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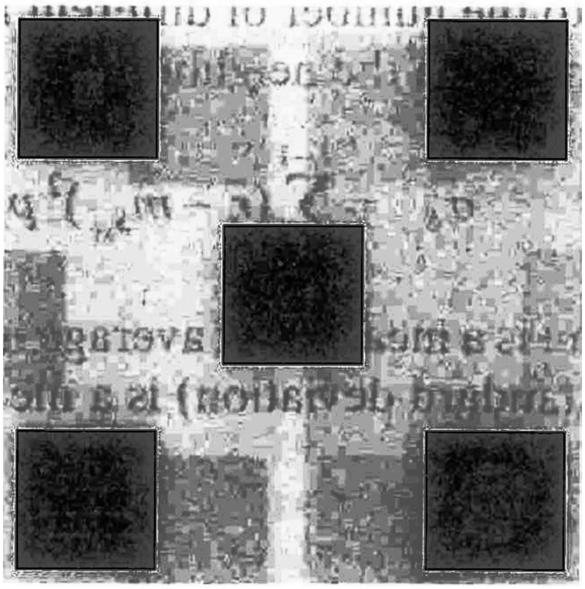
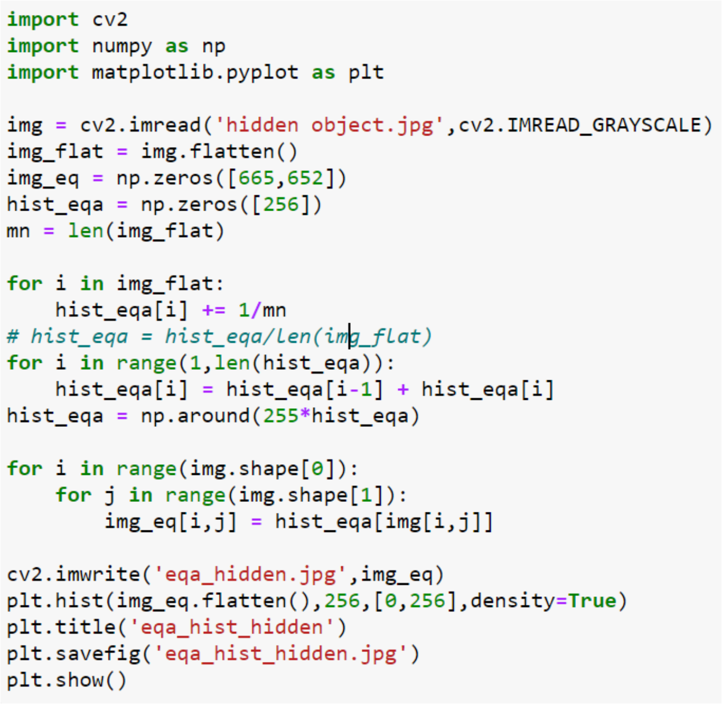
1.

Local enhancement method

在使用 Local enhancement method 之前，我先嘗試用 Global Histogram Equalization，結果及程式碼如下：

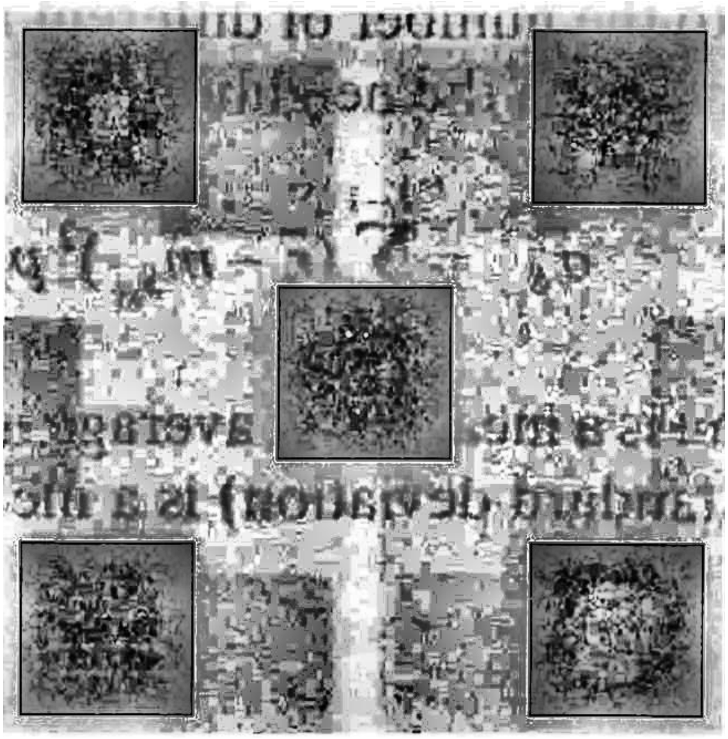


Code

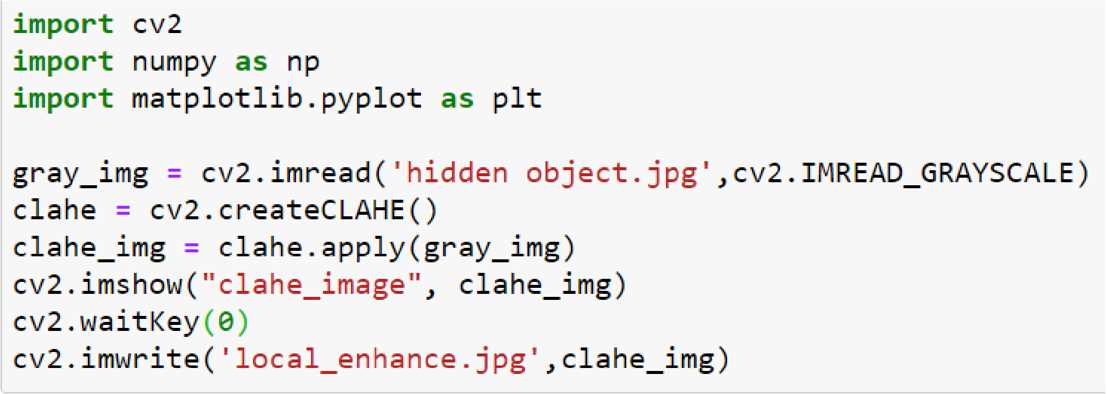


```python
import cv2
import numpy as np
import matplotlib.pyplot as plt

img = cv2.imread('hidden object.jpg',cv2.IMREAD_GRAYSCALE)
img_flat = img.flatten()
img_eq = np.zeros([665,652])
hist_eqa = np.zeros([256])
mn = len(img_flat)

for i in img_flat:
    hist_eqa[i] += 1/mn
# hist_eqa = hist_eqa/len(img_flat)
for i in range(1,len(hist_eqa)):
    hist_eqa[i] = hist_eqa[i-1] + hist_eqa[i]
hist_eqa = np.around(255*hist_eqa)

for i in range(img.shape[0]):
    for j in range(img.shape[1]):
        img_eq[i,j] = hist_eqa[img[i,j]]

cv2.imwrite('eqa_hidden.jpg',img_eq)
plt.hist(img_eq.flatten(),256,[0,256],density=True)
plt.title('eqa_hist_hidden')
plt.savefig('eqa_hist_hidden.jpg')
plt.show()
```

接著使用 Local Histogram Equalization，結果及程式碼如下：



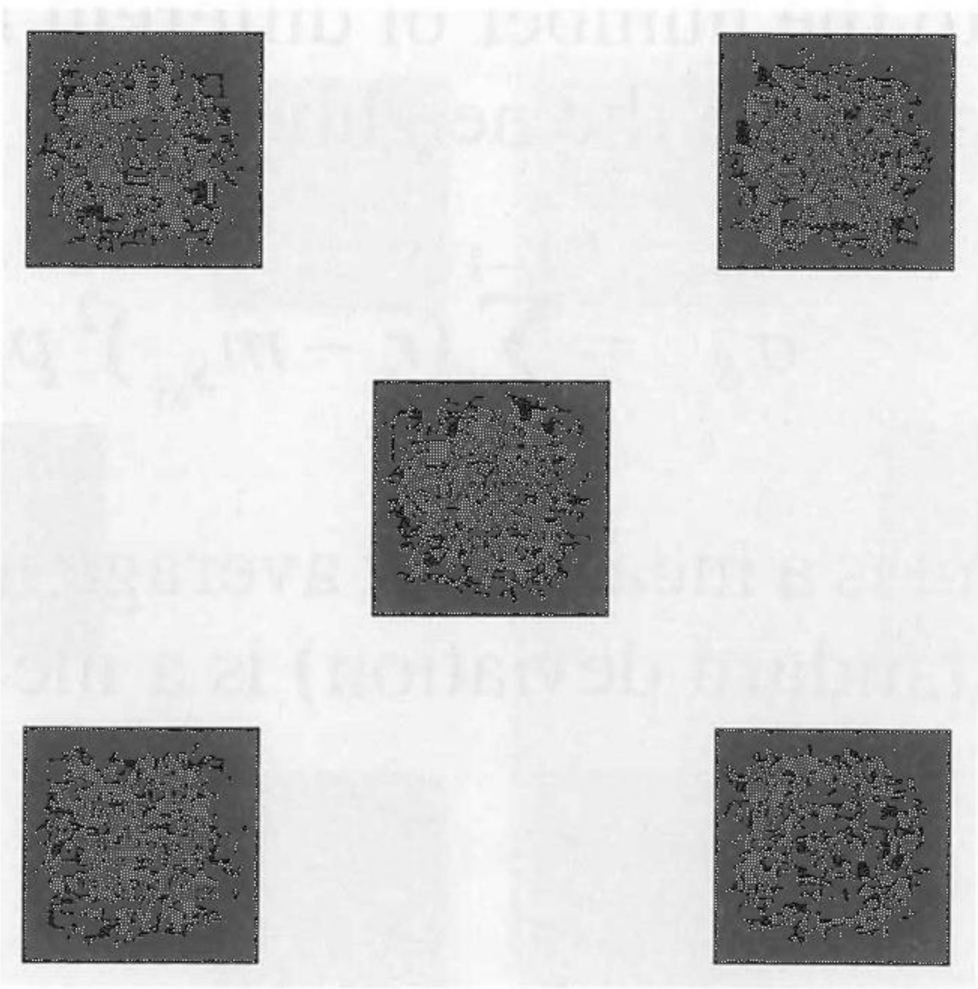
Code



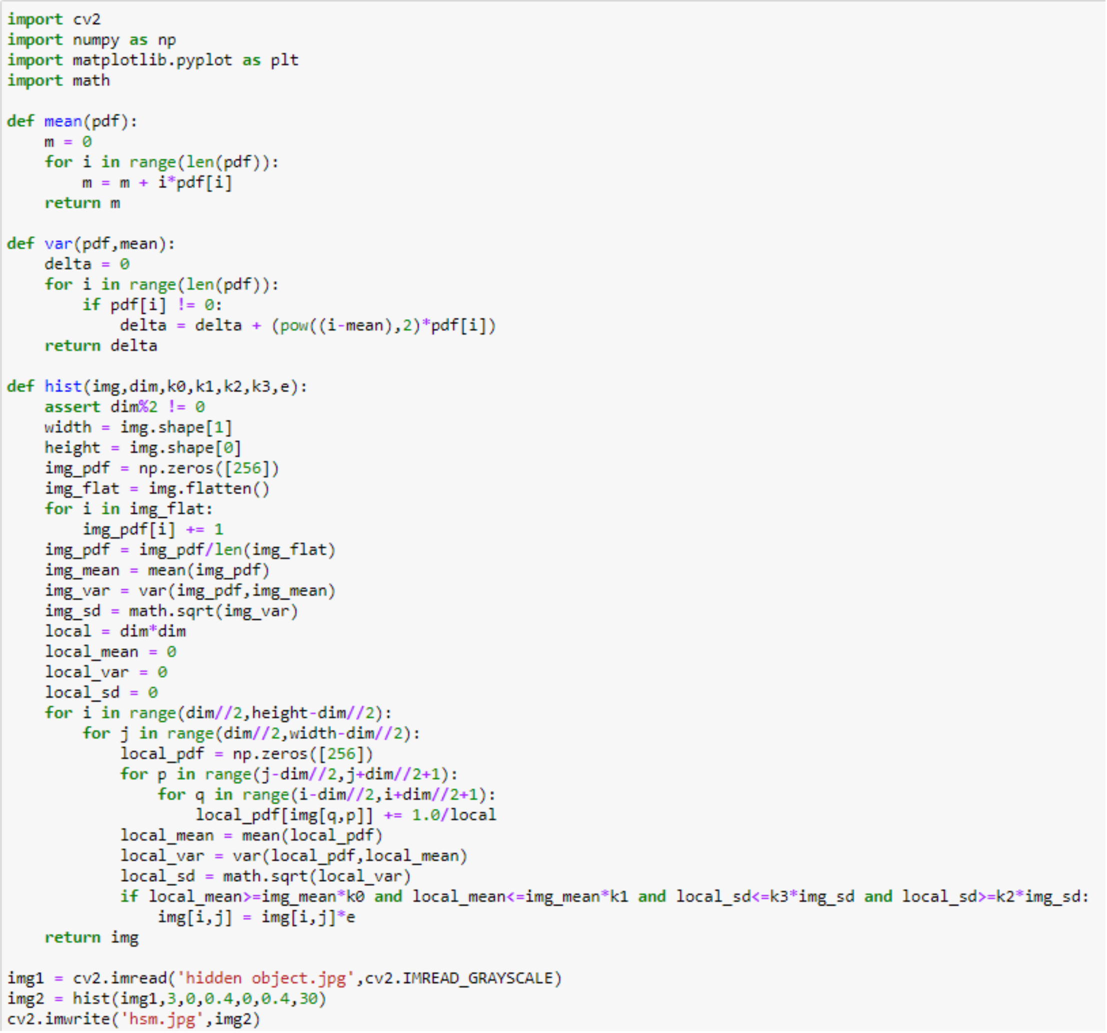
```
import cv2
import numpy as np
import matplotlib.pyplot as plt

gray_img = cv2.imread('hidden object.jpg',cv2.IMREAD_GRAYSCALE)
clahe = cv2.createCLAHE()
clahe_img = clahe.apply(gray_img)
cv2.imshow("clahe_image", clahe_img)
cv2.waitKey(0)
cv2.imwrite('local_enhance.jpg',clahe_img)
```

Histogram Statistics method

結果及程式碼如下：



Code



```
import cv2
import numpy as np
import matplotlib.pyplot as plt
import math

def mean(pdf):
    m = 0
    for i in range(len(pdf)):
        m = m + i*pdf[i]
    return m

def var(pdf,mean):
    delta = 0
    for i in range(len(pdf)):
        if pdf[i] != 0:
            delta = delta + (pow((i-mean),2)*pdf[i])
    return delta

def hist(img,dim,k0,k1,k2,k3,e):
    assert dim%2 != 0
    width = img.shape[1]
    height = img.shape[0]
    img_pdf = np.zeros([256])
    img_flat = img.flatten()
    for i in img_flat:
        img_pdf[i] += 1
    img_pdf = img_pdf/len(img_flat)
    img_mean = mean(img_pdf)
    img_var = var(img_pdf,img_mean)
    img_sd = math.sqrt(img_var)
    local = dim*dim
    local_mean = 0
    local_var = 0
    local_sd = 0
    for i in range(dim//2,height-dim//2):
        for j in range(dim//2,width-dim//2):
            local_pdf = np.zeros([256])
            for p in range(j-dim//2,j+dim//2+1):
                for q in range(i-dim//2,i+dim//2+1):
                    local_pdf[img[q,p]] += 1.0/local
            local_mean = mean(local_pdf)
            local_var = var(local_pdf,local_mean)
            local_sd = math.sqrt(local_var)
            if local_mean>=img_mean*k0 and local_mean<=img_mean*k1 and local_sd<=k3*img_sd and local_sd>=k2*img_sd:
                img[i,j] = img[i,j]*e
    return img

img1 = cv2.imread('hidden object.jpg',cv2.IMREAD_GRAYSCALE)
img2 = hist(img1,3,0,0.4,0,0.4,30)
cv2.imwrite('hsm.jpg',img2)
```

其中參數選擇上，我經過幾次嘗試將 k0 及 k2 設為 0，k1 及 k3 設為 0.4，鄰域大小為 3*3，E 設為 30，雖然仍看不出隱藏的圖片，但比起其他參數，能稍微看出黑暗中的一些細節。

2.Comment

局部直方圖等化是將每個位置計算鄰域內諸點的直方圖並獲得直方圖等化獲指定的轉換函數，此函數用於映射鄰域中心像素的強度，並再將鄰域中心移到相鄰的像素位置上重複上述步驟。而使用直方圖統計增強影像是使用全域的平均值以及變異數兩個參數來做局部的增強，以局部的平均值及變異數來當成改變的基礎。由結果可以發現，直方圖統計法比起局部直方圖等化法在增強黑暗區域中的細節時，較不改變亮的背景。