Lab06 - Object Detection

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Thực hiện segmentation tất cả các đối tượng sau từ tập thư mục ảnh (tùy chọn 1 trong 5 ảnh mỗi loại)

- Vết Defect A
- Vết Defect B
- Biển số xe
- Vết xuất huyết và xuất tiết
- Khuôn mặt người
- Lửa
- Bông hoa
- Trái bóng
- Bàn tay
- Võng mạc
- Lá phổi
- Vết melanoma trên da

In [1]:
```
import numpy as np
import cv2
from matplotlib import pyplot as plt
from skimage.color import rgb2gray
from skimage.filters import threshold_otsu
from skimage.measure import label, regionprops
from skimage.segmentation import mark_boundaries
from scipy import ndimage as ndi
import pandas as pd
import json
import os
import timeit
import random
```

In [2]:
```
def ShowImage(ImageList, nRows = 1, nCols = 2, WidthSpace = 0.00, HeightSpace = 0.00):
    from matplotlib import pyplot as plt
    import matplotlib.gridspec as gridspec
    gs = gridspec.GridSpec(nRows, nCols)
    gs.update(wspace=WidthSpace, hspace=HeightSpace) # set the spacing between axes.
    plt.figure(figsize=(20,20))
    for i in range(len(ImageList)):
        ax1 = plt.subplot(gs[i])
        ax1.set_xticklabels([])
        ax1.set_yticklabels([])
        ax1.set_aspect('equal')

        plt.subplot(nRows, nCols,i+1)

        image = ImageList[i].copy()
        if (len(image.shape) < 3):
            plt.imshow(image, plt.cm.gray)
        else:
            plt.imshow(image)
        plt.title("Image " + str(i))
        plt.axis('off')

    plt.show()
```

In [3]:
```
def morphology(Mask, Size):
    from skimage.morphology import erosion, dilation, opening, closing, white_tophat
    from skimage.morphology import disk
    selem = disk(abs(Size))
    if(Size > 0):
        result = dilation(Mask, selem)
    else:
        result = erosion(Mask, selem)
    return result
```

In [4]:
```
import os
import pandas as pd

def get_subfiles(dir):
    ''' Get a list of immediate subfiles '''
    return next(os.walk(dir))[2]
```

In [5]:
```
def SegmentColorImageByMask(IM, Mask):
    Mask = Mask.astype(np.uint8)
    result = cv2.bitwise_and(IM, IM, mask = Mask)
    return result
```

In [6]:
```
def SegmentationByOtsu(image, mask):
    image_process = image.copy()
    image_mask = mask.copy()

    image_process[image_mask == 0] = 0
    ListPixel = image_process.ravel()
    ListPixel = ListPixel[ListPixel > 0]

    from skimage.filters import threshold_otsu
    otsu_thresh = threshold_otsu(ListPixel)

    return otsu_thresh
```

In [7]:
```
def ResizeImage(IM, DesiredWidth, DesiredHeight):
    from skimage.transform import rescale, resize

    OrigWidth = float(IM.shape[1])
    OrigHeight = float(IM.shape[0])
    Width = DesiredWidth
    Height = DesiredHeight

    if((Width == 0) & (Height == 0)):
        return IM

    if(Width == 0):
        Width = int((OrigWidth * Height)/OrigHeight)

    if(Height == 0):
        Height = int((OrigHeight * Width)/OrigWidth)
    dim = (Width, Height)
    # print(dim)
    resizedIM = cv2.resize(IM, dim, interpolation = cv2.INTER_NEAREST)
    # imshows([IM, resizedIM], ["Image", "resizedIM"],1,2)
    return resizedIM
```

In [8]:

```
def SegmentByKmeans(image_orig, nClusters = 3):
    img = image_orig.copy()
    Z = img.reshape((-1,3))

    # convert to np.float32
    Z = np.float32(Z)

    # define criteria, number of clusters(K) and apply kmeans()
    criteria = (cv2.TERM_CRITERIA_EPS + cv2.TERM_CRITERIA_MAX_ITER, 100, 1.0)
    K = nClusters
    ret,labellist,center=cv2.kmeans(Z,K,None,criteria,10,cv2.KMEANS_RANDOM_CENTERS)

    # Now convert back into uint8, and make original image
    center = np.uint8(center)
    res = center[labellist.flatten()]
    res2 = res.reshape((img.shape))
    label2 = labellist.reshape((img.shape[:2]))

    image_index = label2
    image_kmeans = res2

    # Sort to make sure the index is stable
    AreaList = []
    for idx in range(image_index.max() + 1):
        mask = image_index == idx
        AreaList.append(mask.sum().sum())

    sort_index = np.argsort(AreaList)[::-1]
    index = 0
    image_index1 = image_index * 0
    for idx in sort_index:
        image_index1[image_index == idx] = index
        index = index + 1

    image_index = image_index1.copy()

    return image_index, image_kmeans
```

In [9]:
```
def LabelObjectByMask(image_input, image_mask, type = "BBox", color = (0,255,0), thick = 2):
    image_input = image_orig.copy()
    image_output = image_input.copy()

    label_img = label(image_mask)
    regions = regionprops(label_img)
    for props in regions:
        minr, minc, maxr, maxc = props.bbox
        left_top = (minc, minr)
        right_bottom = (maxc, maxr)
        at_row, at_col = props.centroid

        if(type == "Center"):
            cv2.drawMarker(image_output, (int(at_col), int(at_row)),color, markerType=cv2.MARKER_STAR, markerSize=15, t
hickness= 1, line_type=cv2.LINE_AA)
        if(type == "BBox"):
            cv2.rectangle(image_output,left_top, right_bottom, color ,thick)

    if(type == "Boundary"):
        color = [(number / 255) for number in color]
        image_mask = morphology(image_mask, 1)
        image_output = mark_boundaries(image_output, image_mask, color = color, mode='thick')
    if(type == "Fill"):
        image_output[image_mask > 0] = color

    return image_output
```

In [10]:
```
def SelectMaskByThreshArea(Mask, minArea = 300, maxArea = 100000):
    import pandas as pd
    from skimage.measure import label, regionprops
    mask = Mask.copy()
    mask_output = mask * 0

    bboxList = []
    label_img = label(mask)
    regions = regionprops(label_img)
    for props in regions:
        area = props.area
        label = props.label
        if((area > minArea) and (area < maxArea)):
            mask_output = mask_output + (label_img == label).astype(int)
    return mask_output
```

In [11]:
```
def load_image(file_name):
    idx = SegDataName.index(file_name)
    print("Selected Image : ", "\nIndex ", idx, "\nName ", SegDataName[idx])
    image = SegDataIMG[idx]
    image_orig = ResizeImage(image, DesiredWidth = 0, DesiredHeight = 350)
    image_orig = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
    image_gray = cv2.cvtColor(image,cv2.COLOR_BGR2GRAY)
    image_hsv = cv2.cvtColor(image, cv2.COLOR_BGR2HSV)
    image_ycbcr = cv2.cvtColor(image, cv2.COLOR_BGR2YCR_CB)
    return [image_orig, image_gray, image_hsv, image_ycbcr]
```

In [12]:
```
def get_mask(image_orig, image_gray, nClusters, minArea, maxArea):
    image_index, image_kmeans = SegmentByKmeans(image_orig, nClusters = nClusters)
    mask_list = []
    mask_abnormal = image_gray * 0
    for idx in range(image_index.max() + 1):
        imask = image_index == idx
        mask_small = SelectMaskByThreshArea(imask, minArea = minArea, maxArea = maxArea)
        mask_list.append(imask)
        mask_abnormal = mask_abnormal + mask_small
    return [image_index, image_kmeans, mask_list, mask_abnormal]
```

In [13]:
```
def get_detectd_images(list_images, nClusters, imask, minArea, maxArea, area_condition, imean_condition):
    image_orig, image_gray, image_hsv, image_ycbcr = list_images

    h = image_hsv[:,:,0]
    s = image_hsv[:,:,1]
    v = image_hsv[:,:,2]
    y = image_ycbcr[:,:,0]
    cb = image_ycbcr[:,:,1]
    cr = image_ycbcr[:,:,2]

    image_index, image_kmeans, mask_list, mask_abnormal = \
                            get_mask(image_orig, image_gray, nClusters, minArea, maxArea)

    label_img = label(imask)
    regions = regionprops(label_img, intensity_image = image_hsv[:,:,0])

    mask_condition = mask_abnormal * 0
    for props in regions:
        area = props.area
        ilabel = props.label
        imask = label_img == ilabel
        imean = props.mean_intensity
        imax = props.max_intensity
        imin = props.min_intensity

        result_area_cond = []
        for cond in area_condition:
            result_area_cond.append(area > cond[0] and area < cond[1])
        condition = result_area_cond[0]
        if len(result_area_cond) > 1:
            for res in result_area_cond[1:]:
                condition = condition or res

        result_imean_cond = []
        for cond in imean_condition:
            result_imean_cond.append(imean >= cond[0] and imean <= cond[1])
        condition2 = result_imean_cond[0]
        if len(result_imean_cond) > 1:
            for res in result_imean_cond[1:]:
                condition2 = condition2 or res

        condition1 = condition and condition2

        if(condition1):
            mask_condition = mask_condition + (imask).astype(int)
```

```
    image_output1 = LabelObjectByMask(image_orig, mask_condition, type = "Fill", color = (0,255,0), thick = 2)
    image_output2 = LabelObjectByMask(image_orig, mask_condition, type = "BBox", color = (0,255,0), thick = 2)
    image_output3 = LabelObjectByMask(image_orig, mask_condition, type = "Center", color = (0,255,0), thick = 2)
    image_output4 = LabelObjectByMask(image_orig, mask_condition, type = "Boundary", color = (0,255,0), thick = 2)

    return [image_output1, image_output2, image_output3, image_output4]
```

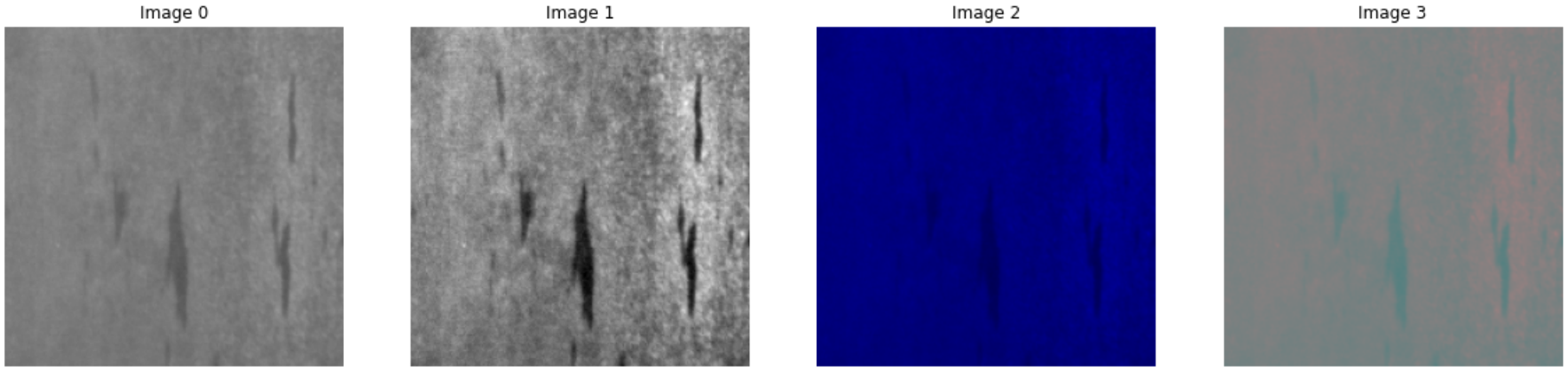
In [14]:
```
path_data = '/home/dinh_anh_huy/GitHub/2020-2021/semester-1/digital-image-processing/lab-06/Lab06 - Image/'

path = path_data
all_names = get_subfiles(path)
print("Number of Images:", len(all_names))
IMG = []
for i in range(len(all_names)):
    tmp = cv2.imread(path + all_names[i])
    IMG.append(tmp)

SegDataIMG = IMG.copy()
SegDataName = all_names
```

```
Number of Images: 60
```

Vết Defect A

In [15]:
```
image_orig, image_gray, image_hsv, image_ycbcr = load_image('DefectA 03.bmp')
ShowImage([image_orig, image_gray, image_hsv, image_ycbcr], 1, 4)
```

```
Selected Image :
Index  14
Name  DefectA 03.bmp
```



In [16]:
```
image_index, image_kmeans, mask_list, mask_abnormal = get_mask(image_orig, image_gray, 5, 500, 2000)
ShowImage([image_orig, image_index, image_kmeans], 1, 3)
ShowImage(mask_list, 1, len(mask_list))
ShowImage([mask_abnormal], 1, 3)
```

Image 0

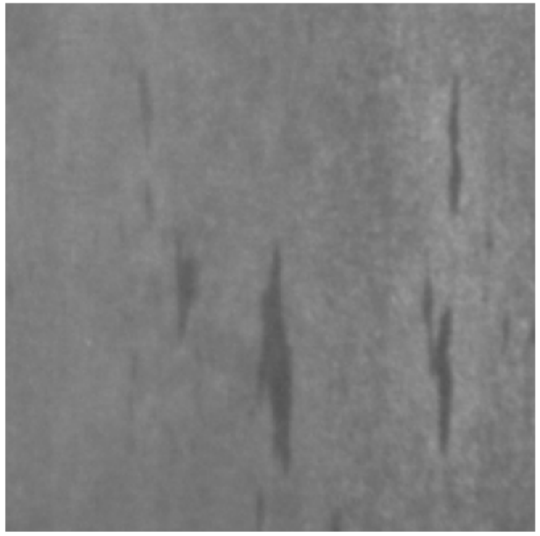


Image 1

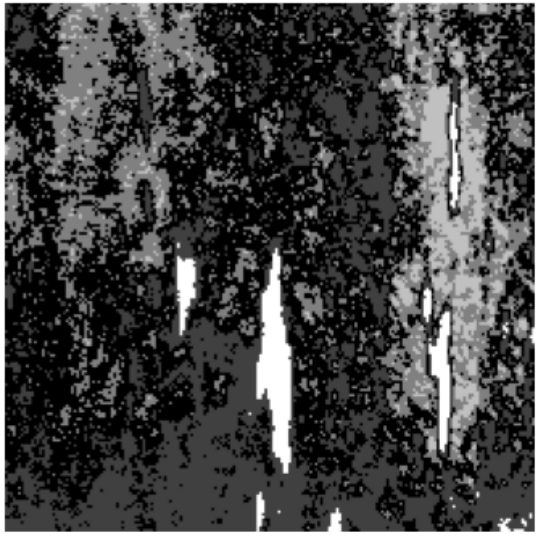


Image 2

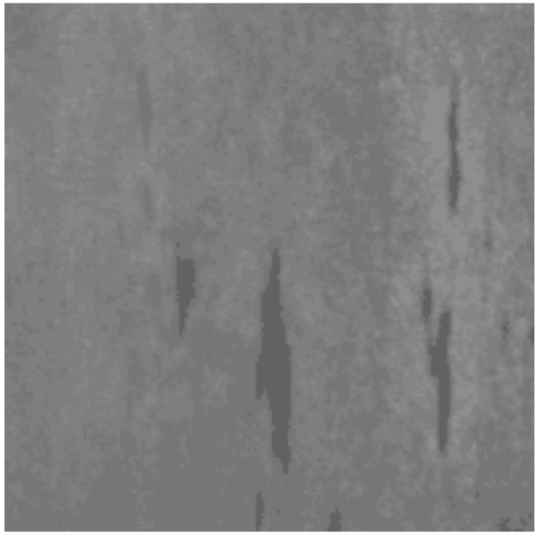


Image 0

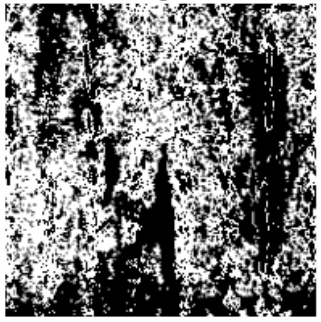


Image 1

Image 2

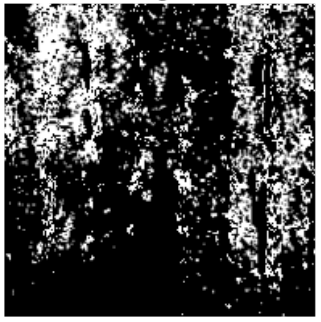


Image 3

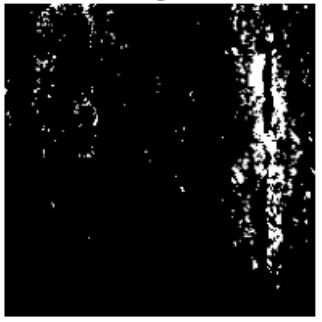


Image 4

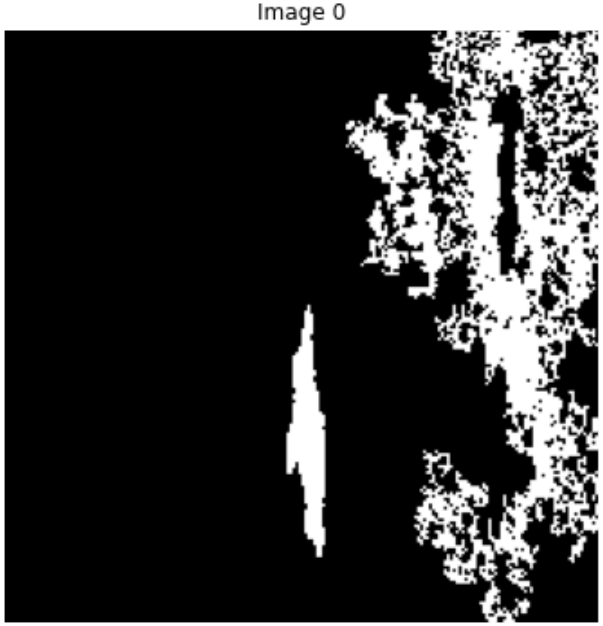


Image 0

In [17]:
```
list_images = [image_orig, image_gray, image_hsv, image_ycbcr]
nClusters = 5
imask = image_index == 4
minArea = 500
maxArea = 2000
area_condition = [[0, 20000]]
max_imean = [[0, 70]]
[image_output1, image_output2, image_output3, image_output4] = get_detectd_images(list_images, nClusters, imask, minAre
a, maxArea, area_condition, max_imean)
ShowImage([image_output1, image_output2], 1, 2)
ShowImage([image_output3, image_output4], 1, 2)
```

Image 0

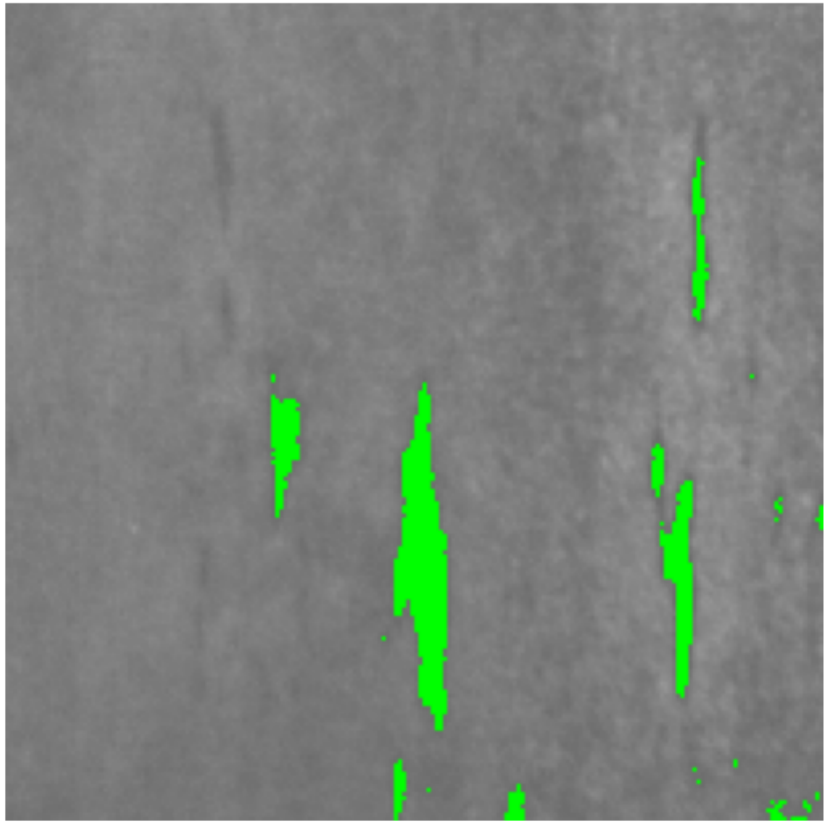
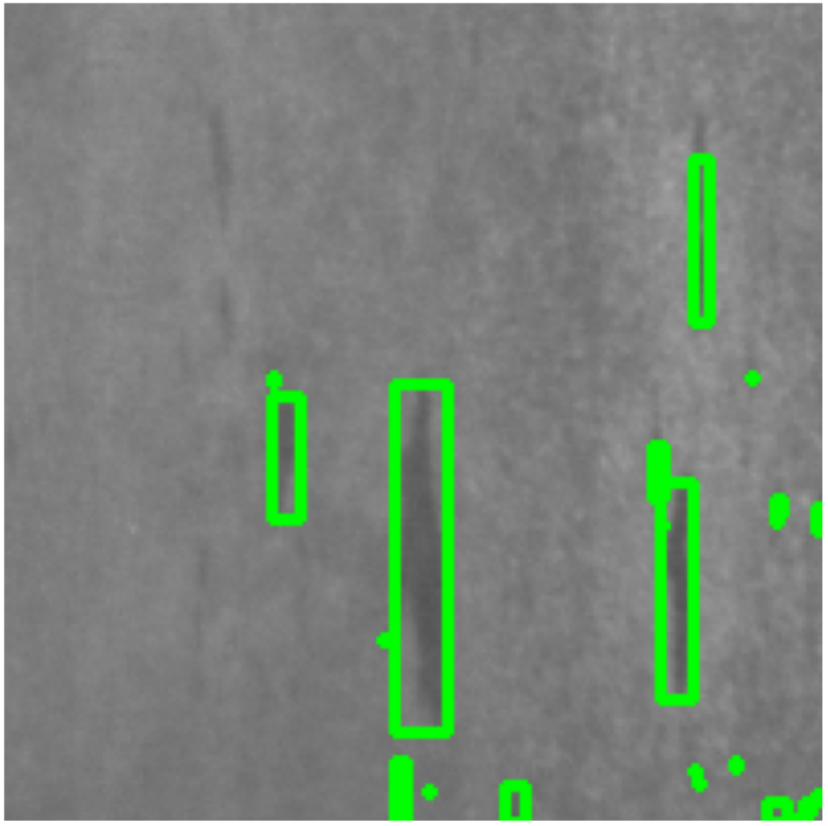
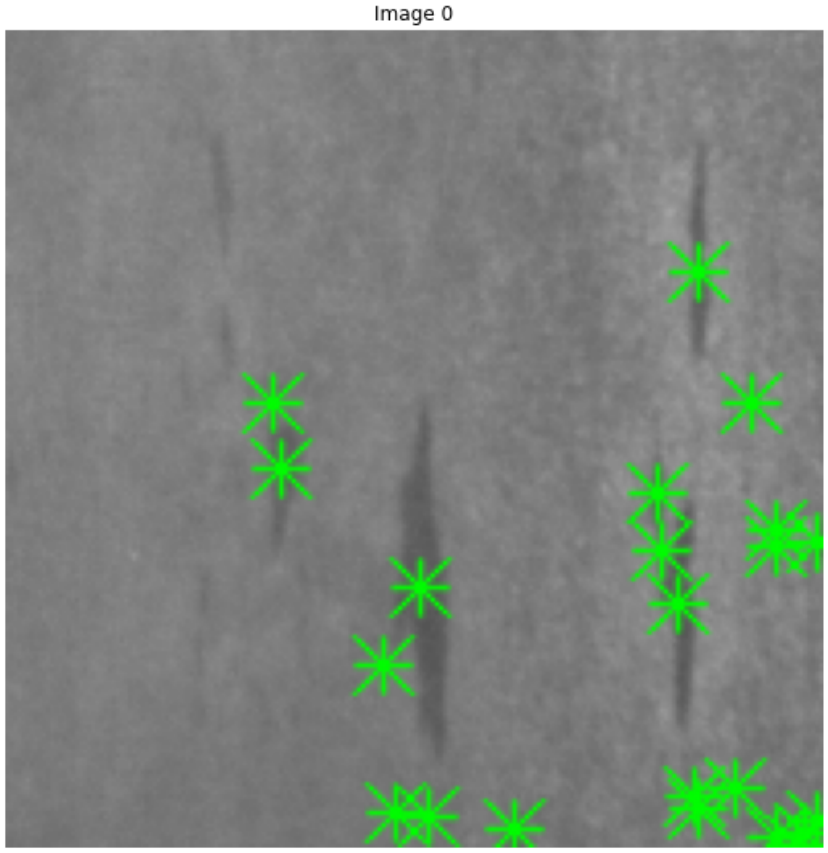
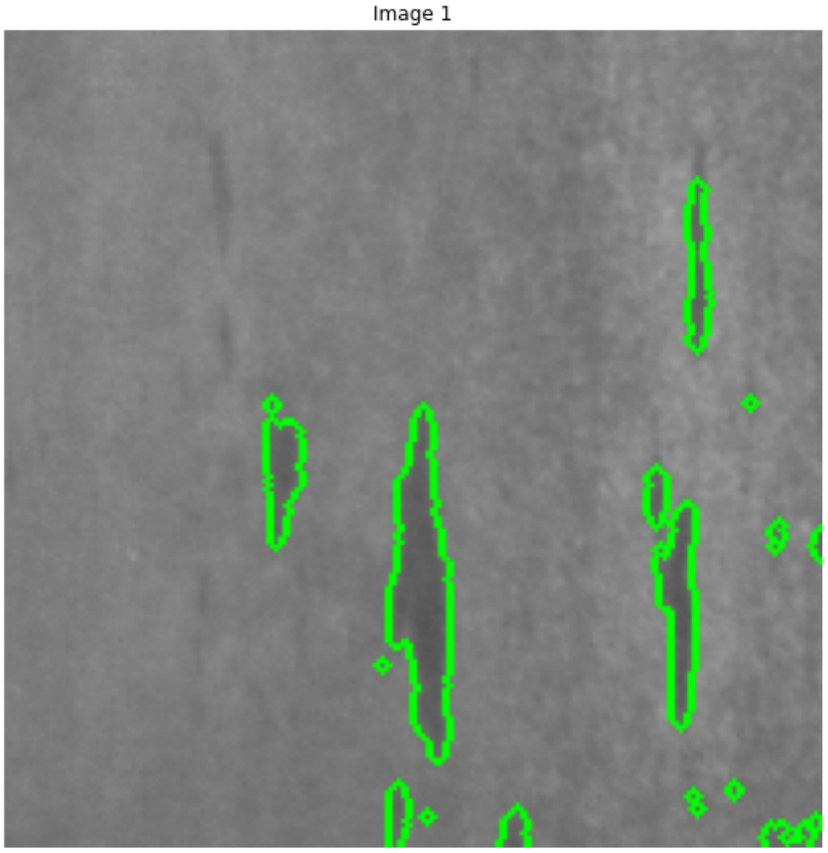


Image 1



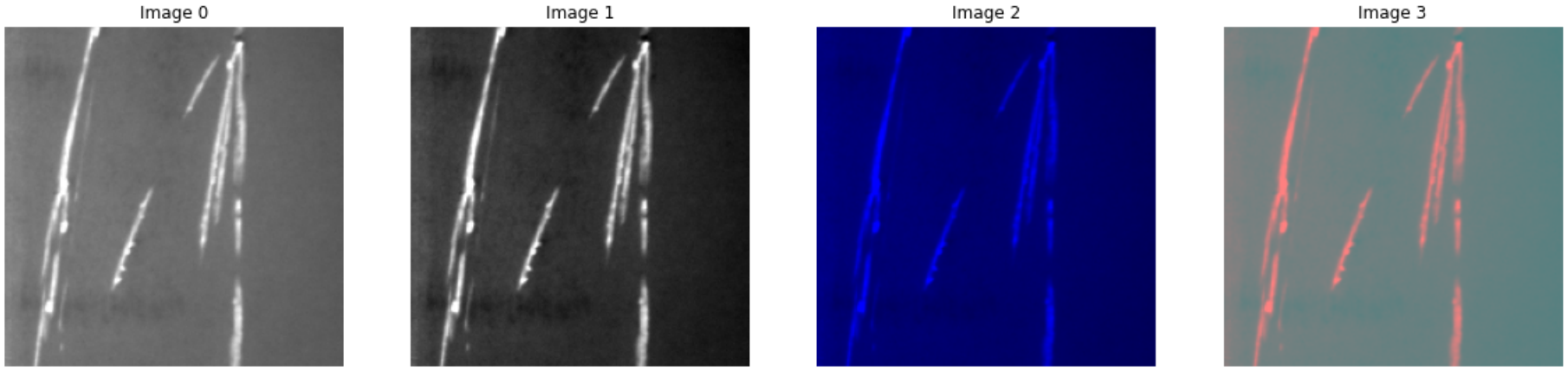




Vết Defect B

In [18]:
```
image_orig, image_gray, image_hsv, image_ycbcr = load_image('DefectB 04.bmp')
ShowImage([image_orig, image_gray, image_hsv, image_ycbcr], 1, 4)
```

```
Selected Image :
Index  54
Name  DefectB 04.bmp
```



In [19]:
```
nClusters = 3
minArea = 50
maxArea = 1500
image_index, image_kmeans, mask_list, mask_abnormal = get_mask(image_orig, image_gray, nClusters, minArea, maxArea)
ShowImage([image_orig, image_index, image_kmeans], 1, 3)
ShowImage(mask_list, 1, len(mask_list))
ShowImage([mask_abnormal], 1, 3)
```

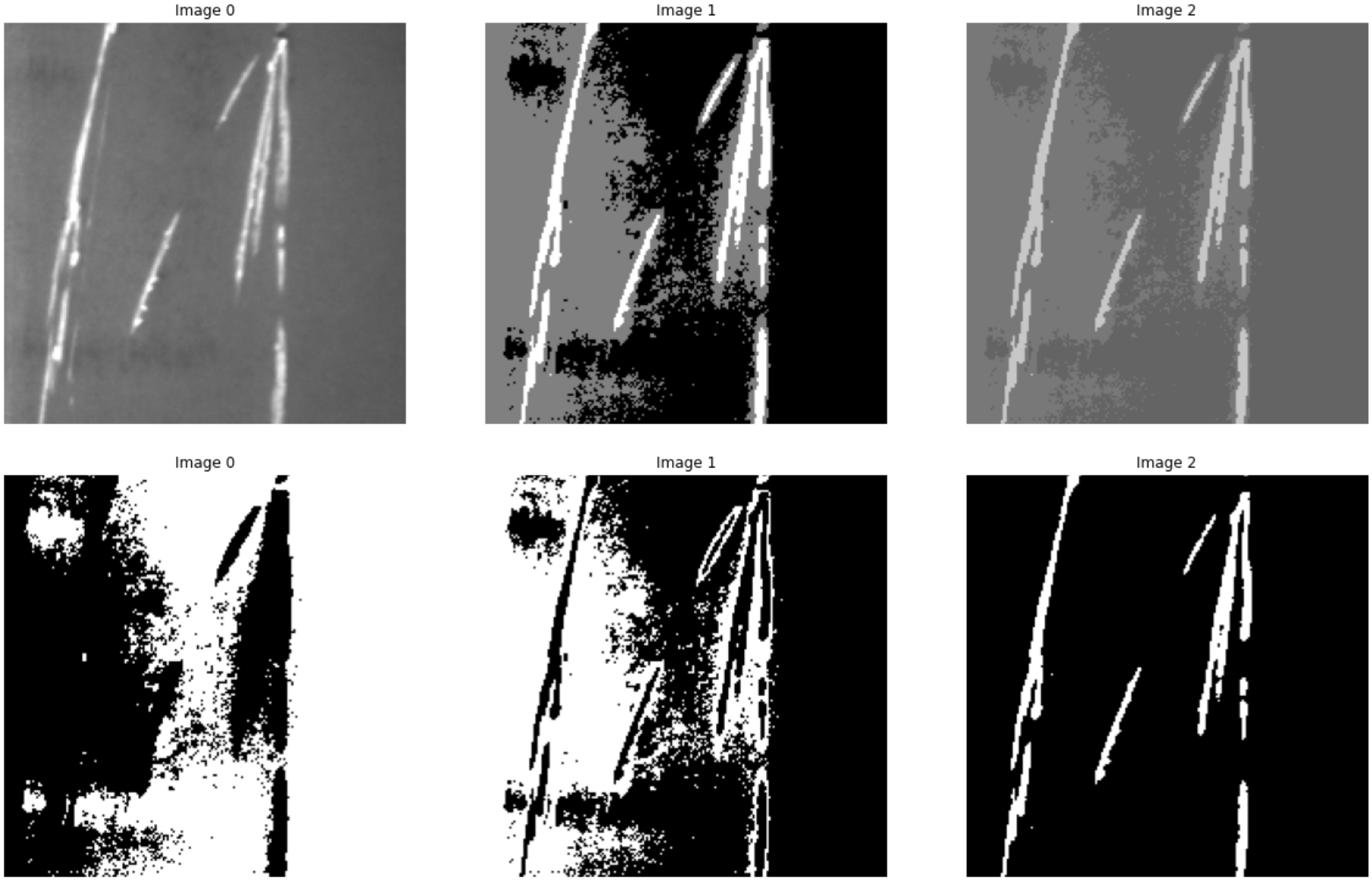


Image 0
Image 1
Image 2
Image 0
Image 1
Image 2

Image 0

In [20]:
```
list_images = [image_orig, image_gray, image_hsv, image_ycbcr]
nClusters = 3
imask = image_index == 2
minArea = 25
maxArea = 1500
area_condition = [[25, 2000]]
max_imean = [[0, 180]]
[image_output1, image_output2, image_output3, image_output4] = get_detectd_images(list_images, nClusters, imask, minAre
a, maxArea, area_condition, max_imean)
ShowImage([image_output1, image_output2], 1, 2)
ShowImage([image_output3, image_output4], 1, 2)
```

Image 0

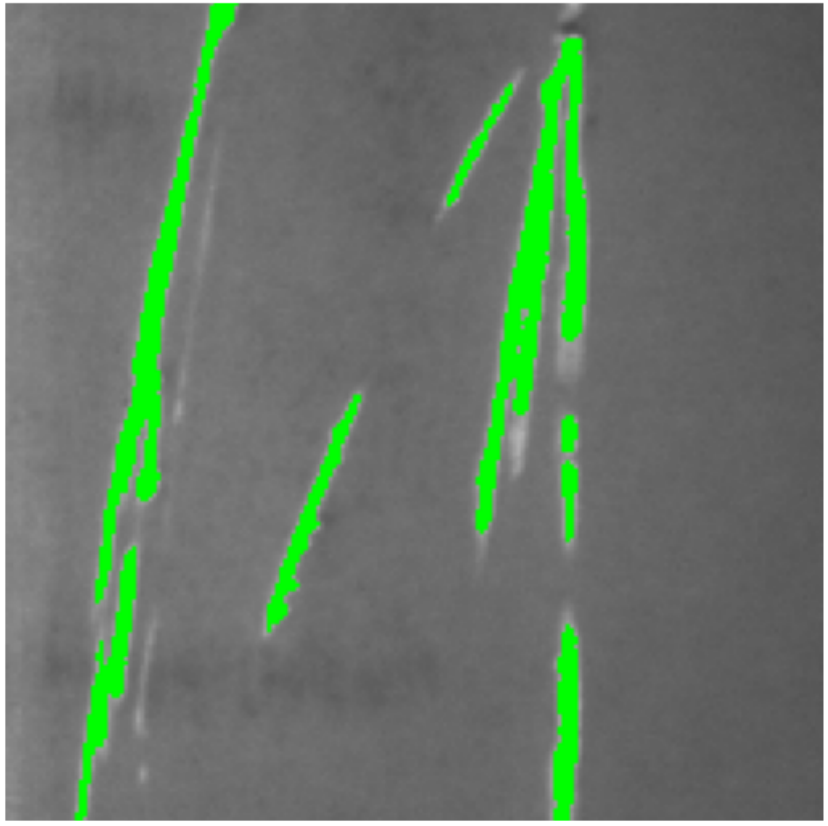
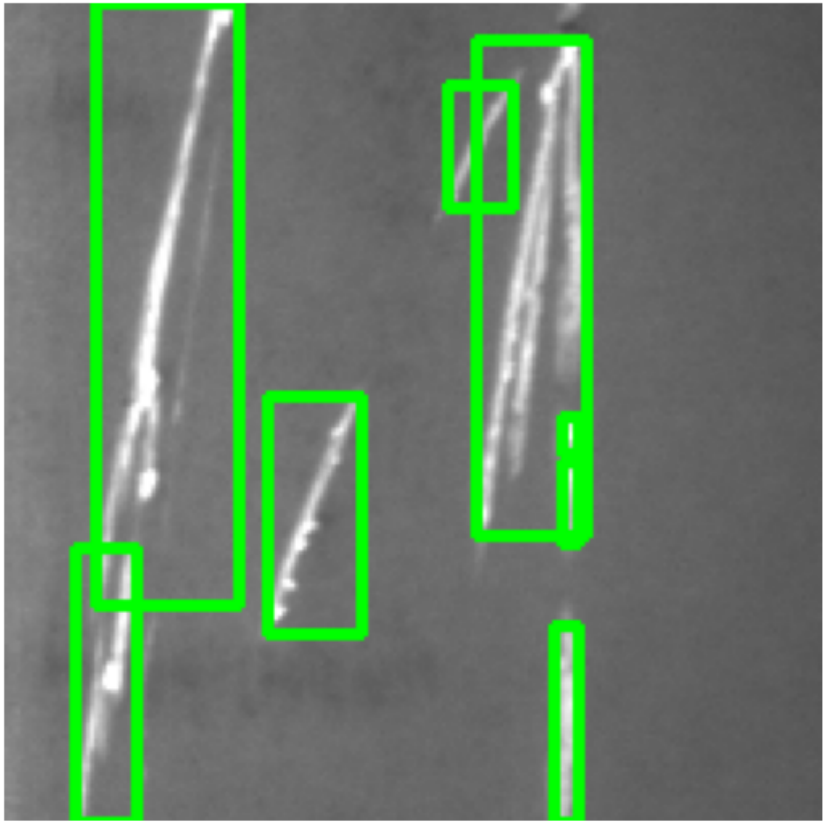
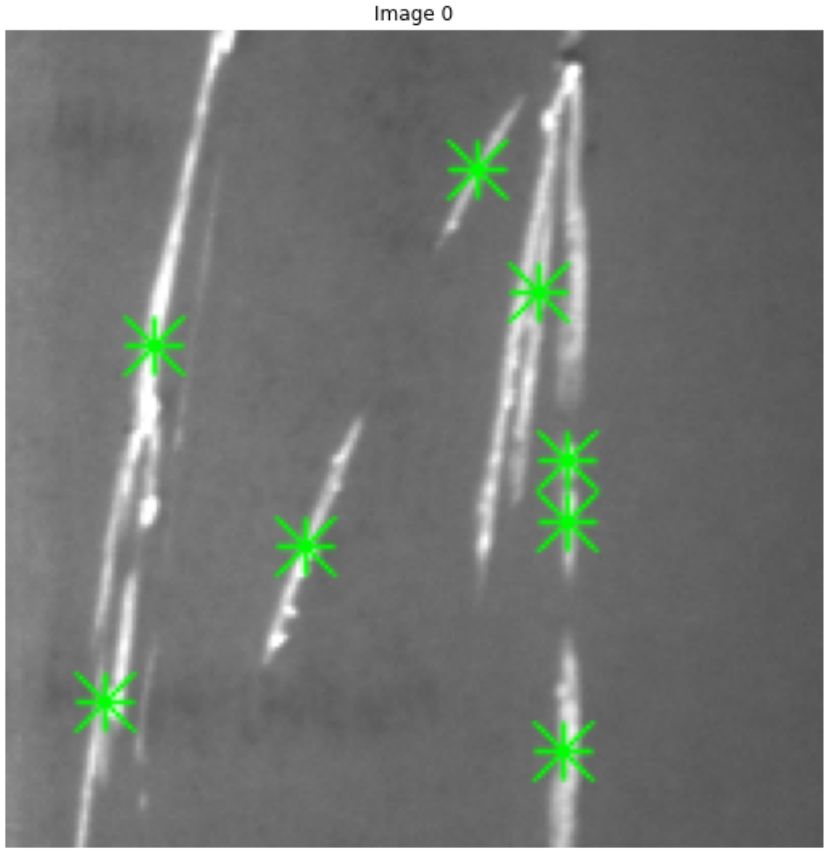
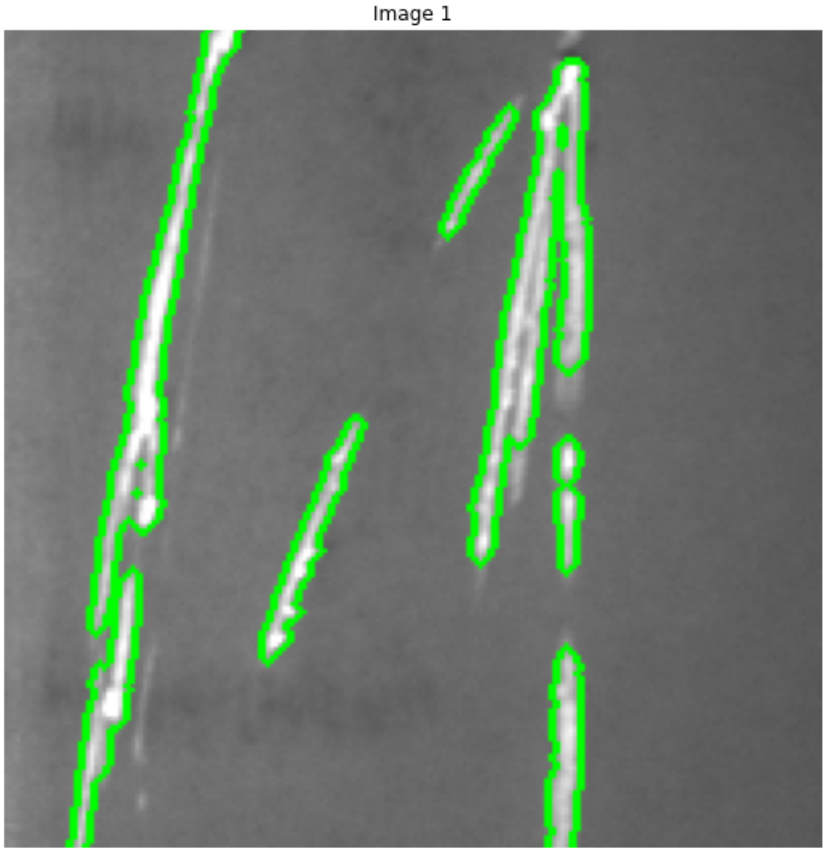


Image 1



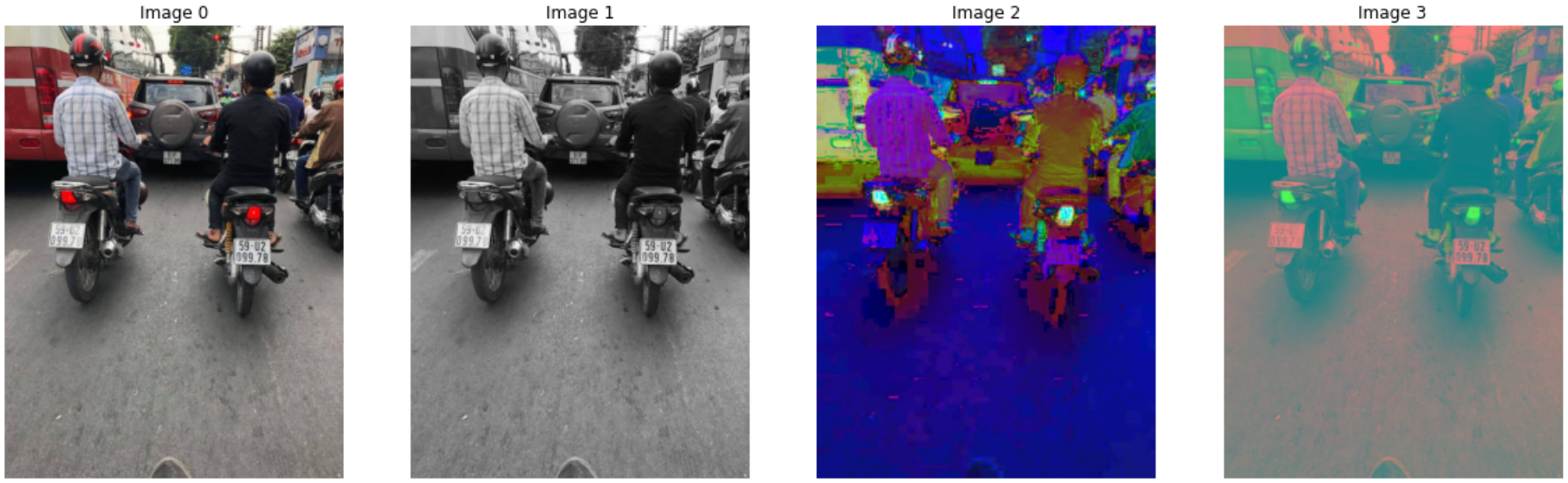




Biển số xe

In [21]:
```
image_orig, image_gray, image_hsv, image_ycbcr = load_image('DrivingPlate 04.jpg')
ShowImage([image_orig, image_gray, image_hsv, image_ycbcr], 1, 4)
```

```
Selected Image :
Index  0
Name  DrivingPlate 04.jpg
```



In [22]:
```
nClusters = 3
minArea = 500
maxArea = 4000
image_index, image_kmeans, mask_list, mask_abnormal = get_mask(image_orig, image_gray, nClusters, minArea, maxArea)
ShowImage([image_orig, image_index, image_kmeans], 1, 3)
ShowImage(mask_list, 1, len(mask_list))
ShowImage([mask_abnormal], 1, 3)
```

Image 0

Image 1

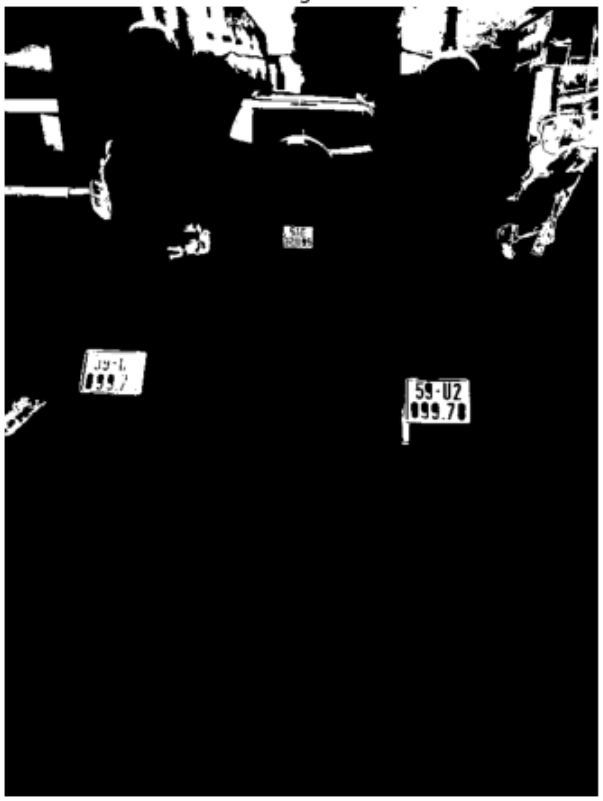
Image 2

Image 0

Image 1

Image 2

Image 0



In [23]:
```
list_images = [image_orig, image_gray, image_hsv, image_ycbcr]
nClusters = 3
imask = mask_abnormal
minArea = 400
maxArea = 4000
area_condition = [[500, 510], [2600, 2620], [2380, 2390]]
max_imean = [[0,180]]
[image_output1, image_output2, image_output3, image_output4] = get_detectd_images(list_images, nClusters, imask, minAre
a, maxArea, area_condition, max_imean)
ShowImage([image_output1, image_output2], 1, 2)
ShowImage([image_output3, image_output4], 1, 2)
```

Image 0

Image 1

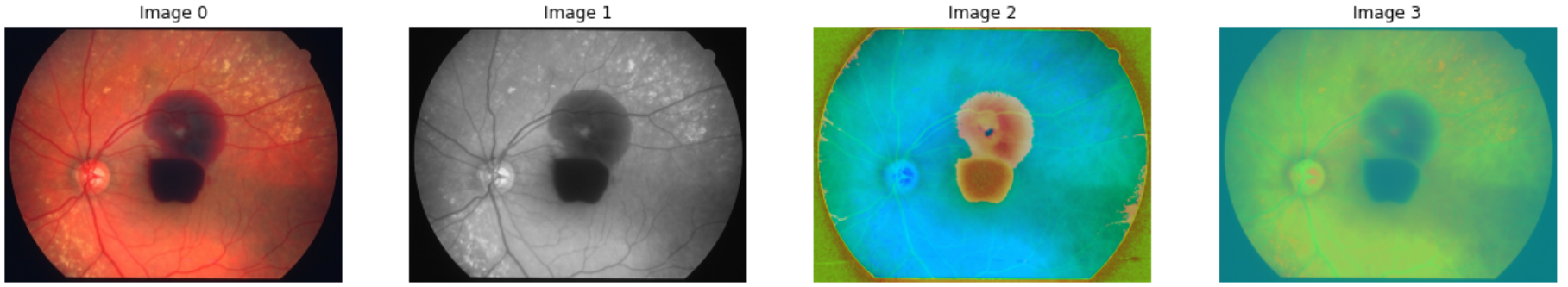
Image 0

Image 1

Vết xuất huyết và xuất tiết

In [24]:
```
image_orig, image_gray, image_hsv, image_ycbcr = load_image('Eye 04.jpg')
ShowImage([image_orig, image_gray, image_hsv, image_ycbcr], 1, 4)
```

```
Selected Image :
Index  46
Name  Eye 04.jpg
```



In [25]:
```
nClusters = 2
minArea = 500
maxArea = 200000
image_index, image_kmeans, mask_list, mask_abnormal = get_mask(image_orig, image_gray, nClusters, minArea, maxArea)
ShowImage([image_orig, image_index, image_kmeans], 1, 3)
ShowImage(mask_list, 1, len(mask_list))
ShowImage([mask_abnormal], 1, 3)
```

Image 0

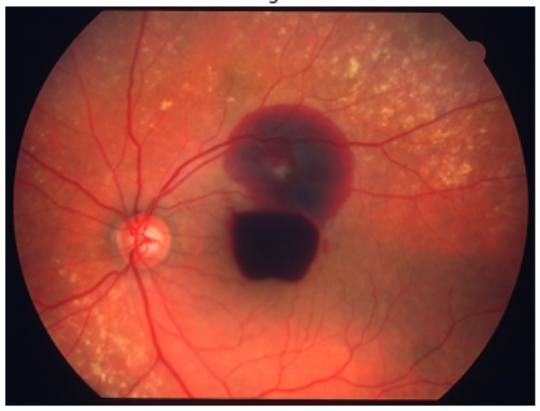


Image 1

Image 2

Image 0

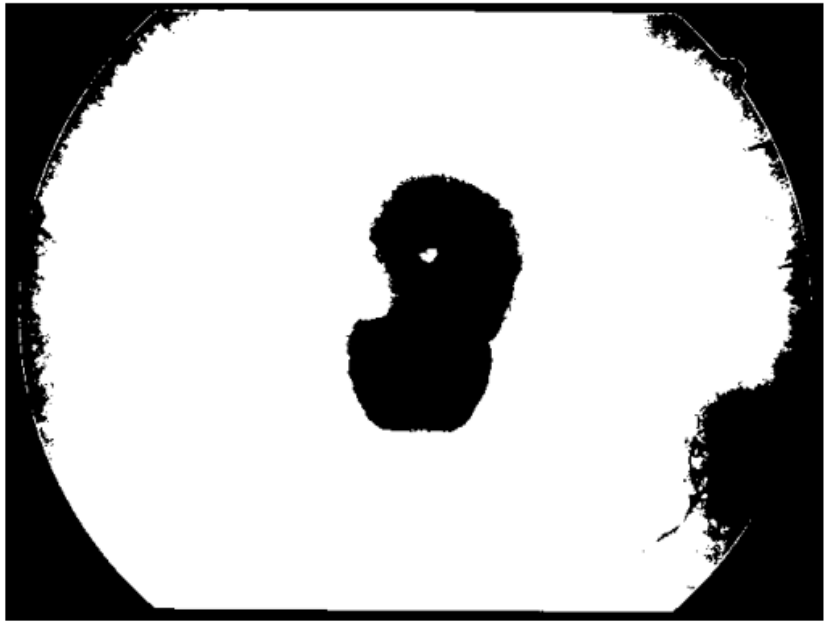


Image 1

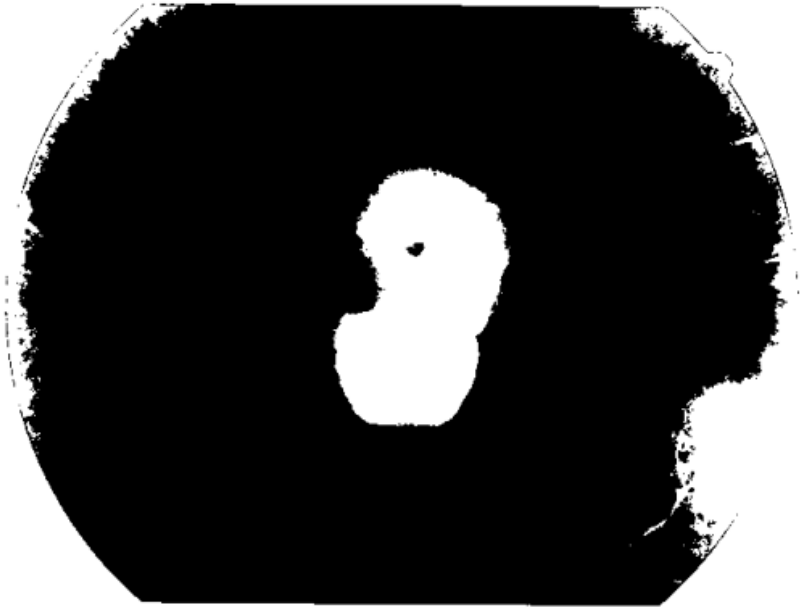


Image 0

In [26]:
```
list_images = [image_orig, image_gray, image_hsv, image_ycbcr]
nClusters = 2
imask = mask_abnormal
minArea = 500
maxArea = 200000
area_condition = [[19000, 20000]]
max_imean = [[0, 180]]
[image_output1, image_output2, image_output3, image_output4] = get_detectd_images(list_images, nClusters, imask, minAre
a, maxArea, area_condition, max_imean)
ShowImage([image_output1, image_output2], 1, 2)
ShowImage([image_output3, image_output4], 1, 2)
```

Image 0

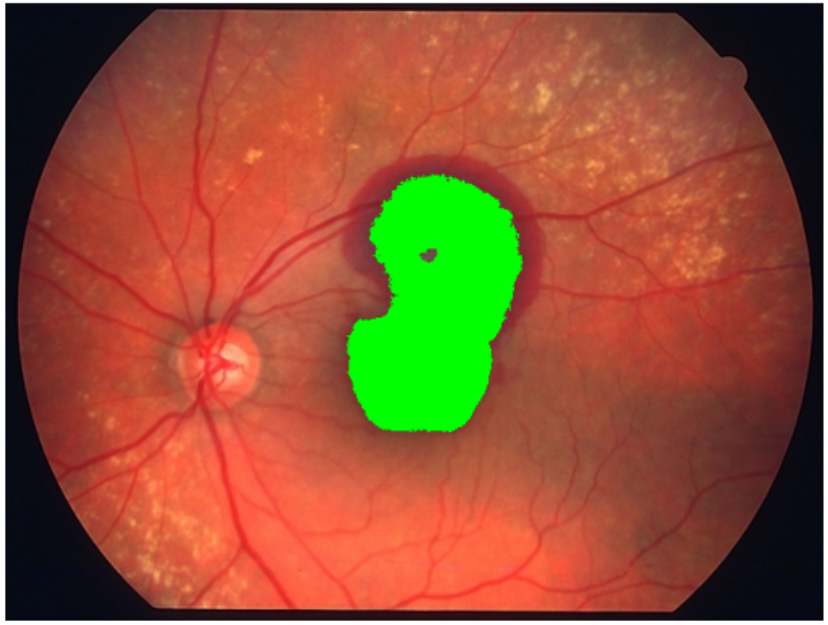


Image 1

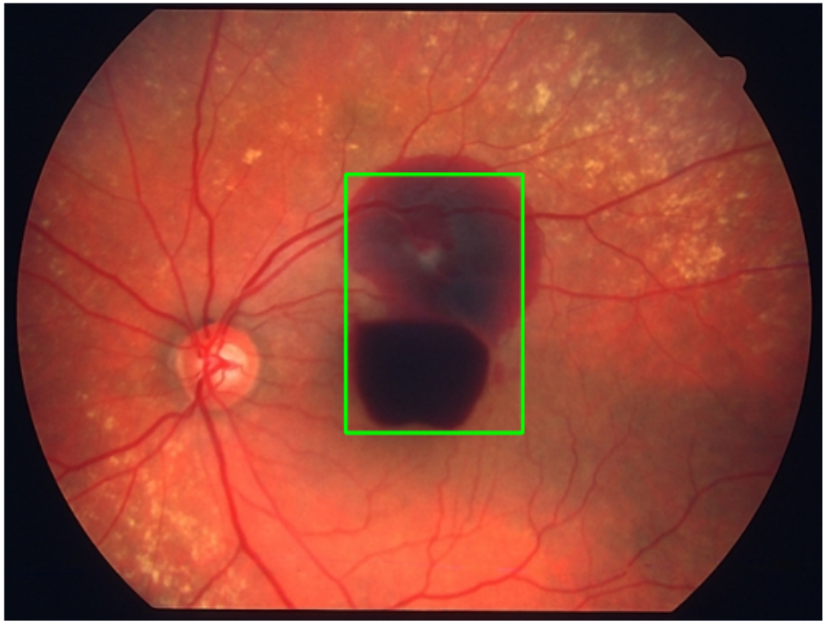


Image 0

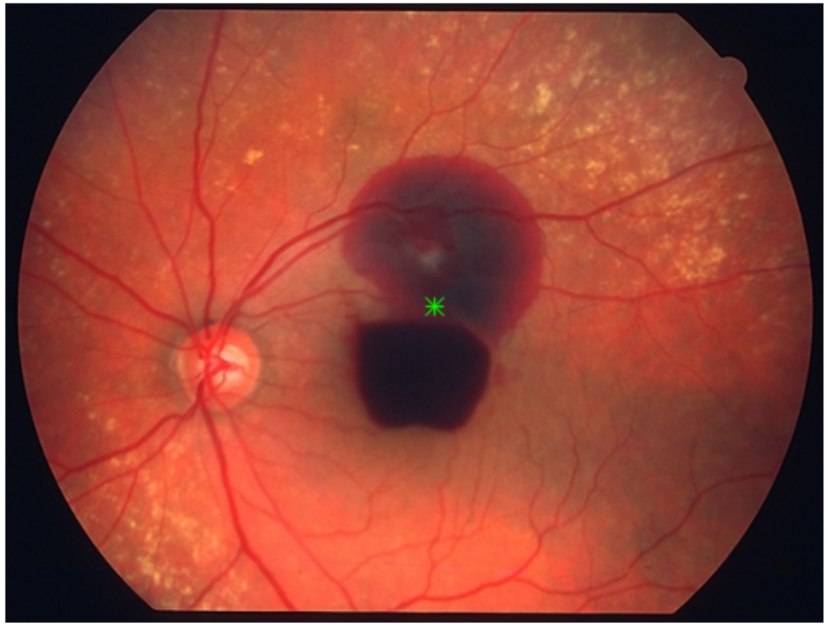


Image 1

Khuôn mặt người

In [27]:
```
image_orig, image_gray, image_hsv, image_ycbcr = load_image('Face 04.jpg')
ShowImage([image_orig, image_gray, image_hsv, image_ycbcr], 1, 4)
```

```
Selected Image :
Index  55
Name  Face 04.jpg
```

Image 0

Image 1

Image 2

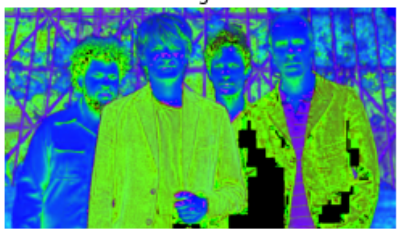


Image 3

In [28]:
```
lower = np.array([0, 50, 80], dtype = "uint8")
upper = np.array([20, 255, 255], dtype = "uint8")
skinMask = cv2.inRange(image_hsv, lower, upper)
ShowImage([image_orig, skinMask], 1, 2)
```

Image 0

Image 1

In [29]:
```
mask_abnormal = image_gray * 0
mask_small = SelectMaskByThreshArea(skinMask, minArea = 2000, maxArea = 10000)
mask_abnormal = mask_abnormal + mask_small
ShowImage([mask_abnormal], 1, 3)
```

In [30]:

```
h = image_hsv[:,:,0]
s = image_hsv[:,:,1]
v = image_hsv[:,:,2]
y = image_ycbcr[:,:,0]
cb = image_ycbcr[:,:,1]
cr = image_ycbcr[:,:,2]

label_img = label(skinMask)
regions = regionprops(label_img, intensity_image = image_hsv[:,:,0])

mask_condition = mask_abnormal * 0
for props in regions:
    area = props.area
    ilabel = props.label
    imask = label_img == ilabel
    imean = props.mean_intensity
    imax = props.max_intensity
    imin = props.min_intensity
    condition1 = (area > 2700) and (area < 7200) and (imean < 70)

    if(condition1):
        mask_condition = mask_condition + (imask).astype(int)

image_output1 = LabelObjectByMask(image_orig, mask_abnormal, type = "Fill", color = (0,255,0), thick = 2)
image_output2 = LabelObjectByMask(image_orig, mask_abnormal, type = "BBox", color = (0,255,0), thick = 2)
image_output3 = LabelObjectByMask(image_orig, mask_abnormal, type = "Center", color = (0,255,0), thick = 2)
image_output4 = LabelObjectByMask(image_orig, mask_abnormal, type = "Boundary", color = (0,255,0), thick = 2)

ShowImage([image_output1, image_output2], 1, 2)
ShowImage([image_output3, image_output4], 1, 2)
```

Image 0

Image 1

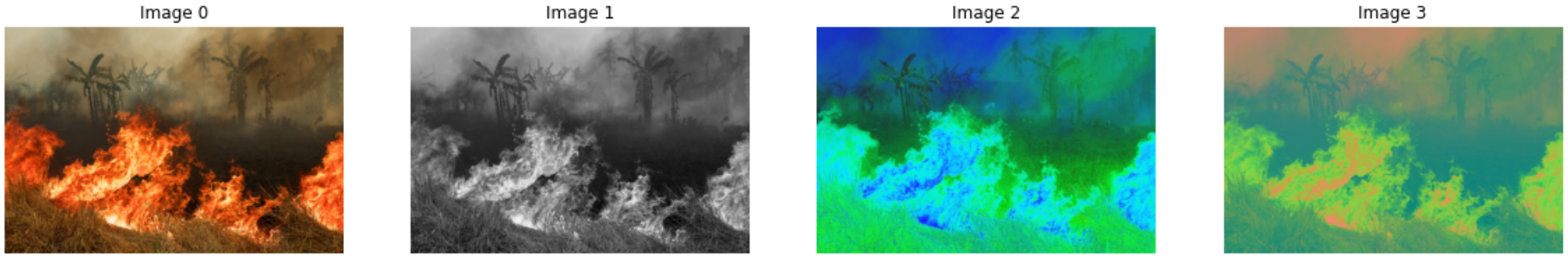
Image 0

Image 1

Lửa

In [31]:
```
image_orig, image_gray, image_hsv, image_ycbcr = load_image('Fire 02.jpg')
ShowImage([image_orig, image_gray, image_hsv, image_ycbcr], 1, 4)
```

```
Selected Image :
Index  3
Name  Fire 02.jpg
```



In [32]:
```
nClusters = 3
minArea = 70000
maxArea = 350000
image_index, image_kmeans, mask_list, mask_abnormal = get_mask(image_orig, image_gray, nClusters, minArea, maxArea)
ShowImage([image_orig, image_index, image_kmeans], 1, 3)
ShowImage(mask_list, 1, len(mask_list))
ShowImage([mask_abnormal], 1, 3)
```

Image 0

Image 1

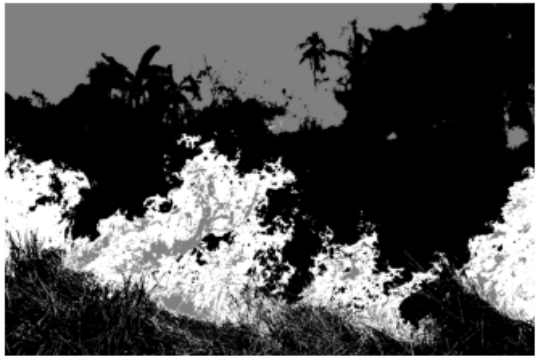


Image 2

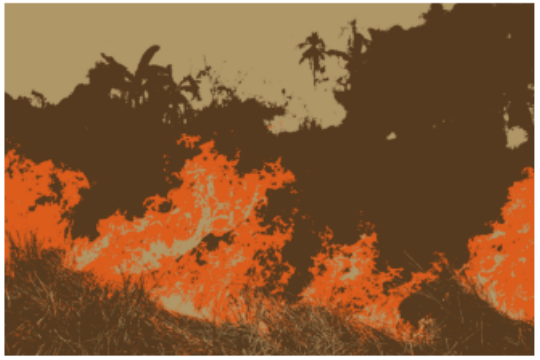


Image 0

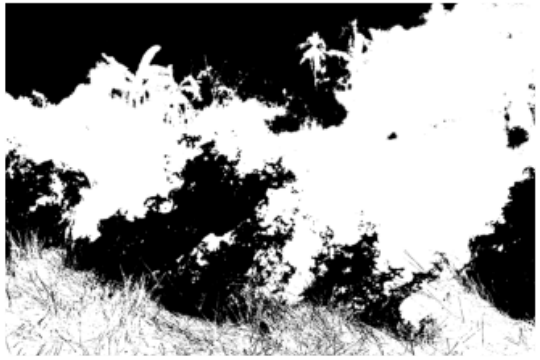


Image 1

Image 2

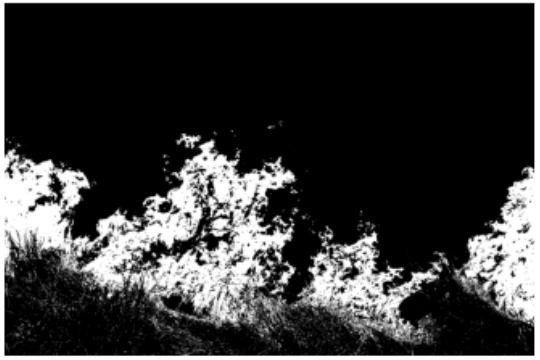
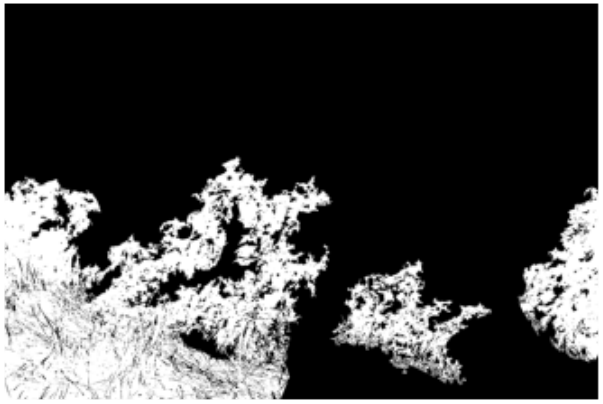


Image 0



In [33]:
```
list_images = [image_orig, image_gray, image_hsv, image_ycbcr]
nClusters = 3
imask = image_index == 2
minArea = 70000
maxArea = 350000
area_condition = [[70000, 350000]]
max_imean = [[0, 180]]
[image_output1, image_output2, image_output3, image_output4] = get_detectd_images(list_images, nClusters, imask, minAre
a, maxArea, area_condition, max_imean)
ShowImage([image_output1, image_output2], 1, 2)
ShowImage([image_output3, image_output4], 1, 2)
```

Image 0

Image 1

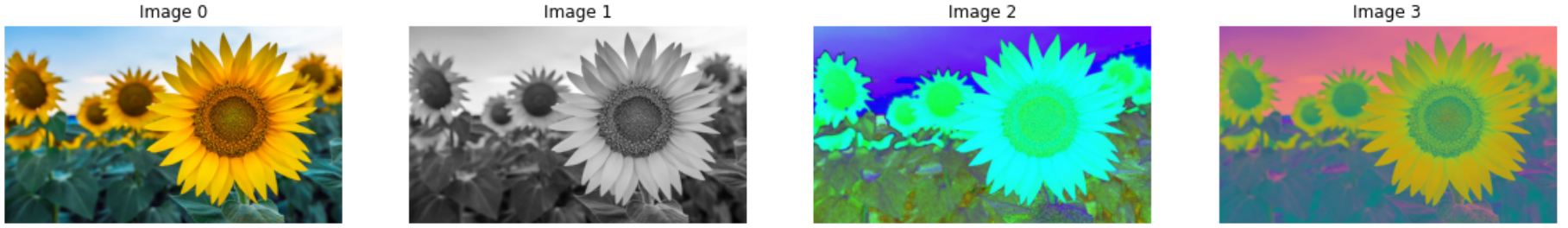
Image 0

Image 1

Bông hoa

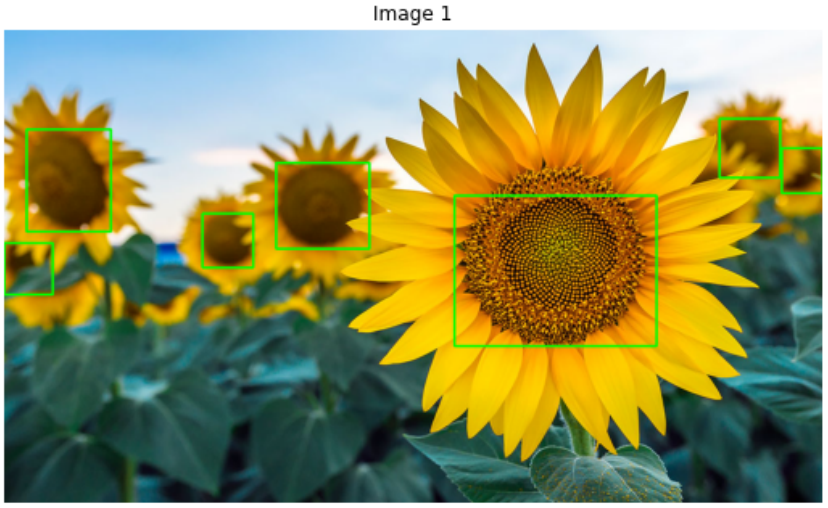
In [62]:
```
image_orig, image_gray, image_hsv, image_ycbcr = load_image('Flower 01.jpg')
ShowImage([image_orig, image_gray, image_hsv, image_ycbcr], 1, 4)
```

```
Selected Image :
Index  22
Name  Flower 01.jpg
```



In [63]:
```
nClusters = 6
minArea = 10000
maxArea = 500000
image_index, image_kmeans, mask_list, mask_abnormal = get_mask(image_orig, image_gray, nClusters, minArea, maxArea)
ShowImage([image_orig, image_index, image_kmeans], 1, 3)
ShowImage(mask_list, 1, len(mask_list))
ShowImage([mask_abnormal], 1, 3)
```

In [64]:
```
list_images = [image_orig, image_gray, image_hsv, image_ycbcr]
nClusters = 6
imask = image_index == 5
minArea = 10000
maxArea = 500000
area_condition = [[1025, 11000]]
max_imean = [[0, 30]]
[image_output1, image_output2, image_output3, image_output4] = get_detectd_images(list_images, nClusters, imask, minAre
a, maxArea, area_condition, max_imean)
ShowImage([image_output1, image_output2], 1, 2)
ShowImage([image_output3, image_output4], 1, 2)
```

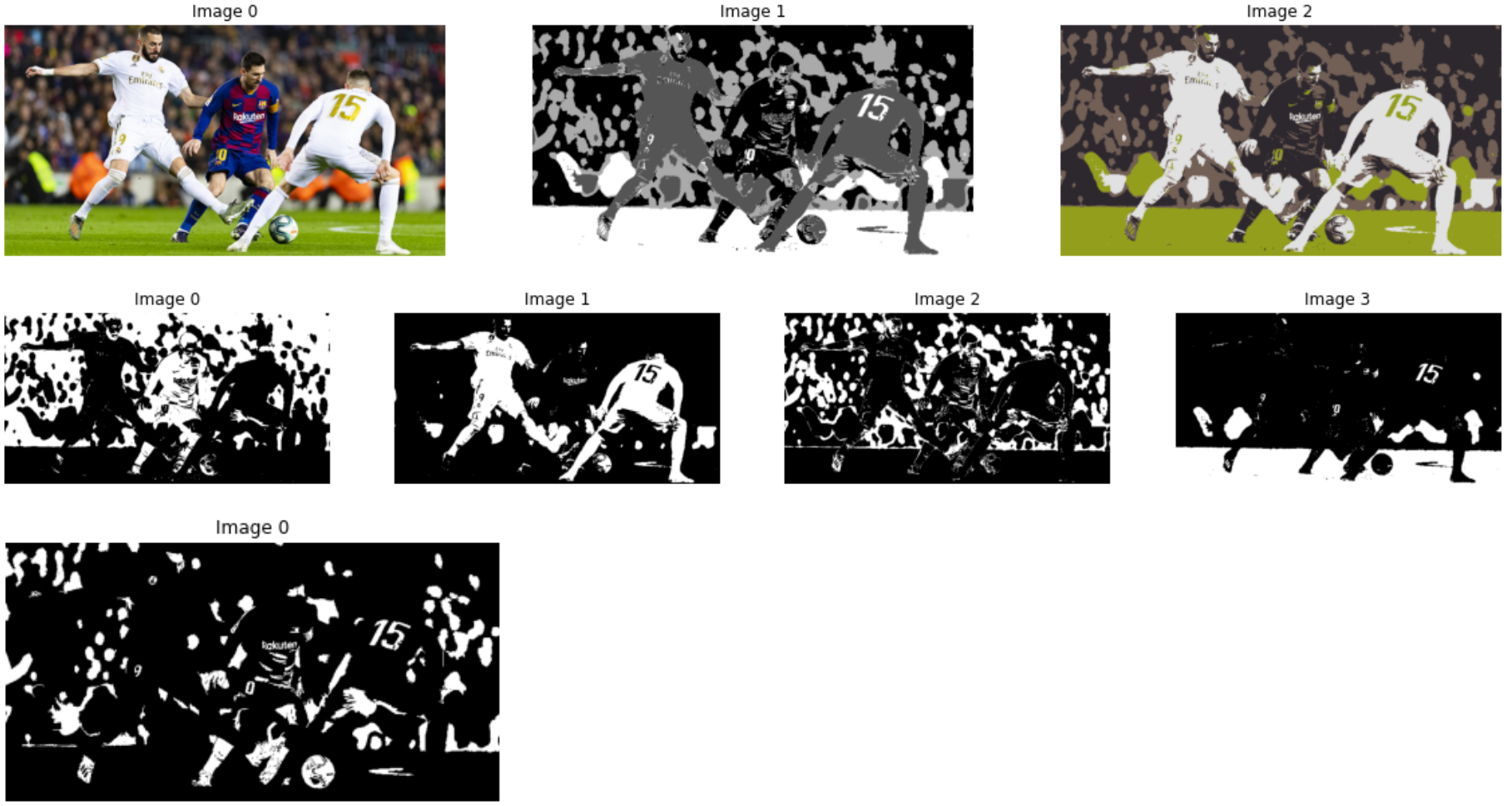


Trái bóng

In [68]:
```
image_orig, image_gray, image_hsv, image_ycbcr = load_image('Football 01.jpg')
ShowImage([image_orig, image_gray, image_hsv, image_ycbcr], 1, 4)
```

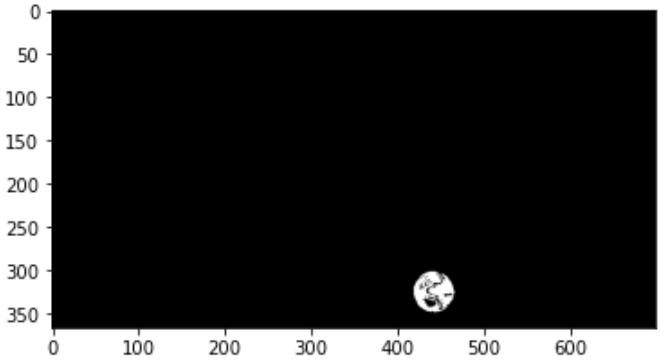
```
Selected Image :
Index  11
Name  Football 01.jpg
```

In [69]:
```
nClusters = 4
minArea = 50
maxArea = 1000
image_index, image_kmeans, mask_list, mask_abnormal = get_mask(image_orig, image_gray, nClusters, minArea, maxArea)
ShowImage([image_orig, image_index, image_kmeans], 1, 3)
ShowImage(mask_list, 1, len(mask_list))
ShowImage([mask_abnormal], 1, 3)
```

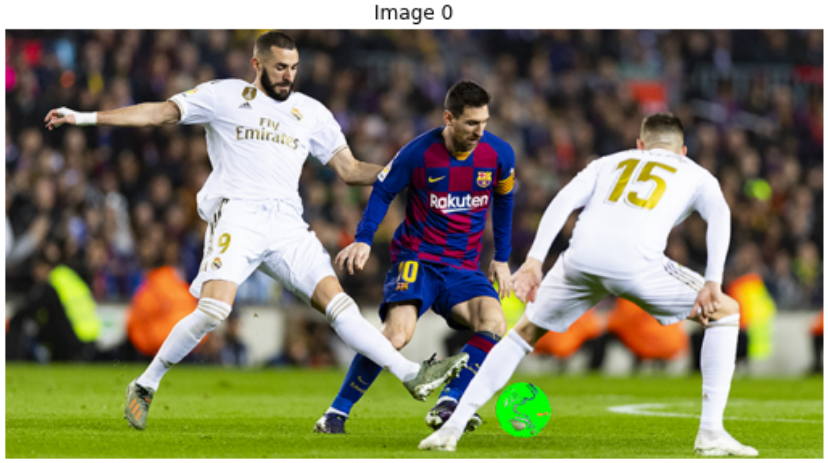


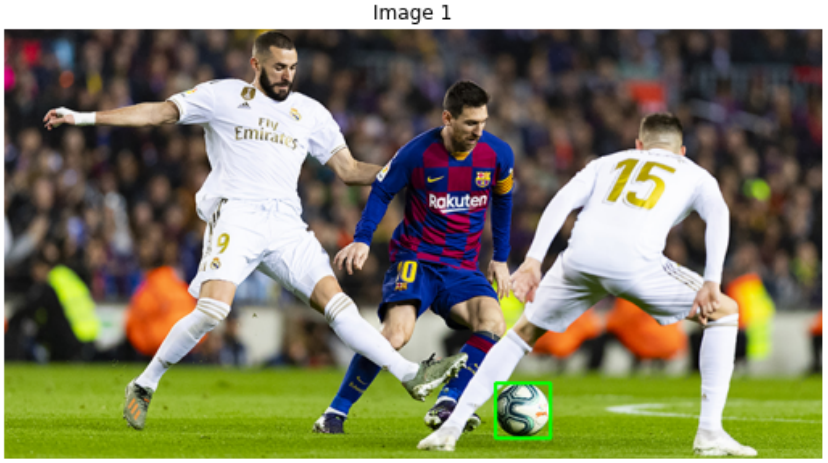
In [72]:
```
imask = mask_abnormal
label_img = label(imask)
regions = regionprops(label_img, intensity_image = image_hsv[:,:,0])
for props in regions:
        area = props.area
        ilabel = props.label
        imask = label_img == ilabel
        imean = props.mean_intensity
        imax = props.max_intensity
        imin = props.min_intensity
        if (area > 1370 and area < 1380):
            print(area)      # in ra diện tích của vết
            plt.imshow(imask, cmap = plt.cm.gray)
            plt.show()
```

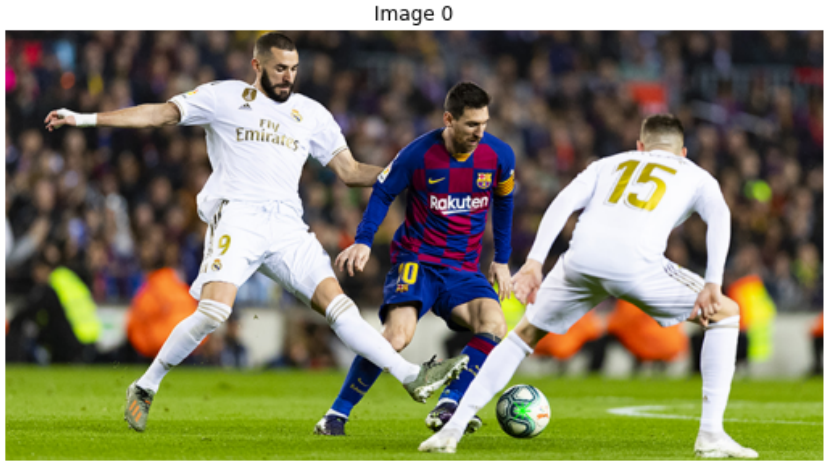
1376

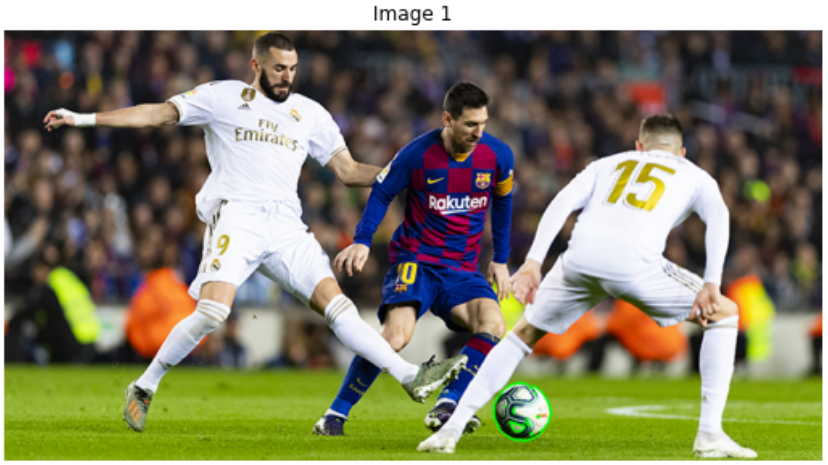


In [74]:
```
list_images = [image_orig, image_gray, image_hsv, image_ycbcr]
nClusters = 4
imask = mask_abnormal
minArea = 50
maxArea = 1000
area_condition = [[1370, 1380]]
max_imean = [[0, 100]]
[image_output1, image_output2, image_output3, image_output4] = get_detectd_images(list_images, nClusters, imask, minAre
a, maxArea, area_condition, max_imean)
ShowImage([image_output1, image_output2], 1, 2)
ShowImage([image_output3, image_output4], 1, 2)
```









Bàn tay

In [40]:
```
image_orig, image_gray, image_hsv, image_ycbcr = load_image('Hand Gesture 03.jpg')
ShowImage([image_orig, image_gray, image_hsv, image_ycbcr], 1, 4)
```

```
Selected Image :
Index  13
Name  Hand Gesture 03.jpg
```

In [41]:
```
nClusters = 4
minArea = 100
maxArea = 10000
image_index, image_kmeans, mask_list, mask_abnormal = get_mask(image_orig, image_gray, nClusters, minArea, maxArea)
ShowImage([image_orig, image_index, image_kmeans], 1, 3)
ShowImage(mask_list, 1, len(mask_list))
ShowImage([mask_abnormal], 1, 3)
```

Image 0

Image 1

Image 2

Image 0

Image 1

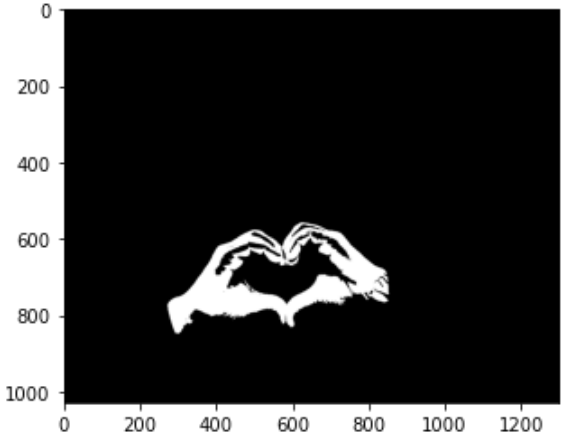
Image 2

Image 3

Image 0

In [42]:
```
imask = image_index == 3
label_img = label(imask)
regions = regionprops(label_img, intensity_image = image_hsv[:,:,0])
for props in regions:
        area = props.area
        ilabel = props.label
        imask = label_img == ilabel
        imean = props.mean_intensity
        imax = props.max_intensity
        imin = props.min_intensity
        if (area > 60900 and area < 70000):
            print(area)      # in ra diện tích của vết
            plt.imshow(imask, cmap = plt.cm.gray)
            plt.show()
```

```
60944
```



In [43]:
```
list_images = [image_orig, image_gray, image_hsv, image_ycbcr]
nClusters = 4
imask = image_index == 3
minArea = 0
maxArea = 10000
area_condition = [[60900, 70000]]
max_imean = [[0, 60]]
[image_output1, image_output2, image_output3, image_output4] = get_detectd_images(list_images, nClusters, imask, minAre
a, maxArea, area_condition, max_imean)
ShowImage([image_output1, image_output2], 1, 2)
ShowImage([image_output3, image_output4], 1, 2)
```

Image 0

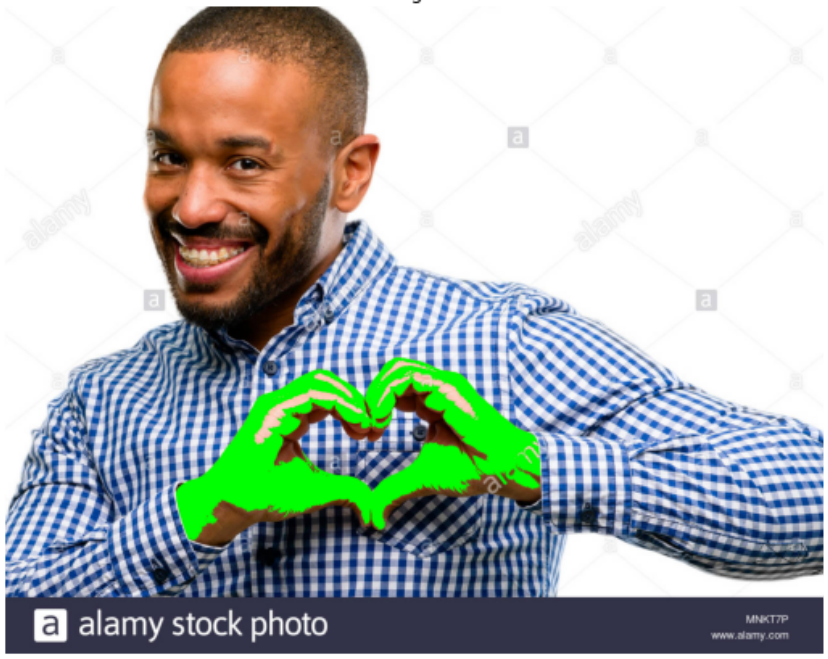


Image 1

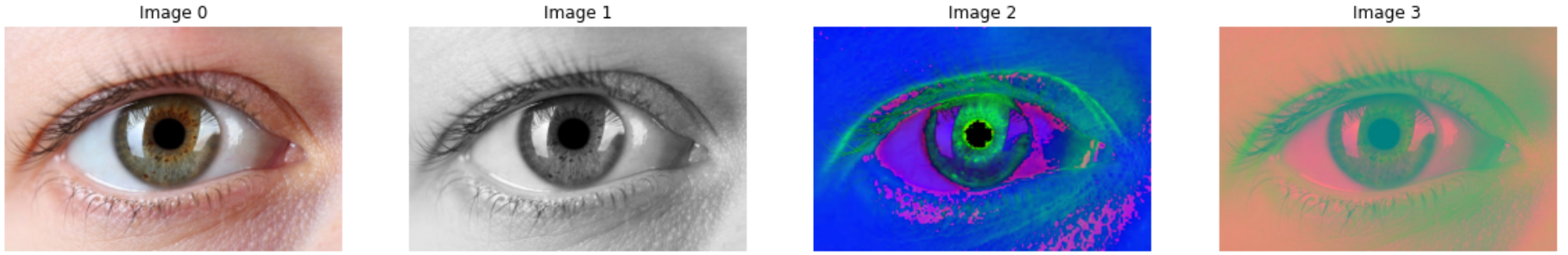
Image 0

Image 1

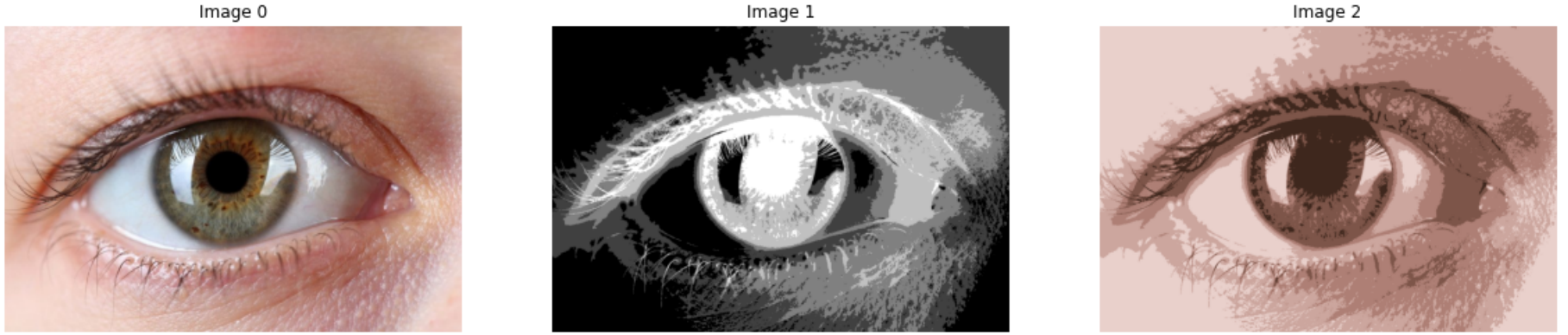
Võng mạc

In [75]:
```
image_orig, image_gray, image_hsv, image_ycbcr = load_image('Iris 04.jpg')
ShowImage([image_orig, image_gray, image_hsv, image_ycbcr], 1, 4)
```

```
Selected Image :
Index  17
Name  Iris 04.jpg
```

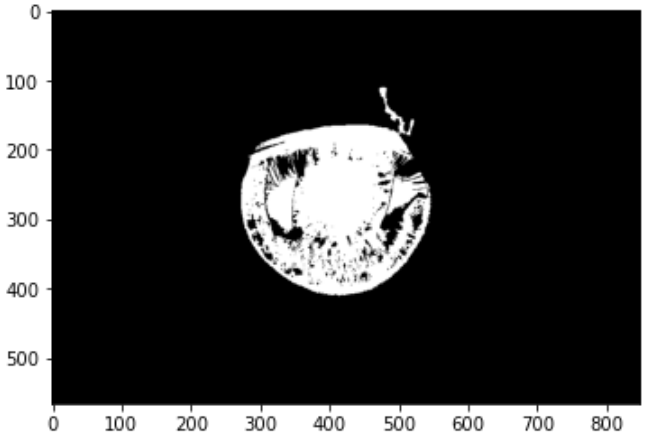


In [76]:
```
nClusters = 5
minArea = 1000
maxArea = 21000
image_index, image_kmeans, mask_list, mask_abnormal = get_mask(image_orig, image_gray, nClusters, minArea, maxArea)
ShowImage([image_orig, image_index, image_kmeans], 1, 3)
ShowImage(mask_list, 1, len(mask_list))
ShowImage([mask_abnormal], 1, 3)
```



In [77]:
```
imask = mask_abnormal
label_img = label(imask)
regions = regionprops(label_img, intensity_image = image_hsv[:,:,0])
for props in regions:
        area = props.area
        ilabel = props.label
        imask = label_img == ilabel
        imean = props.mean_intensity
        imax = props.max_intensity
        imin = props.min_intensity
        if (area > 44000 and area < 45000):
            print(area)      # in ra diện tích của vết
            plt.imshow(imask, cmap = plt.cm.gray)
            plt.show()
```

```
44621
```



In [78]:
```
list_images = [image_orig, image_gray, image_hsv, image_ycbcr]
nClusters = 5
imask = mask_abnormal
minArea = 1000
maxArea = 21000
area_condition = [[44000, 45000]]
max_imean = [[0, 80]]
[image_output1, image_output2, image_output3, image_output4] = get_detectd_images(list_images, nClusters, imask, minAre
a, maxArea, area_condition, max_imean)
ShowImage([image_output1, image_output2], 1, 2)
ShowImage([image_output3, image_output4], 1, 2)
```

Image 0

Image 1

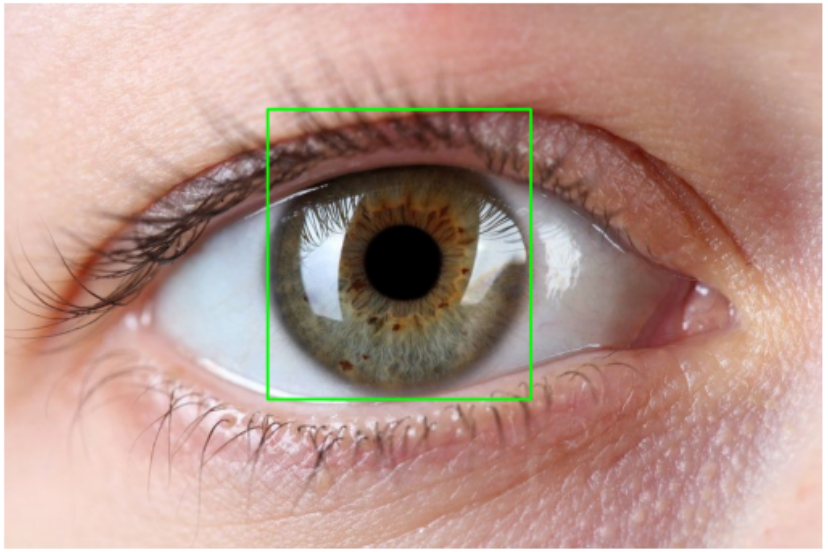


Image 0

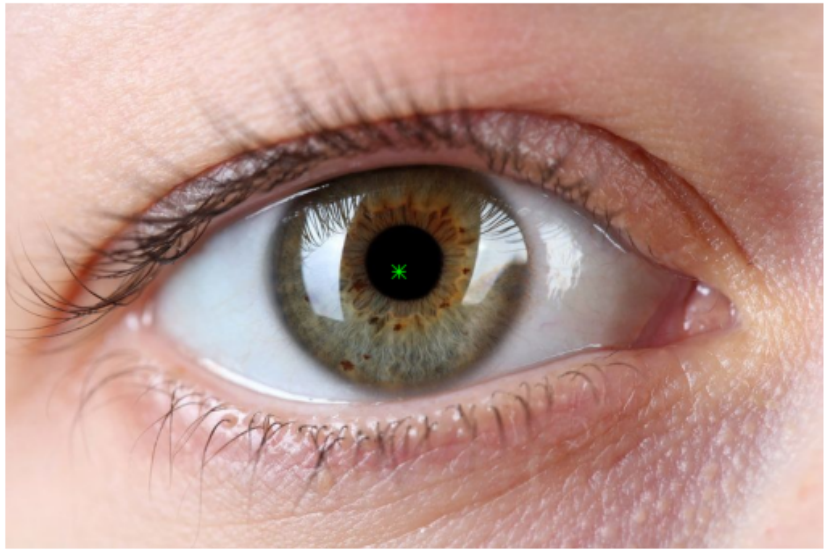
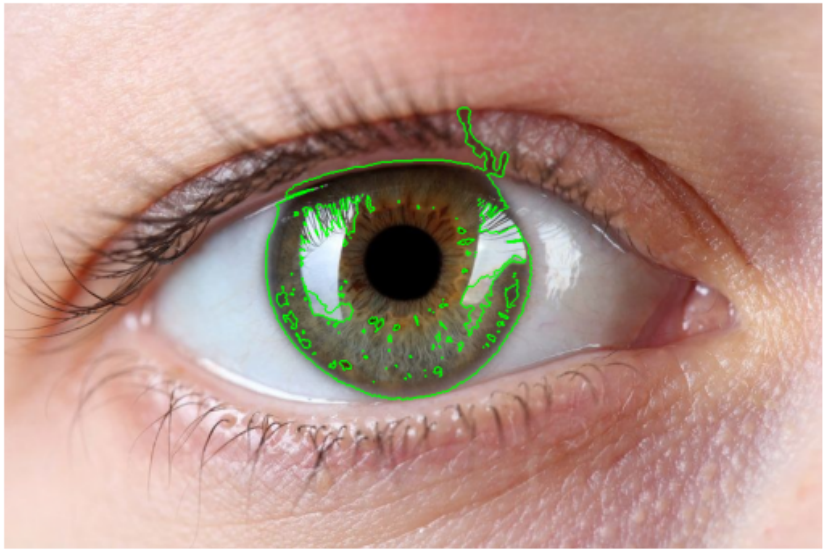


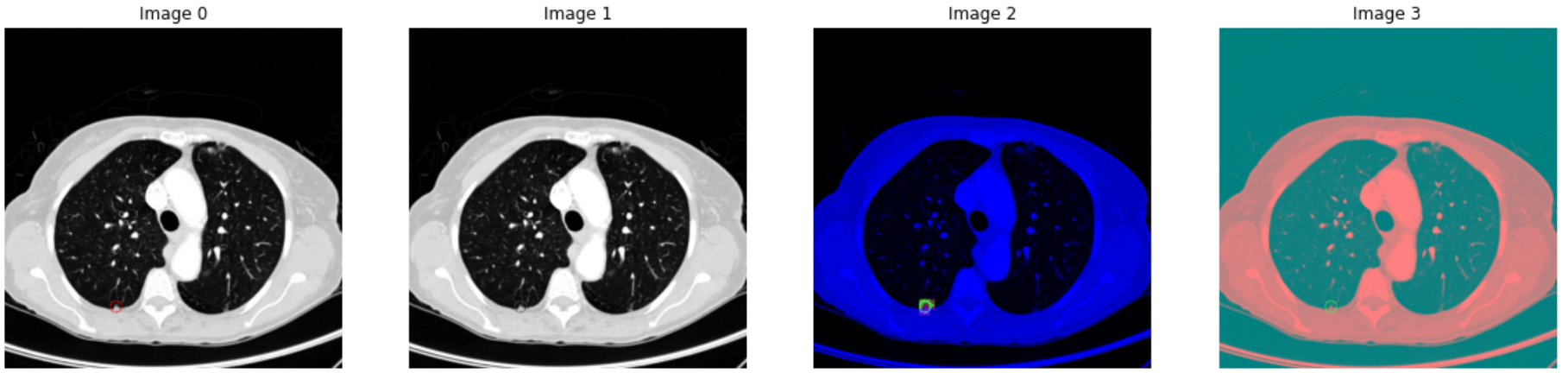
Image 1



Lá phổi

In [134]:
```
image_orig, image_gray, image_hsv, image_ycbcr = load_image('Lung 05.jpg')
ShowImage([image_orig, image_gray, image_hsv, image_ycbcr], 1, 4)
```

```
Selected Image :
Index  45
Name  Lung 05.jpg
```



In [151]:
```
nClusters = 4
minArea = 9000
maxArea = 30000
image_index, image_kmeans, mask_list, mask_abnormal = get_mask(image_orig, image_gray, nClusters, minArea, maxArea)
ShowImage([image_orig, image_index, image_kmeans], 1, 3)
ShowImage(mask_list, 1, len(mask_list))
ShowImage([mask_abnormal], 1, 3)
```

Image 0

Image 1

Image 2

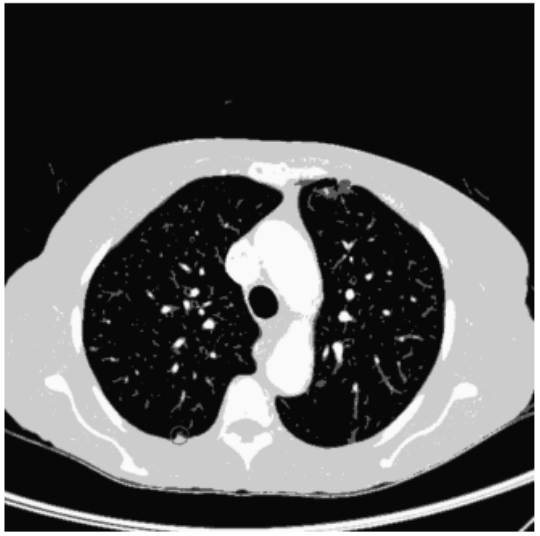


Image 0

Image 1

Image 2

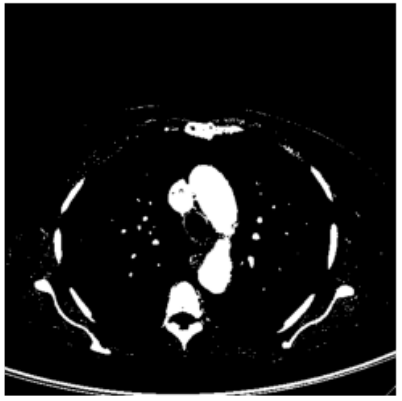


Image 3

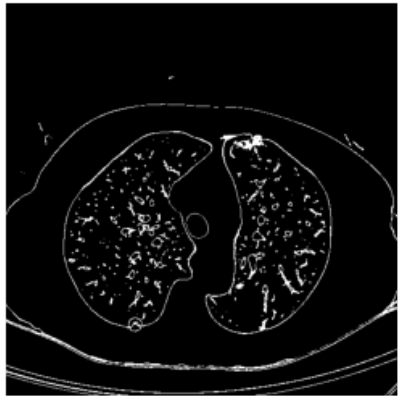
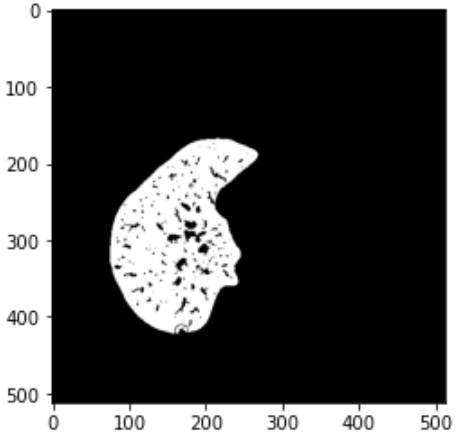



Image 0

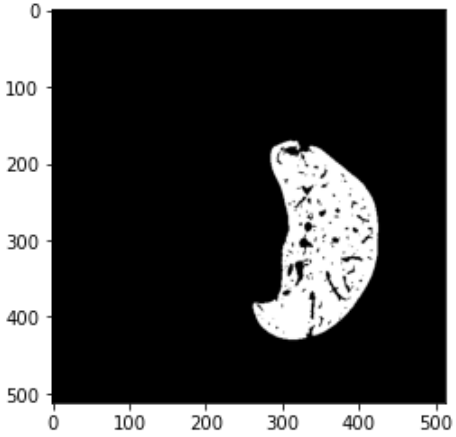
In [156]:

```
imask = mask_abnormal
label_img = label(imask)
regions = regionprops(label_img, intensity_image = image_hsv[:,:,0])
for props in regions:
        area = props.area
        ilabel = props.label
        imask = label_img == ilabel
        imean = props.mean_intensity
        imax = props.max_intensity
        imin = props.min_intensity
        if (area > 24000 and area < 30000):
            print(area)      # in ra diện tích của vết
            plt.imshow(imask, cmap = plt.cm.gray)
            plt.show()
```

28510


0
100
200
300
400
500
0
100
200
300
400
500

24120


0
100
200
300
400
500
0
100
200
300
400
500

In [157]:
```
list_images = [image_orig, image_gray, image_hsv, image_ycbcr]
nClusters = 4
imask = mask_abnormal
minArea = 9000
maxArea = 30000
area_condition = [[24000, 30000]]
max_imean = [[0, 120]]
[image_output1, image_output2, image_output3, image_output4] = get_detectd_images(list_images, nClusters, imask, minAre
a, maxArea, area_condition, max_imean)
ShowImage([image_output1, image_output2], 1, 2)
ShowImage([image_output3, image_output4], 1, 2)
```

Image 0

Image 1

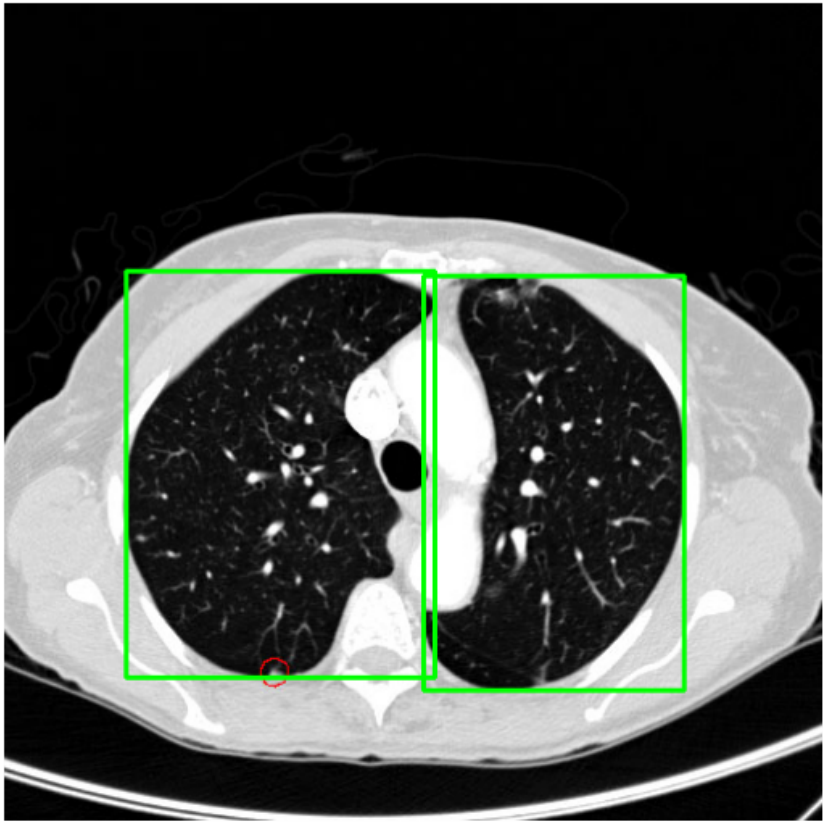


Image 0

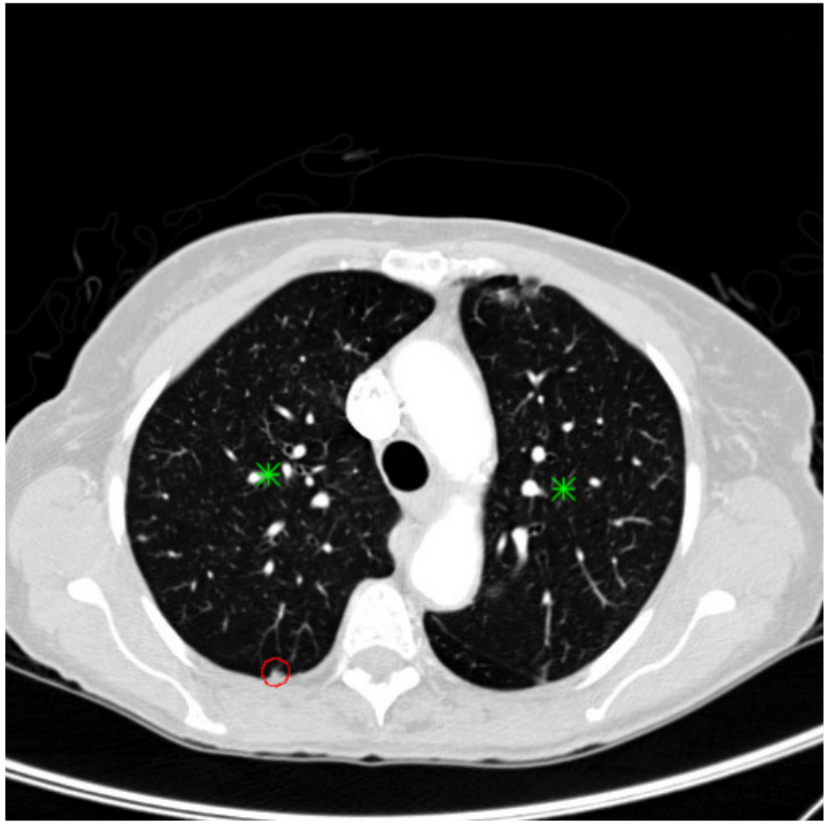
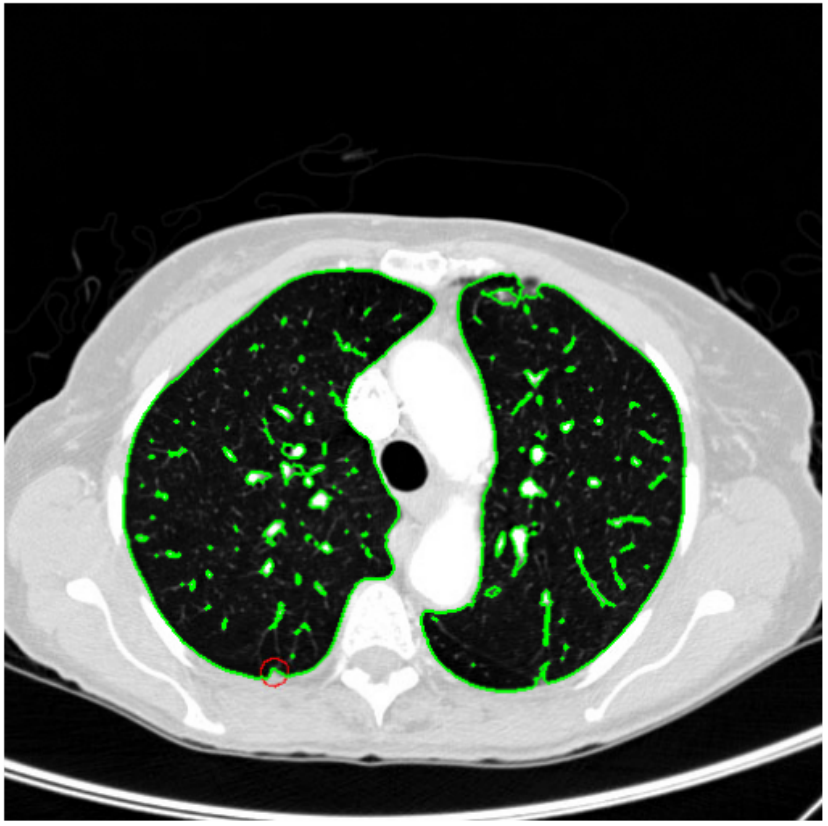


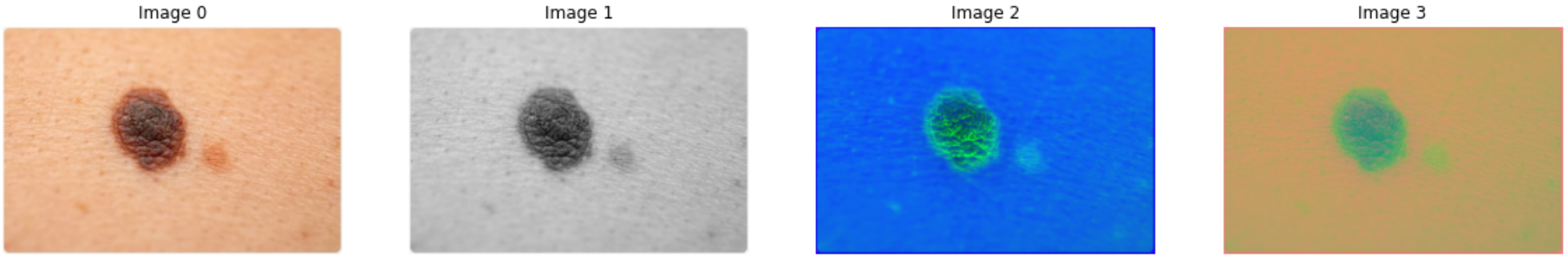
Image 1



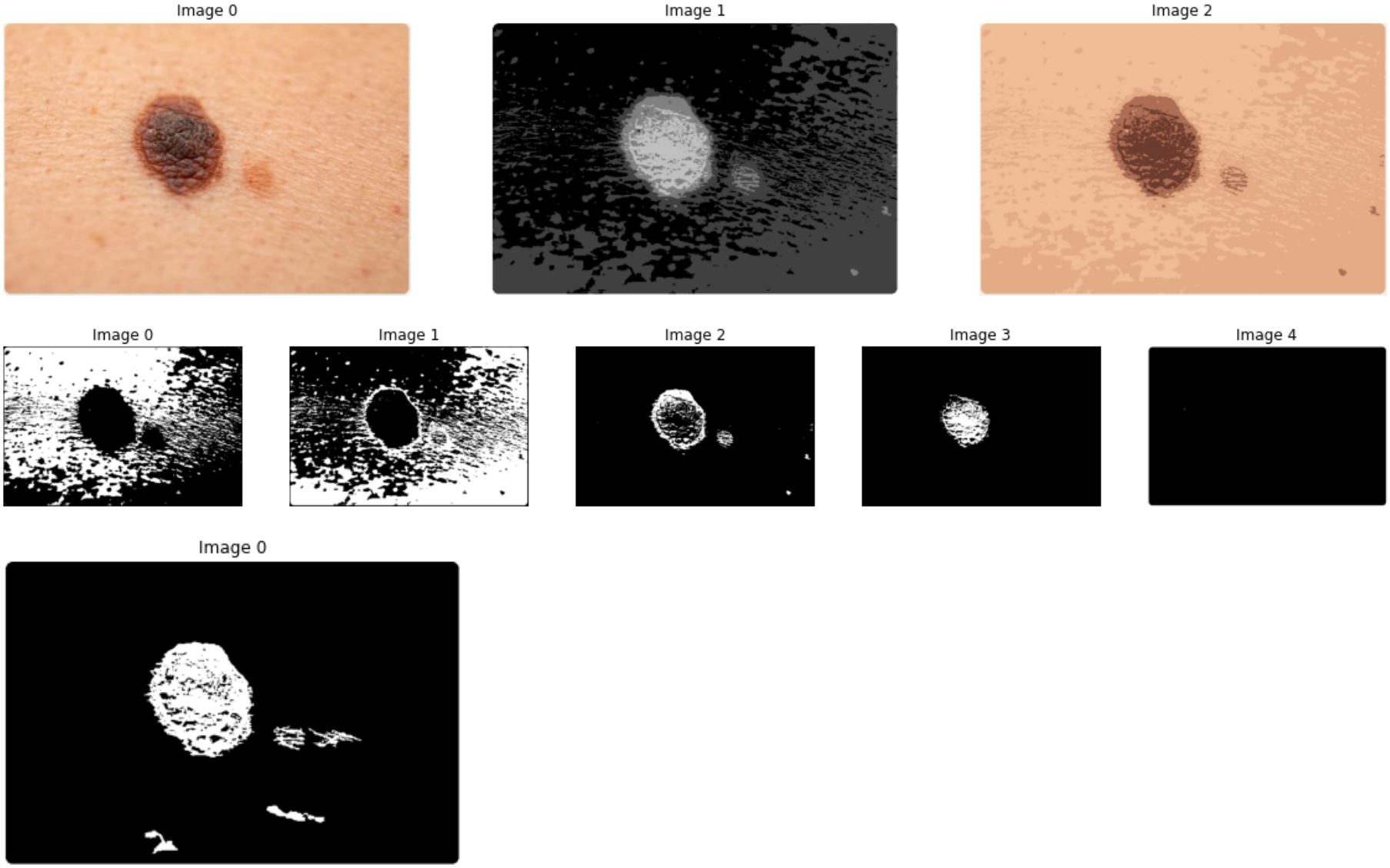
Vết melanoma trên da

In [126]:
```
image_orig, image_gray, image_hsv, image_ycbcr = load_image('Skin 02.jpg')
ShowImage([image_orig, image_gray, image_hsv, image_ycbcr], 1, 4)
```

```
Selected Image :
Index  49
Name  Skin 02.jpg
```



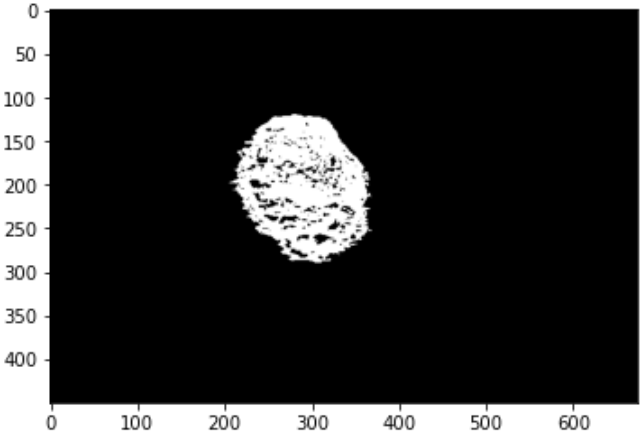
In [129]:
```
nClusters = 5
minArea = 500
maxArea = 20000
image_index, image_kmeans, mask_list, mask_abnormal = get_mask(image_orig, image_gray, nClusters, minArea, maxArea)
ShowImage([image_orig, image_index, image_kmeans], 1, 3)
ShowImage(mask_list, 1, len(mask_list))
ShowImage([mask_abnormal], 1, 3)
```



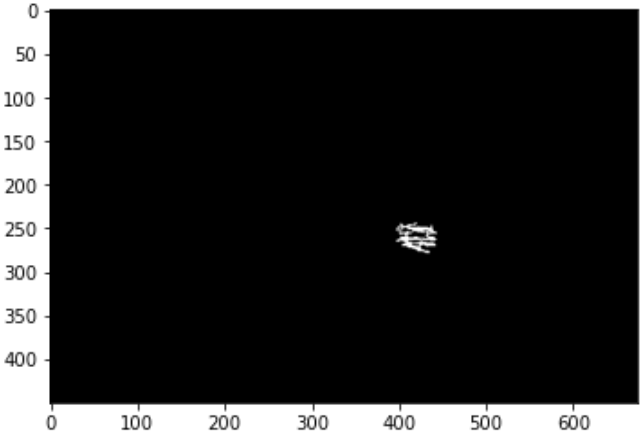
In [132]:

```
imask = mask_abnormal
label_img = label(imask)
regions = regionprops(label_img, intensity_image = image_hsv[:,:,0])
for props in regions:
        area = props.area
        ilabel = props.label
        imask = label_img == ilabel
        imean = props.mean_intensity
        imax = props.max_intensity
        imin = props.min_intensity
        if (area > 690 and area < 700) or (area > 16000 and area < 17000):
            print(area)      # in ra diện tích của vết
            plt.imshow(imask, cmap = plt.cm.gray)
            plt.show()
```

16675


0
50
100
150
200
250
300
350
400
0
100
200
300
400
500
600

699


0
50
100
150
200
250
300
350
400
0
100
200
300
400
500
600

In [133]:
```
list_images = [image_orig, image_gray, image_hsv, image_ycbcr]
nClusters = 5
imask = mask_abnormal
minArea = 500
maxArea = 20000
area_condition = [[690, 700], [16000, 17000]]
max_imean = [[0, 80]]
[image_output1, image_output2, image_output3, image_output4] = get_detectd_images(list_images, nClusters, imask, minAre
a, maxArea, area_condition, max_imean)
ShowImage([image_output1, image_output2], 1, 2)
ShowImage([image_output3, image_output4], 1, 2)
```

Image 0

Image 1

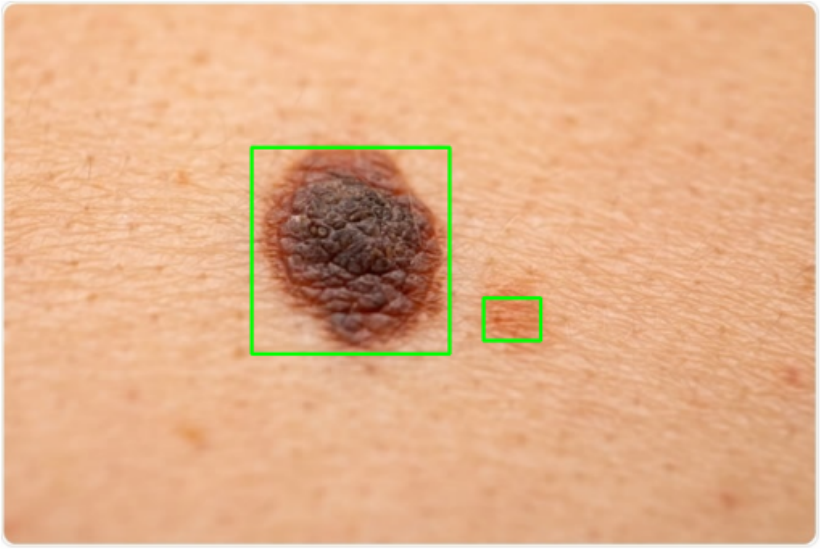


Image 0

Image 1