Relatorio Trabalho 1
Image Processing
UNICAMP

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1 Introduction

2 Color Images

2.1 Sepia Effect

It's requested to alter the channels using the following equation:

$$R' = 0.393R + 0.769G + 0.189B$$
$$G' = 0.349R + 0.686G + 0.168B$$
$$B' = 0.272R + 0.534G + 0.131B$$

For this task, the three channels are separated in variables. It's important to remember that OpenCV, read the color images in the BGR order. After applyng the formula, it's necessary to verify if the new values. Are in the real range $[0, 255]$. If we don't apply this verification weird behaviors could happened, like in Fig. 1.

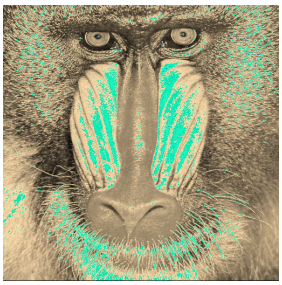


Figure 1: Wrong behavior without verification of values are in range

The following code returns the new image, casted as Unsigned Int 8 bits.

```
import numpy as np

def sepia(image):
    b = image[:,:,0]
    g = image[:,:,1]
    r = image[:,:,2]

    rp = 0.393*r + 0.796*g + 0.189*b
    gp = 0.349*r + 0.686*g + 0.168*b
    bp = 0.272*r + 0.534*g + 0.131*b

    # Verify if new values aren't greater
    # than 255, else write 255
    rp = np.where(rp>255,255,rp)
    gp = np.where(gp>255,255,gp)
    bp = np.where(bp>255,255,bp)


    new_image = np.stack((bp,gp,rp),axis=2)
    return new_image.astype(np.uint8)
```

The results are shown in the images below. The execution time is near to 0.1s per image.

(a) Original Picture

(b) After transformation

(a) Original Picture

(b) After transformation

(c) Original Picture

(d) After transformation

(e) Original Picture

(f) After transformation

2.2 Gray scale Transform

$$I = 0.2989R + 0.5870G + 0.1140B$$

In this case the following code will output a one channel image. It will produce a gray scale image, based on the previous formula.

```
def to_gris(image):
    b = image[:,:,0]
    g = image[:,:,1]
    r = image[:,:,2]

    i = 0.2989*r + 0.5870*g + 0.1140*b
    i = np.where(i>255,255,i)

    return i.astype(np.uint8)
```

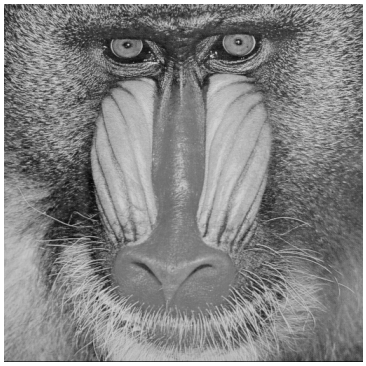
3 Monochromatic Filters

The following code receives a 2D grayscale image as first argument, and a square kernel ($3x3$, $5x5$, ...)

```
def filter(image2D,kernel):
    padding = int((kernel.shape[0]-1)/2)
    image2D_pad = np.pad( image2D, padding )

    new_image = np.zeros( image2D.shape )

    for x in range( image2D.shape[0] - padding ):
        for y in range ( image2D.shape[1] - padding):
            window = image2D_pad[ x : x + kernel.shape[0]
                , y : y + kernel.shape[0] ]
            new_image[x][y] = ( window * kernel ).sum()

    new_image = np.where(new_image>255,255,new_image)
    new_image = np.where(new_image<0,0,new_image)

    return new_image.astype(np.uint8)
```

3.1 Filter h1

$$\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$



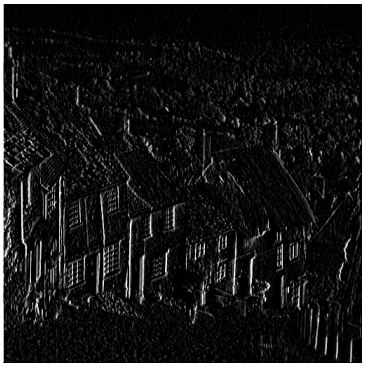
(a) Original Picture

(b) After transformation

(c) Original Picture

(d) After transformation

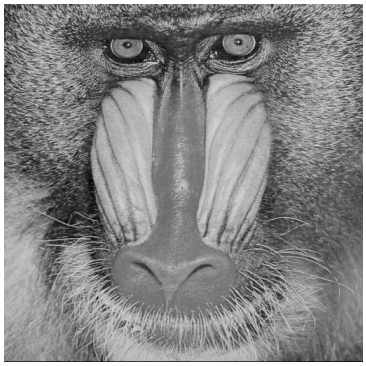
(e) Original Picture



(f) After transformation

3.2 Filter h2

$$\begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$



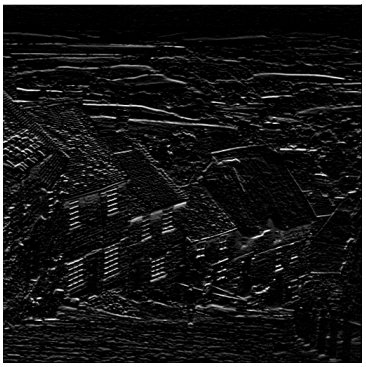
(a) Original Picture

(b) After transformation

(c) Original Picture

(d) After transformation

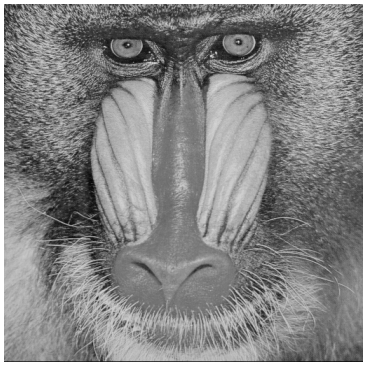
(e) Original Picture



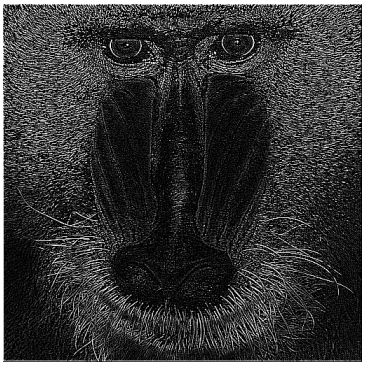
(f) After transformation

3.3 Filter h3

$$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$$

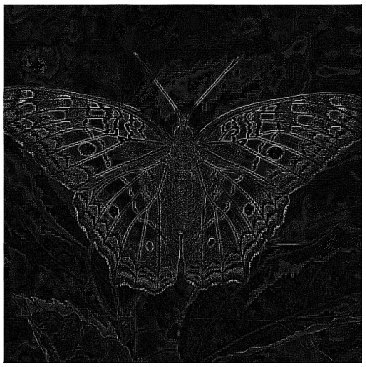


(a) Original Picture



(b) After transformation

(c) Original Picture



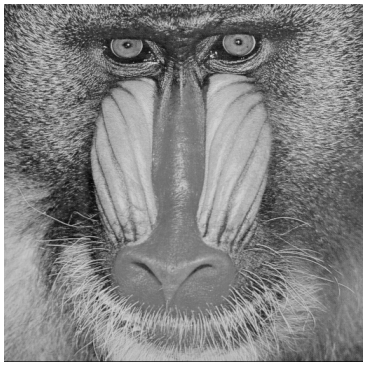
(d) After transformation

(e) Original Picture

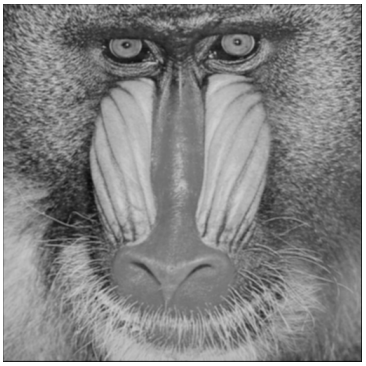
(f) After transformation

3.4 Filter h4

$$\frac{1}{9}\begin{bmatrix}1 & 1 & 1\\ 1 & 1 & 1\\ 1 & 1 & 1\end{bmatrix}$$



(a) Original Picture



(b) After transformation

(c) Original Picture

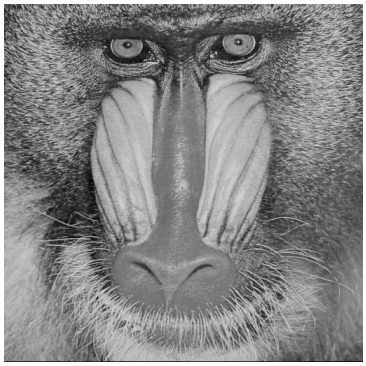
(d) After transformation

(e) Original Picture

(f) After transformation

3.5 Filter h5

$$\begin{bmatrix} -1 & -1 & 2 \\ -1 & 2 & -1 \\ 2 & -1 & -1 \end{bmatrix}$$



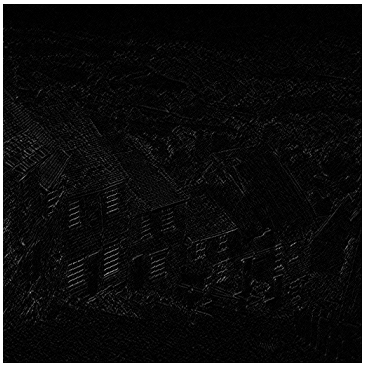
(a) Original Picture

(b) After transformation

(c) Original Picture

(d) After transformation

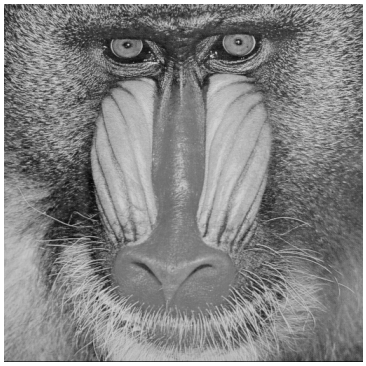
(e) Original Picture



(f) After transformation

3.6 Filter h6

$$\begin{bmatrix} 2 & -1 & -1 \\ -1 & 2 & -1 \\ -1 & -1 & 2 \end{bmatrix}$$



(a) Original Picture

(b) After transformation

(c) Original Picture

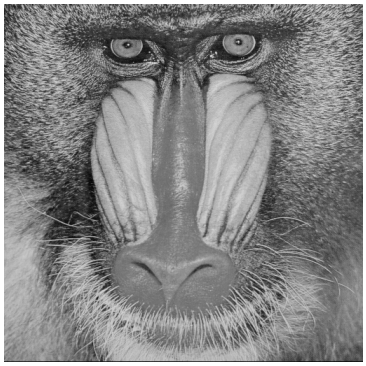
(d) After transformation

(e) Original Picture

(f) After transformation

3.7 Filter h7

$$\begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ -1 & 0 & 0 \end{bmatrix}$$



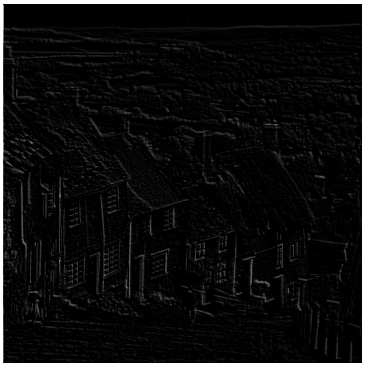
(a) Original Picture

(b) After transformation

(c) Original Picture

(d) After transformation

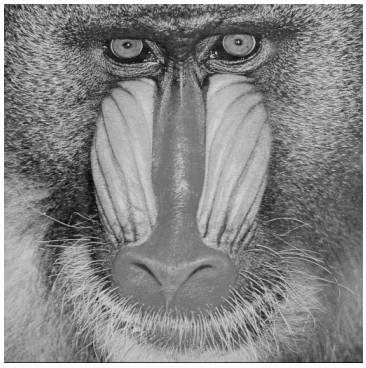
(e) Original Picture



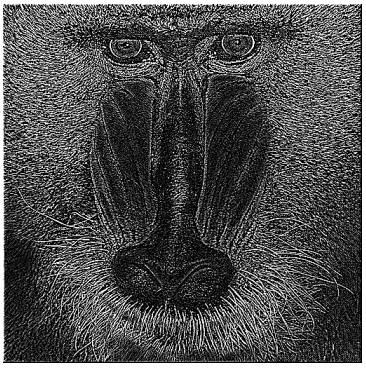
(f) After transformation

3.8 Filter h8

$$\begin{bmatrix} 0 & 0 & -1 & 0 & 0 \\ 0 & -1 & -2 & -1 & 0 \\ -1 & -2 & 16 & -2 & -1 \\ 0 & -1 & -2 & -1 & 0 \\ 0 & 0 & -1 & 0 & 0 \end{bmatrix}$$

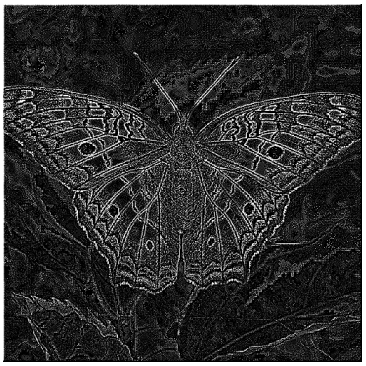


(a) Original Picture



(b) After transformation

(c) Original Picture



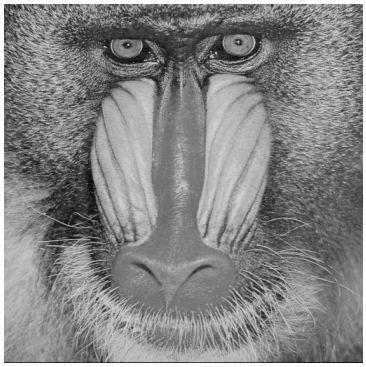
(d) After transformation

(e) Original Picture

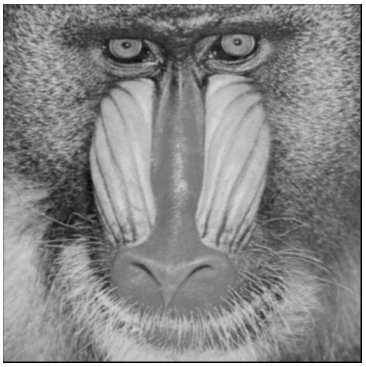
(f) After transformation

3.9 Filter h9

$$\begin{bmatrix} 1 & 4 & 6 & 4 & 1 \\ 4 & 16 & 24 & 16 & 4 \\ 6 & 24 & 36 & 24 & 6 \\ 4 & 16 & 24 & 16 & 4 \\ 1 & 4 & 6 & 4 & 1 \end{bmatrix}$$



(a) Original Picture



(b) After transformation

(c) Original Picture

(d) After transformation

(e) Original Picture

(f) After transformation

References

[1] OpenCV Python Documentation (https://docs.opencv.org/master/d7/d16/tutorial_py_table_of_contents_core.html)

[2] Szeliski, R. (2010). Computer vision: algorithms and applications. Springer Science & Business Media.