影像處理-作業三

Color Image Enhancement

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Given four color images, enhance the four color images in the RGB, HSI, and L*a*b* color spaces.(題目給定四張 color images，在三個 color spaces 中增強四張 images。

)

Note that the hue (H) component will not be changed and all the final resulting images should be transformed back to the RGB color space for displaying.

Technical description

1. RGB:

   這裡不知道圖片是不是在 RGB color space，所以我當圖片一開始就是在 RGB color space。我把圖片 aloe.jpg 和

church.jpg 利用 histogram equalization 的方式增強圖片，而另外兩張圖片 house.jpg 和 kitchen.jpg 則是利用 power low 的方式增強圖片。

hw3_rgb.py

```
if __name__ == "__main__":

    img1 = mpimg.imread('./aloe.jpg')  # 讀取圖片
    img2 = mpimg.imread('./church.jpg')
    img3 = mpimg.imread('./house.jpg')
    img4 = mpimg.imread('./kitchen.jpg')

    # histogram equalization
    uniform_rgb1 = histoequ(img1)
    uniform_rgb2 = histoequ(img2)

    # power low
    powerlow_img3 = powerlow(img3)
    powerlow_img4 = powerlow(img4)
```

2. HSI:

這裡因為題目有說色調(H)的部分不用改，所以我就只改 S 和 I 的部分，由講義中的公式可得知:

$$S = 1 - \frac{3}{(R+G+B)}[\min(R,G,B)]$$

$$I = 1/3*(R+G+B)$$

$$H = \begin{cases} \theta, & \text{if } B \le G, \\ 360-\theta, & \text{if } B > G, \end{cases}$$

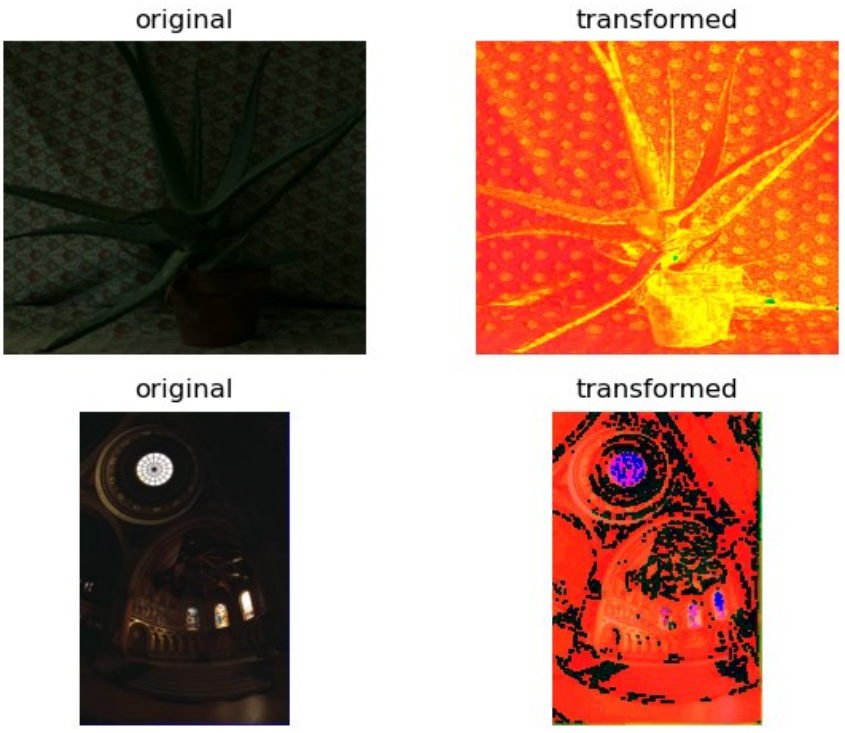
$$\theta = \cos^{-1}\left\{\frac{\frac{1}{2}[(R-G)+(R-B)]}{[(R-G)^2+(R-B)(G-B)]^{1/2}}\right\},$$

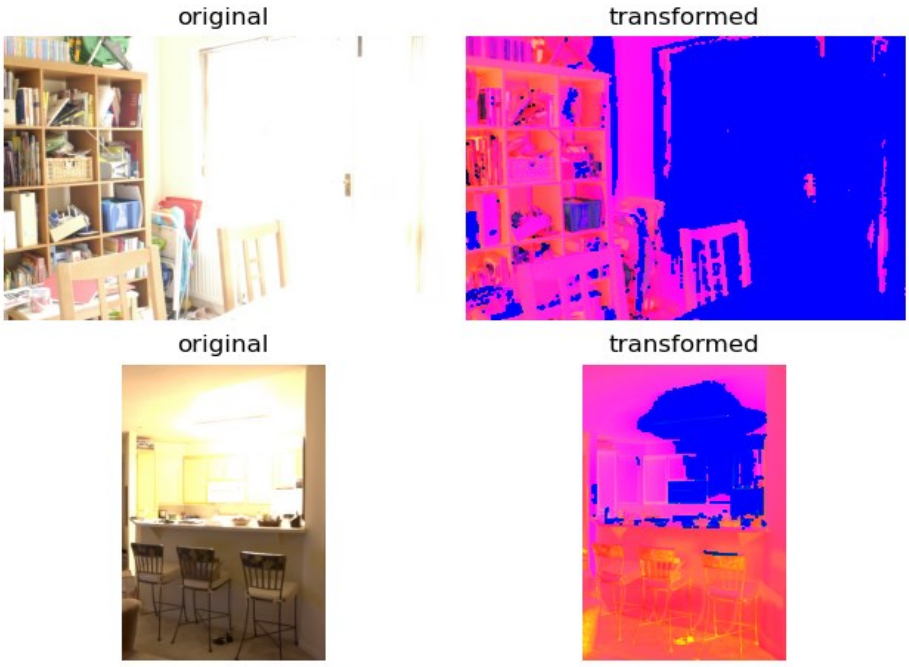
hw3_hsi.py

這裡做 RGB 轉為 HIS 的過程。

```python
    # 計算強度(I = 1/3*(R+G+B))

    def calc_intensity(red, blue, green):
        return np.divide(blue + green + red, 3)

    # 計算飽和度(S = 1 - 3/(R+G+B)*[min(R,G,B)])
    def calc_saturation(red, blue, green):
        minimum = np.minimum(np.minimum(red, green), blue)
        saturation = 1 - (3 / (red + green + blue + 0.001)*minimum)
        return saturation
    # 色調H的部分

    def calc_hue(red, blue, green):
        hue = np.copy(red)

        for i in range(0, blue.shape[0]):
            for j in range(0, blue.shape[1]):
                hue[i][j] = 0.5 * ((red[i][j] - green[i][j]) + (red[i][j] - blue[i][j])) / (math.sqrt(
                    (red[i][j] - green[i][j])**2 + ((red[i][j] - blue[i][j]) * (green[i][j] - blue[i][j]))))
                hue[i][j] = math.acos(hue[i][j])

                if blue[i][j] <= green[i][j]:
                    hue[i][j] = hue[i][j]
                else:
                    hue[i][j] = ((360 * math.pi) / 180.0) - hue[i][j]
        return hue
    # Merge channels into picture and return image
    hsi = cv2.merge((calc_hue(red, blue, green), calc_saturation(red, blue, green),
                     calc_intensity(red, blue, green)))
    return hsi
```

最後有從 RGB 轉為 HSI:



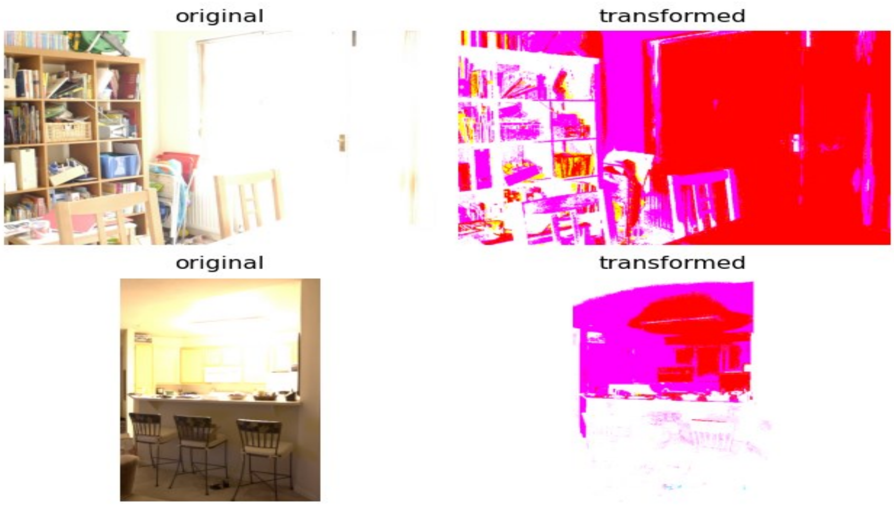


然後將圖片經過 power_low 增強之後，後面轉回 RGB 的地方就卡住了。

3. L*a*b*:

這裡我是用 mahotas 套件直接將圖片從 RGB 轉到 L*A*B*，然後再用 power low 把圖片做增強，最後轉回 RGB 的時候也卡住了。

以下為轉到 L*A*B*時的結果:

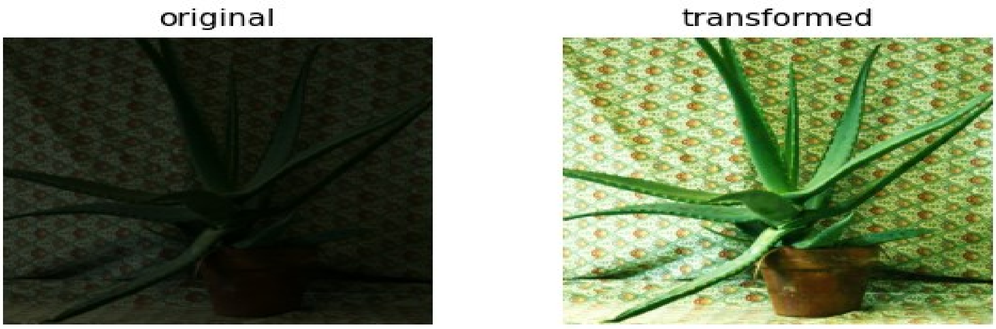


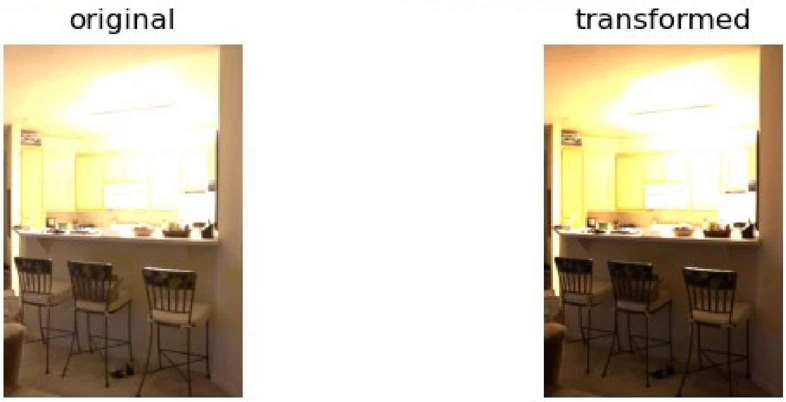
hw3_lab.py

```
from cv2 import cv2
import math
import histo_powerlow
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
import mahotas
import mahotas.demos
from pylab import gray, imshow, show
import numpy as np


# import picture & create HSI copy using algorithm
img1 = mpimg.imread('./aloe.jpg')
img2 = mpimg.imread('./church.jpg')
img3 = mpimg.imread('./house.jpg')
img4 = mpimg.imread('./kitchen.jpg')

lab_img1 = mahotas.colors.rgb2lab(img1)
```

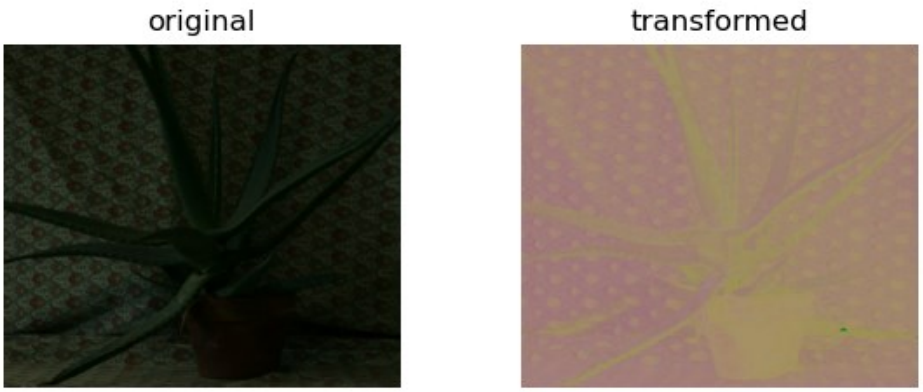
Experimental results

1. RGB





2. HIS


original
transformed


original
transformed

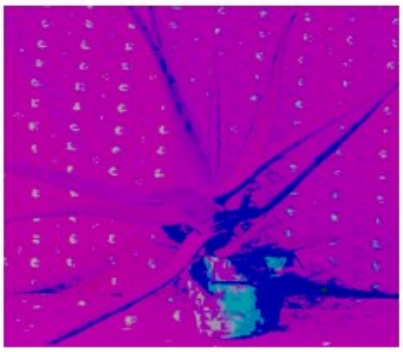

original
transformed


original
transformed

3. L*a*b*

original

transformed



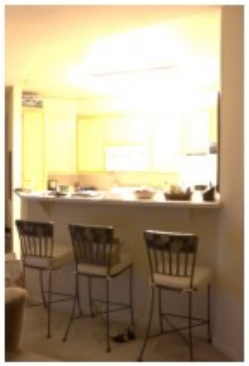
original

transformed

original

transformed

original



transformed

Discussions

1. 不知道圖片一開始是不是在 RGB color space???
2. 因為 hue(色調)的部分沒有做修改，HSI 轉回 RGB 的部分不會做
3. L*a*b*轉回 RGB 的部分也不會做
4. 希望以上轉回 RGB 的部分助教能提供詳解

References and Appendix

Chapter 6 COLOR IMAGE PROCESSING