 42.0)
('The max pixel value of img1_green is', 192.0)
('The mean pixel value of img1_green is', 133.78757246376813)
('The std dev of img1_green is', 24.642551522850102)
```

4b: Arithmetic Operation

ps1-4-b-1.png (numpy.uint8 data type)



ps1-4-b-1.png (numpy.float64 data type)

Note: center_and_normalize(image, scale) function needs to return floating data (image) in order to pass Bonnie auto-grader. I converted it to uint8 when producing this image.

4c: Shifted Image

ps1-4-c-1.png

4d: Difference Image

ps1-4-d-1.png

5a: Noisy Green Channel

ps1-5-a-1.png

5b: Noisy Blue Channel

ps1-5-b-1.png

6a: Discussion (3 slides)

Q: Use the image **southafricaflagface.png** and look at all three channels individually as monochrome. Between all color channels, which channel most resembles a grayscale conversion of the original? Why is this? Does it matter if you use other images? (For this problem, you will have to read a bit on how the eye works/cameras to discover which channel is more prevalent and widely used)

Ans: From testing and generating different monochrome images (see last slide), it is clear that green channel monochrome image most resembles a grayscale conversion of the original. It is because that human eyes (retina) are twice as sensitive to green color than red and blue colors [1][3]. Due to this biological structure, the camera is also designed to filter in twice as many green color than other two colors, which is known as Bayer filter[4]. Therefore, green color has more weight on the luminance of the image. A grayscale image represents the luminance of a image (the shades from black to white). A typical equation to generate grayscale is “Gray = (Red * 0.299 + Green * 0.587 + Blue * 0.114)” [3]. Green color has much larger coefficient than the other two. It does matter if I use the other image. For an extreme case, if the original image has zero value for the green channel, then green channel has no weight on the grayscale equation. In this case, I would think that red channel monochrome will be closer to the grayscale image.

6b&c:

Q: What does it mean when an image has negative pixel values stored? Why is it important to maintain negative pixel values?

Ans: The important concept is the pixel values are relative to each other. For example, green channel value of -5 means that it is less ”green” than a green channel value of 0. The negative pixel values allow us to perform computation on the images or between images. The final pixel values can always be normalize to have only positive values. Conceptually, a negative pixel can potentially defined to represent a invisible light.

Q: In question 5, noise was added to the green channel and also to the blue channel. Which looks better to you? Why? What sigma was used to detect any discernable difference?

Ans: The blue channel looks better to me as it has less visible noise with the same sigma value (5). It is because that human eyes are more sensitive to green color due to our biology structure. There are much more light receptors can be stimulated by green color in the eyes[3]. For the posted images in this slide, the sigma value of 5 was used. But I can see the difference with lower sigma value (e.g 2) if I inspect the images carefully.

southafricaflagface.png

Monochrome blue channel

Monochrome green channel

Monochrome red channel

OpenCV Grayscale

References:

[1] https://en.wikipedia.org/wiki/Retina
[2] http://www.tannerhelland.com/3643/grayscale-image-algorithm-vb6/
[3] https://hypertextbook.com/facts/2007/SusanZhao.shtml
[4] https://en.wikipedia.org/wiki/Bayer_filter