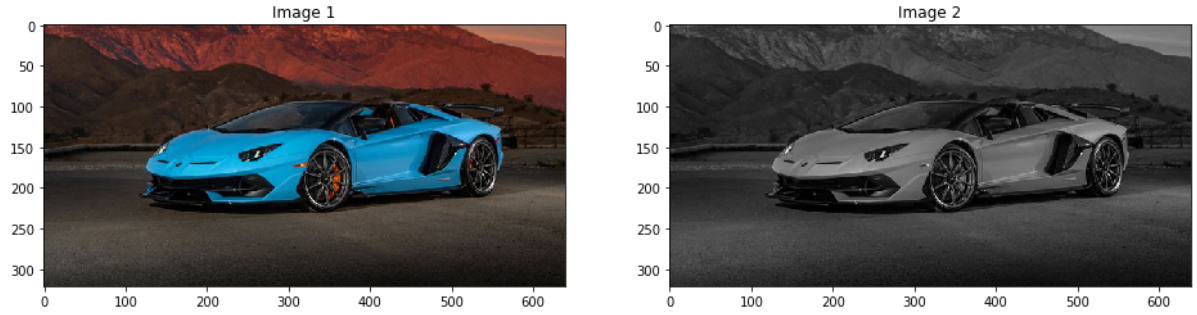
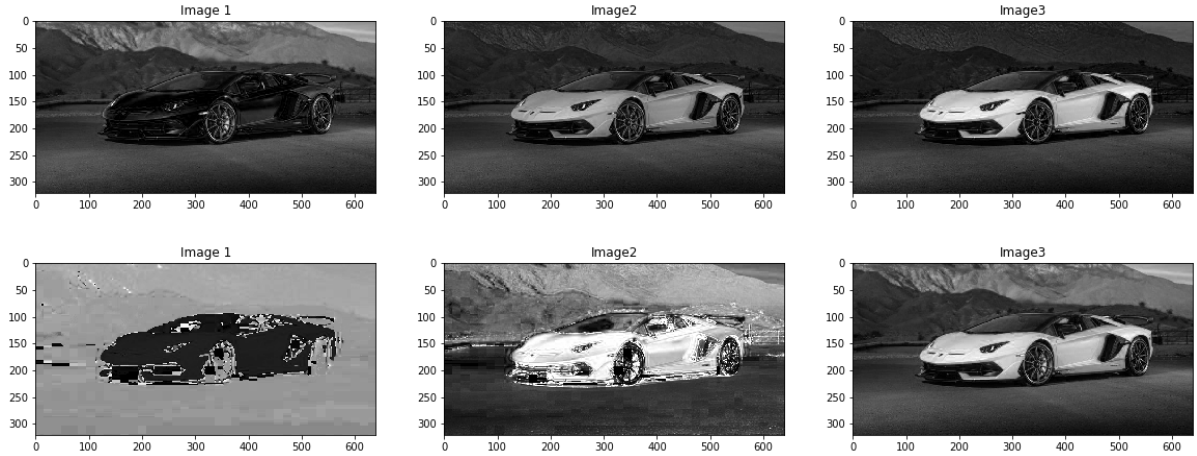
In [2]:
```
import numpy as np
import pandas as pd
import cv2
from matplotlib import pyplot as plt
from pylab import imread
from skimage.color import rgb2gray
```

In [3]:
```
def imshows(ImageData, LabelData, rows, cols, gridType=False):
#Convert ImageData and LabelData to List
    from matplotlib import pyplot as plt
    ImageArray=list(ImageData)
    LabelArray=list(LabelData)
    if(rows ==1 & cols==1):
        fig=plt.figure(figsize=(20,20))
    else:
        fig=plt.figure(figsize=(cols*8,rows*5))

    for i in range(1,cols*rows+1):
        fig.add_subplot(rows,cols,i)
        image=ImageArray[i-1]
    # If the channel number is less than 3, we display as grayscale image
    # otherwise, we display as color image
        if(len(image.shape)<3):
            plt.imshow(image,plt.cm.gray)
            plt.grid(gridType)
        else:
            plt.imshow(image)
            plt.grid(gridType)
        plt.title(LabelArray[i-1])
    plt.show()

def ShowThreeImages(IM1, IM2, IM3):
    imshows([IM1,IM2,IM3],["Image 1","Image2","Image3"], 1, 3)
def ShowTwoImages(IM1,IM2):
    imshows([IM1,IM2],["Image 1","Image 2"], 1, 2)
def ShowOneImages(IM):
    imshows([IM], ["Image"], 1, 1)
def ShowListImages(listImage,row,col):
    listCaption = []
    for i in range(len(listImage)):
        listCaption.append(str(i))
    imshows(listImage,listCaption,row,col)
```

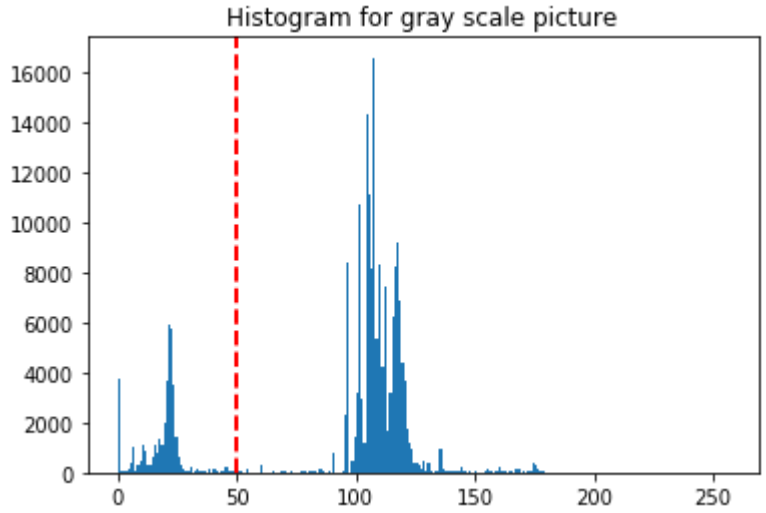
In [4]:
```
#Read Image
image_color=imread("Documents/Sample01/2020-lamborghini-aventador-svj-roadster
-drive-107-1576871367.jpg")
#convert Image into Gray
#1.1 Tạo ảnh gray scale
image_gray=cv2.cvtColor(image_color,cv2.COLOR_RGB2GRAY)

#Display Image
ShowTwoImages(image_color,image_gray)
```

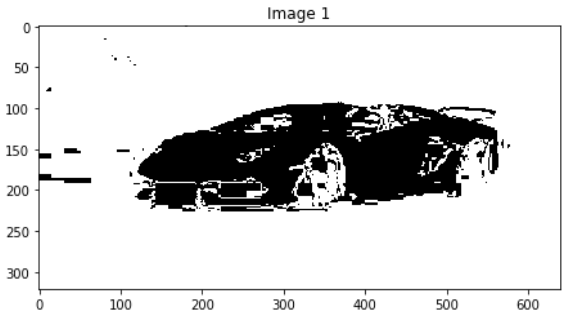


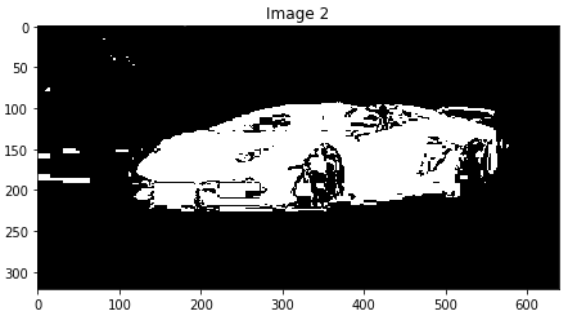
In [5]:
```
#Convert Image into HSV color spaces
image_hsv=cv2.cvtColor(image_color,cv2.COLOR_BGR2HSV)

#Show each channel R,G and B
ShowThreeImages(image_color[:,:,0],image_color[:,:,1],image_color[:,:,2])

#1.2Tạo ảnh hsv và hiển thị các kênh hue, saturation và value
#Show each chanel H,S and V
ShowThreeImages(image_hsv[:,:,0],image_hsv[:,:,1],image_hsv[:,:,2])
```



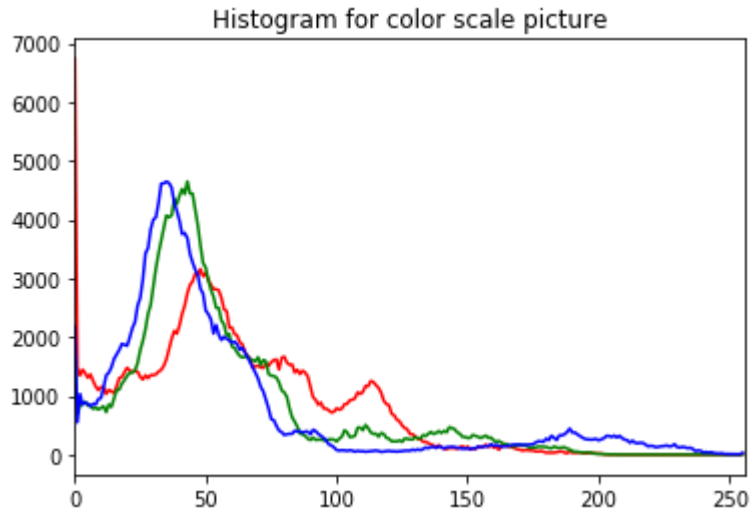
In [6]:
```
hue_img=image_hsv[:,:,0]
hue_threshold=50
# Làm thêm vẽ biểu đồ Hue channel
#Show Histogram of Hue Channel
hist=cv2.calcHist([hue_img],[0],None,[256],[0,256])
plt.hist(hue_img.ravel(),256,[0,256])
plt.axvline(x=hue_threshold,color='r',linestyle='dashed',linewidth=2)
plt.title('Histogram for gray scale picture')
plt.show()

#Use threshold to segment object by histogram
hue_binary01=hue_img>hue_threshold
hue_binary02=1-hue_binary01

ShowTwoImages(hue_binary01,hue_binary02)
```



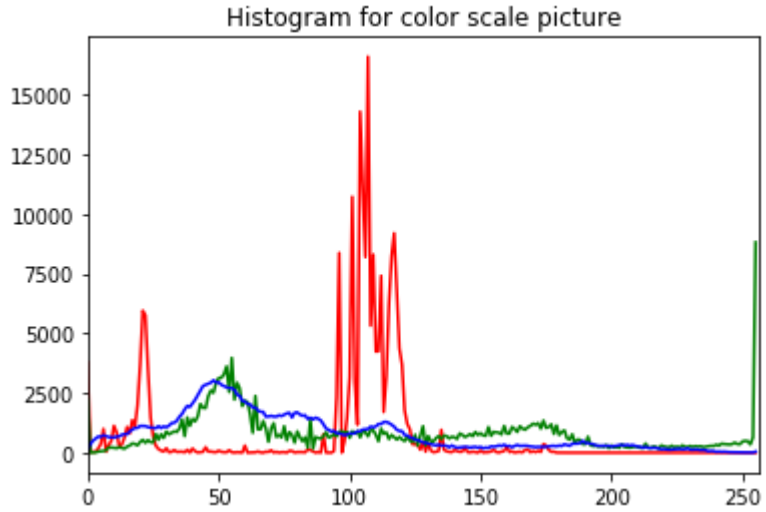




In [7]:
```
#1.5 Hiển thị các histogram của r,g,b
color=('r','g','b')
for channel,col in enumerate(color):
    histr=cv2.calcHist([image_color],[channel],None,[256],[0,256])
    plt.plot(histr,color=col)
    plt.xlim([0,256])
plt.title('Histogram for color scale picture')
plt.show()
```

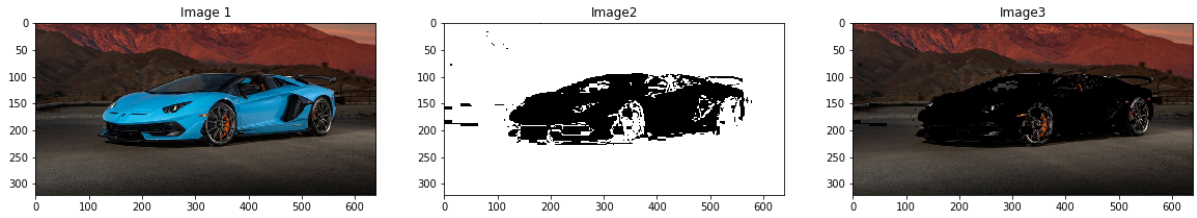


In [8]:
```
# Làm thêm hiển thị các histogram 3 kênh màu của ảnh h,s,v
color=('r','g','b')
for channel,col in enumerate(color):
    histr=cv2.calcHist([image_hsv],[channel],None,[256],[0,256])
    plt.plot(histr,color=col)
    plt.xlim([0,256])
plt.title('Histogram for color scale picture')
plt.show()
```

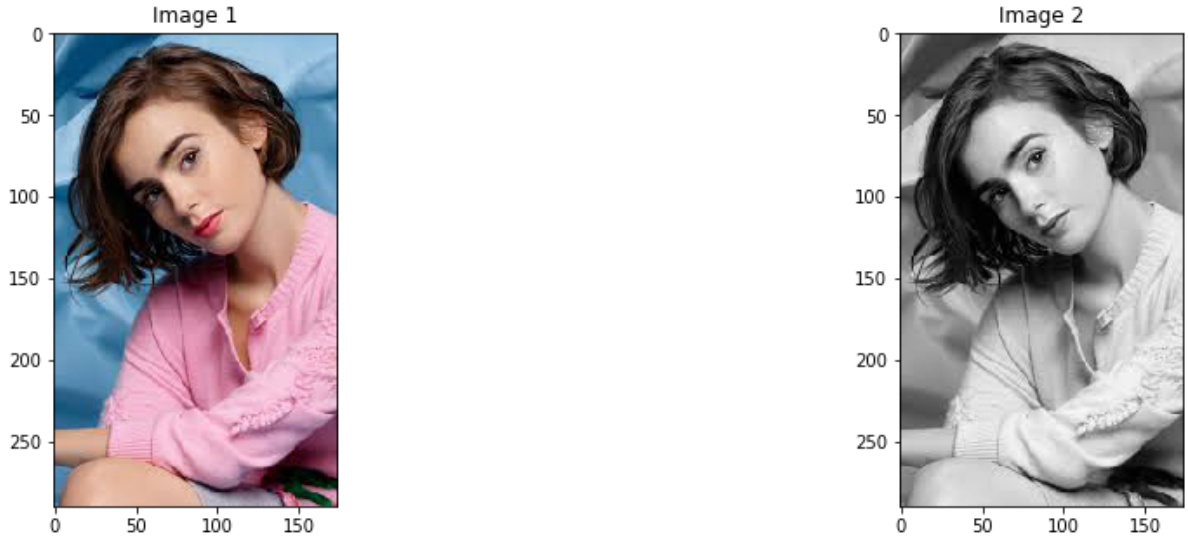


In [9]:
```
def SegmentColorImageByMask(IM,Mask):
    Mask=Mask.astype(np.uint8)
    result=cv2.bitwise_and(IM,IM,mask=Mask)
    return result
```

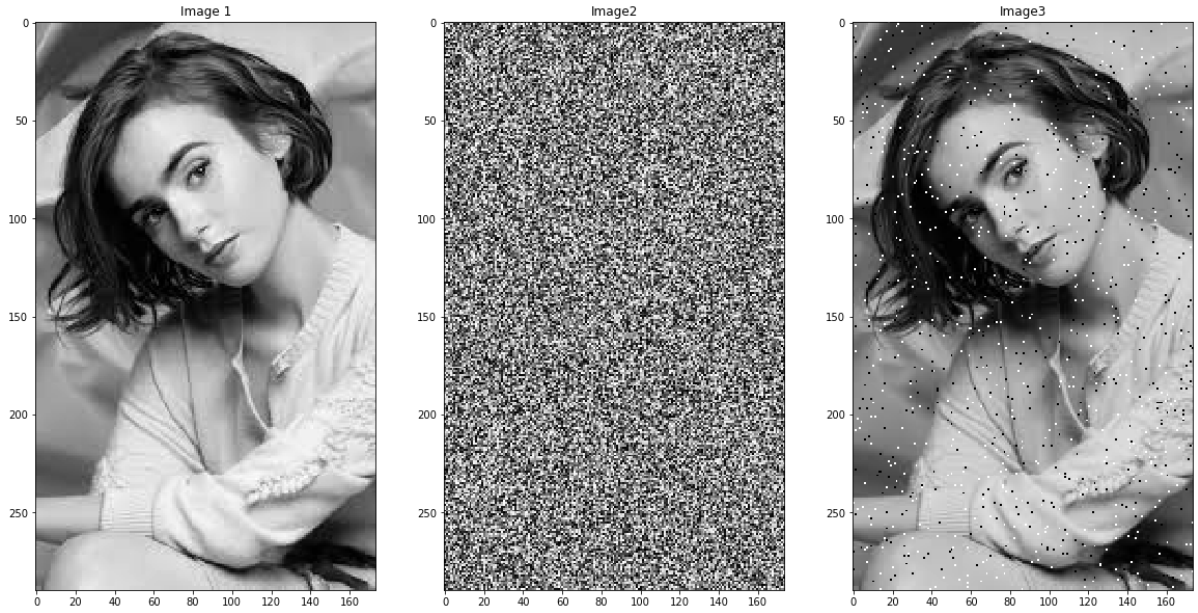
In [11]:
```
#1.3 Chọn ngưỡng hue để trích xuất đối tượng chủ đạo trong ảnh (hiển thị ảnh màu đối tượng sau khi trích xuất)
hue_binary01_rgb=SegmentColorImageByMask(image_color,hue_binary01)
ShowThreeImages(image_color,hue_binary01,hue_binary01_rgb)
```



In [12]:
```
#Read Image
image_color=imread("Documents/Sample01/images.jpg")
#Convert Image into Gray
image_gray=cv2.cvtColor(image_color,cv2.COLOR_RGB2GRAY)

#2.1) Tạo ảnh xám từ ảnh màu
#Display Image
ShowTwoImages(image_color,image_gray)
```

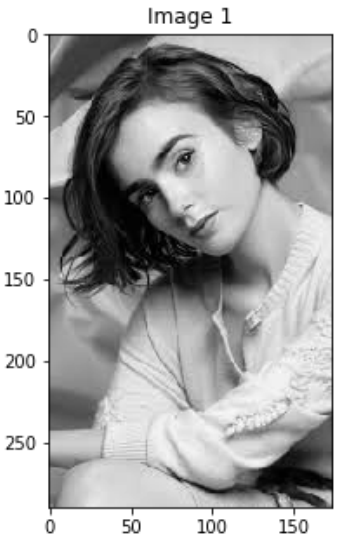


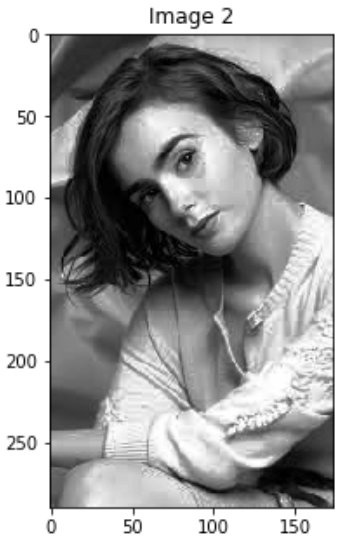
In [13]:
```
#Create Noise Image
#2.3 Làm nhiễu ảnh
noise=np.random.random(image_gray.shape)
image_noise=image_gray.copy()
image_noise[noise>0.99]=255
image_noise[noise<0.01]=0

ShowThreeImages(image_gray,noise,image_noise)
```

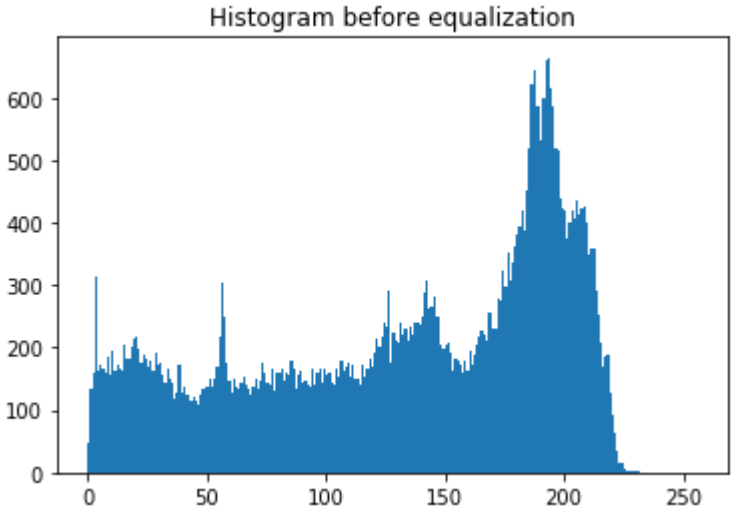


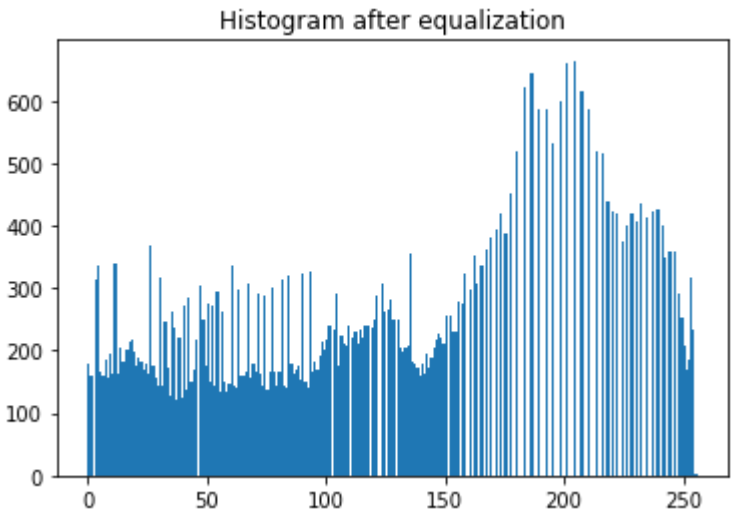
In [14]:
```
# Create Blurred Image
# 2.2) làm mờ ảnh
from skimage.filters.rank import median
from skimage.morphology import disk
image_blurred = median(image_gray, disk(10))
ShowTwoImages(image_gray, image_blurred)
```

In [15]:
```
from skimage import data, exposure
#2.4)Hiển thị histogram của ảnh xám và cân bằng histogram, hiển thị ảnh sau kh
i cân bằng
image_equalization = exposure.equalize_hist(image_gray)
image_equalization = np.float32(image_equalization * 255)
ShowTwoImages(image_gray, image_equalization)
hist = cv2.calcHist([image_gray],[0],None,[256],[0,256])
plt.hist(image_gray.ravel(),256,[0,256])
plt.title('Histogram before equalization')
plt.show()
hist = cv2.calcHist([image_equalization],[0],None,[256],[0,256])
plt.hist(image_equalization.ravel(),256,[0,256])
plt.title('Histogram after equalization')
plt.show()
```





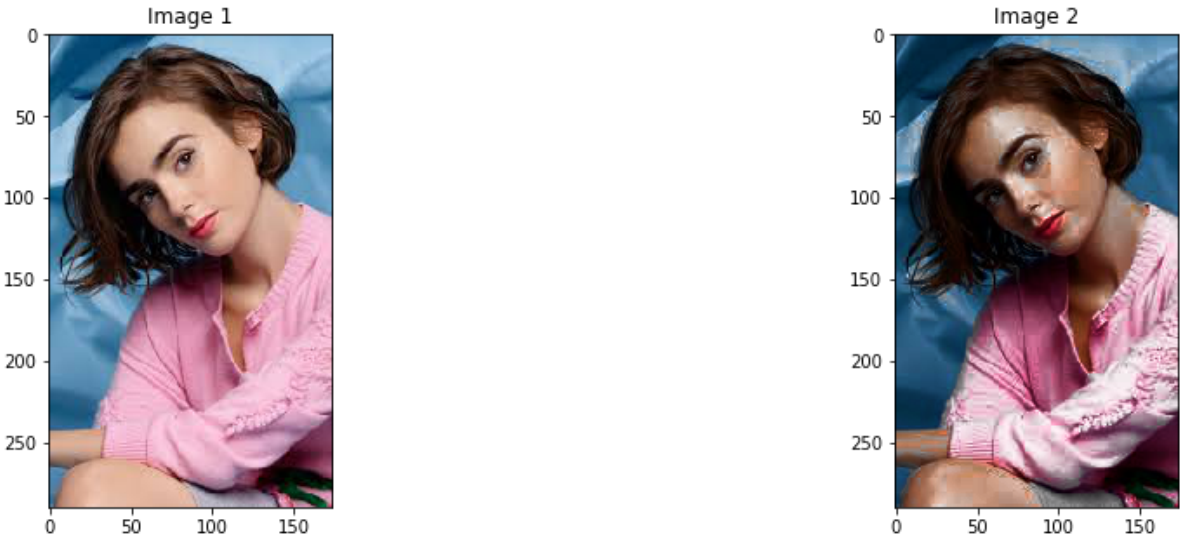




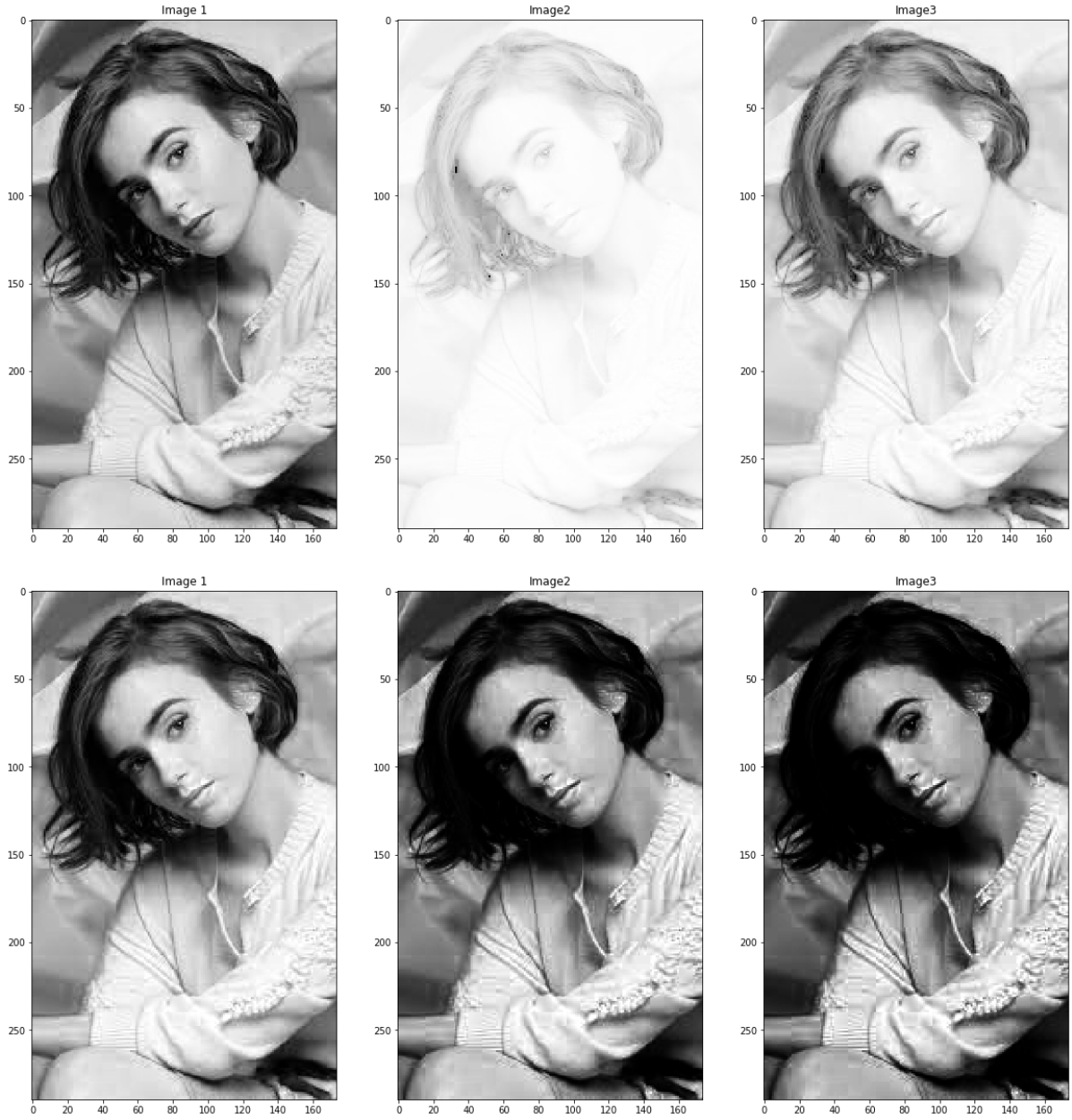
In [16]:
```
def histogram_equalize(img):
    r, g, b = cv2.split(img)
    red = cv2.equalizeHist(r)
    green = cv2.equalizeHist(g)
    blue = cv2.equalizeHist(b)
    return cv2.merge((red, green, blue))
```

In [17]:
```
image_equalization_color = histogram_equalize(image_color)
ShowTwoImages(image_color, image_equalization_color)
```

In [18]:
```
# Convert Image into HSV color spaces
#2.5 Cân bằng 3 kênh màu hsv cùng lúc và hiển thị ảnh kết quả sau khi cân bằng
image_hsv = cv2.cvtColor(image_color, cv2.COLOR_RGB2HSV)
# Apply histogram equalization
channel = 1
image_hsv[:, :, channel] = cv2.equalizeHist(image_hsv[:, :, channel])
channel = 2
image_hsv[:, :, channel] = cv2.equalizeHist(image_hsv[:, :, channel])
# Convert to RGB
image_enhanced = cv2.cvtColor(image_hsv, cv2.COLOR_HSV2RGB)
ShowTwoImages(image_color, image_enhanced)
```



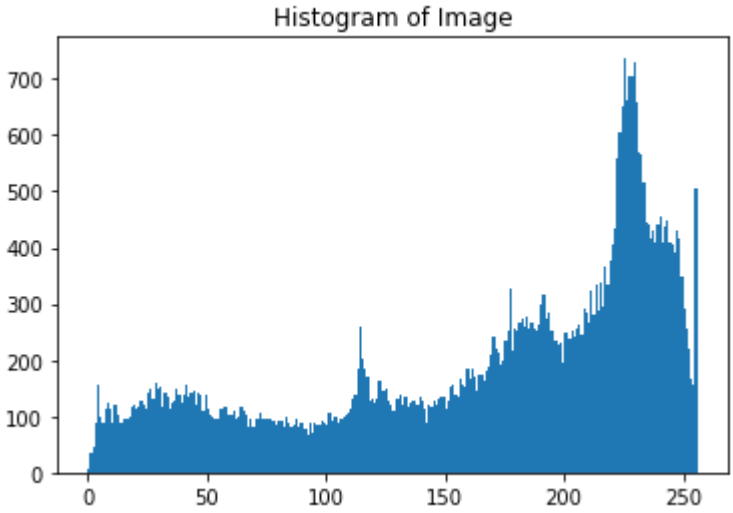
In [19]:
```
#2.7)Thực hiện các biến đổi gamma và hiển thị ảnh màu tương ứng
image_hsv = cv2.cvtColor(image_color, cv2.COLOR_RGB2HSV)
img = image_hsv[:,:,2]
gamma = [0.1, 0.5, 1.2, 2.2, 3.2]
gamma_corrected_01 = np.array(255*(img / 255) ** gamma[0], dtype = 'uint8')
gamma_corrected_02 = np.array(255*(img / 255) ** gamma[1], dtype = 'uint8')
gamma_corrected_03 = np.array(255*(img / 255) ** gamma[2], dtype = 'uint8')
gamma_corrected_04 = np.array(255*(img / 255) ** gamma[3], dtype = 'uint8')
gamma_corrected_05 = np.array(255*(img / 255) ** gamma[4], dtype = 'uint8')
ShowThreeImages(image_gray, gamma_corrected_01, gamma_corrected_02)
ShowThreeImages(gamma_corrected_03, gamma_corrected_04, gamma_corrected_05)
```



In [20]:
```
#2.8Chọn ngưỡng mức tối và ngưỡng mức sáng mà ở đó dưới mức tối sẽ cho tối hơn
và trên mức
#sáng sẽ cho sáng hơn trên kênh màu value trong hsv. Sau đó hiển thị ảnh kết q
uả sau khi
#enhance
channel = 2
image_hsv_01 = image_hsv.copy()
image_hsv_01[:,:,2] = gamma_corrected_01
image_enhanced_01 = cv2.cvtColor(image_hsv_01, cv2.COLOR_HSV2RGB)
image_hsv_02 = image_hsv.copy()
image_hsv_02[:,:,2] = gamma_corrected_02
image_enhanced_02 = cv2.cvtColor(image_hsv_02, cv2.COLOR_HSV2RGB)
image_hsv_03 = image_hsv.copy()
image_hsv_03[:,:,2] = gamma_corrected_03
image_enhanced_03 = cv2.cvtColor(image_hsv_03, cv2.COLOR_HSV2RGB)
image_hsv_04 = image_hsv.copy()
image_hsv_04[:,:,2] = gamma_corrected_04
image_enhanced_04 = cv2.cvtColor(image_hsv_04, cv2.COLOR_HSV2RGB)
image_hsv_05 = image_hsv.copy()
image_hsv_05[:,:,2] = gamma_corrected_05
image_enhanced_05 = cv2.cvtColor(image_hsv_05, cv2.COLOR_HSV2RGB)
ShowThreeImages(image_color, image_enhanced_01, image_enhanced_02)
ShowThreeImages(image_enhanced_03, image_enhanced_04, image_enhanced_05)
```

In [21]:
```
# With (r1, s1), (r2, s2) as parameters, the function stretches the intensity
 levels
# by essentially decreasing the intensity of the dark pixels and increasing th
e intensity
# of the light pixels. If r1 = s1 = 0 and r2 = s2 = L-1, the function becomes
 a straight
# dotted line in the graph (which gives no effect).
# The function is monotonically increasing so that the order of intensity leve
ls between pixels
# is preserved.
# Function to map each intensity level to output intensity level.
def pixelValTransformation(pix, r1, s1, r2, s2):
    if (0 <= pix and pix <= r1):
        return (s1 / r1)*pix
    elif (r1 < pix and pix <= r2):
        return ((s2 - s1)/(r2 - r1)) * (pix - r1) + s1
    else:
        return ((255 - s2)/(255 - r2)) * (pix - r2) + s2
```

In [22]:
```
#2.6) Enhance ảnh bằng cách cân bằng histogram kênh v
image_hsv = cv2.cvtColor(image_color, cv2.COLOR_RGB2HSV)
image_hsv_value = image_hsv[:,:,2]
hist = cv2.calcHist([image_hsv_value],[0],None,[256],[0,256])
plt.hist(image_hsv_value.ravel(),256,[0,256])
plt.title('Histogram of Image')
plt.show()
# Define parameters.
r1 = 50
s1 = 0
r2 = 200
s2 = 255
# Vectorize the function to apply it to each value in the Numpy array.
pixelVal_vec = np.vectorize(pixelValTransformation)
# Apply contrast stretching.
contrast_stretched = pixelVal_vec(image_hsv_value, r1, s1, r2, s2)
image_hsv[:,:,2] = contrast_stretched
image_enhanced = cv2.cvtColor(image_hsv, cv2.COLOR_HSV2RGB)
ShowTwoImages(image_gray, contrast_stretched)
ShowTwoImages(image_color, image_enhanced)
```


Histogram of Image
0
100
200
300
400
500
600
700
0
50
100
150
200
250

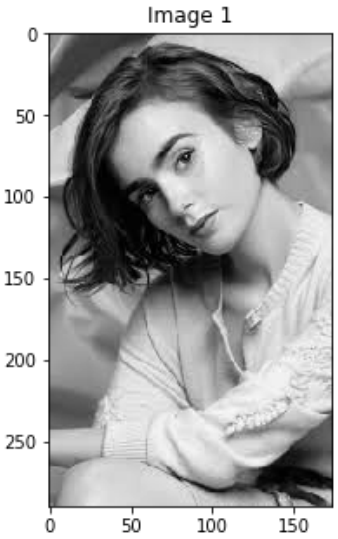


Image 1
0
50
100
150
200
250
0
50
100
150

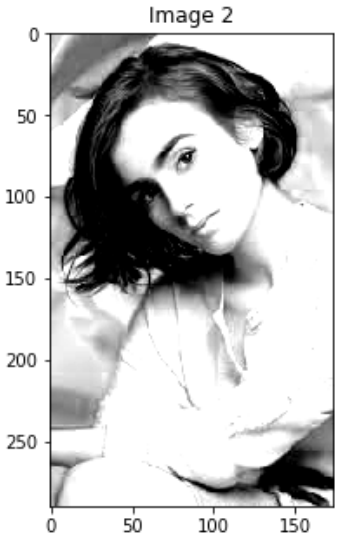


Image 2
0
50
100
150
200
250
0
50
100
150


Image 1
0
50
100
150
200
250
0
50
100
150

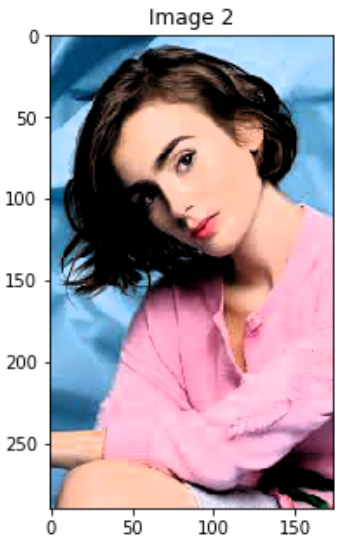
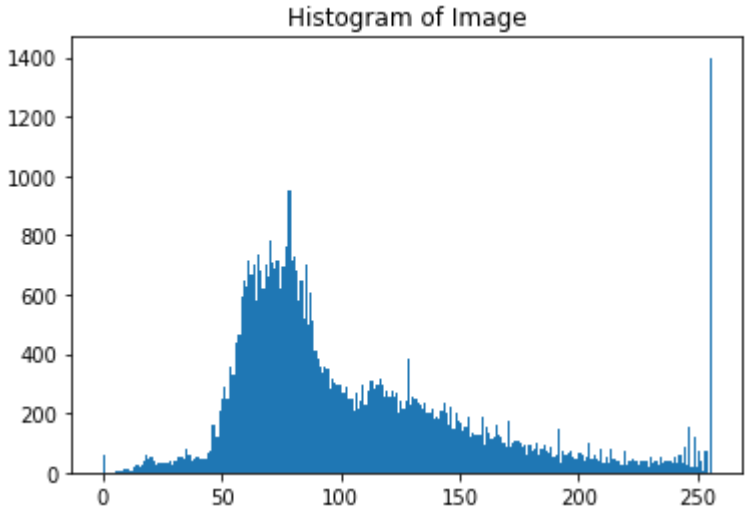


Image 2
0
50
100
150
200
250
0
50
100
150

In [26]:
```
#2.6 Enhance ảnh bằng cách cân bằng histogram kênh s
image_hsv = cv2.cvtColor(image_color, cv2.COLOR_RGB2HSV)
image_hsv_value = image_hsv[:,:,1]
hist = cv2.calcHist([image_hsv_value],[0],None,[256],[0,256])
plt.hist(image_hsv_value.ravel(),256,[0,256])
plt.title('Histogram of Image')
plt.show()
# Define parameters.
r1 = 50
s1 = 0
r2 = 200
s2 = 255
# Vectorize the function to apply it to each value in the Numpy array.
pixelVal_vec = np.vectorize(pixelValTransformation)
# Apply contrast stretching.
contrast_stretched = pixelVal_vec(image_hsv_value, r1, s1, r2, s2)
image_hsv[:,:,1] = contrast_stretched
image_enhanced = cv2.cvtColor(image_hsv, cv2.COLOR_HSV2RGB)
ShowTwoImages(image_gray, contrast_stretched)
ShowTwoImages(image_color, image_enhanced)
```


Histogram of Image
1400
1200
1000
800
600
400
200
0
0
50
100
150
200
250

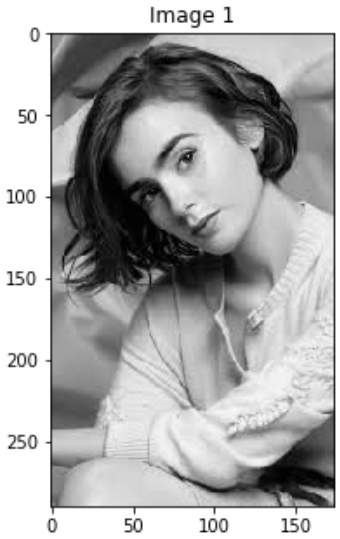


Image 1
0
50
100
150
200
250
0
50
100
150

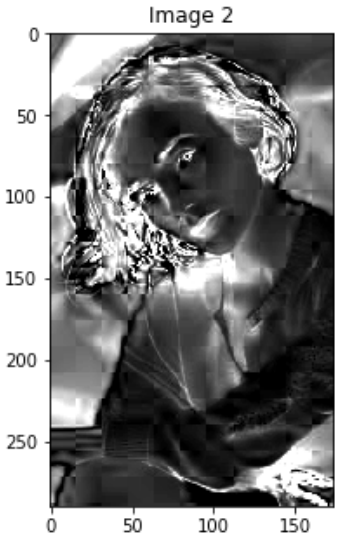


Image 2
0
50
100
150
200
250
0
50
100
150

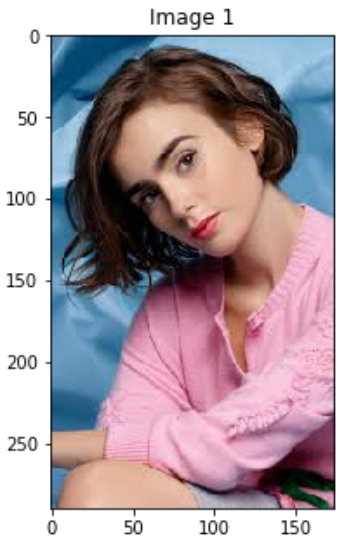


Image 1
0
50
100
150
200
250
0
50
100
150

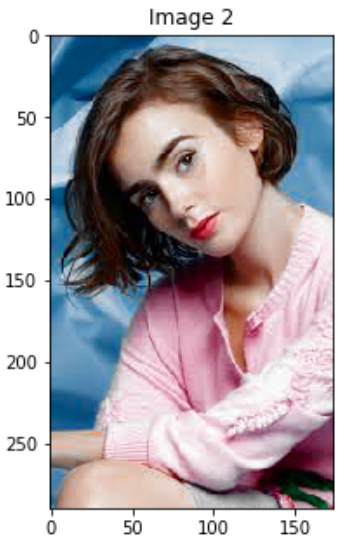


Image 2
0
50
100
150
200
250
0
50
100
150

In [25]:
```
from skimage import feature
# sigma help to remove the noisy image in edge detection
# 2.9) Xuất ảnh biên và cạnh của ảnh gốc
image_edges_01 = feature.canny(image_gray)
image_edges_02 = feature.canny(image_gray, sigma=2)
ShowThreeImages(image_color, image_edges_01, image_edges_02)
```

In [ ]:

In [ ]: