Lab03 - Biến hình và xử lý ảnh

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In [1]:
```
import numpy as np
import cv2
import pandas as pd
import json
import os
import timeit
import random
from matplotlib import pyplot as plt

from scipy import ndimage as ndi
from skimage.color import rgb2gray
from skimage.filters import threshold_otsu, rank, sobel
from skimage.measure import label, regionprops
from skimage.segmentation import mark_boundaries
from skimage.feature import peak_local_max
from skimage.morphology import watershed, disk
from skimage import data
from skimage.util import img_as_ubyte
```

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.
    if (nCols == 1) or (nRows == 1):
      plt.figure(figsize=(20,20))
    else:
      plt.figure(figsize=(nCols*8,nRows*5))
    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 get_subfiles(dir):
    "Get a list of immediate subfiles"
    return next(os.walk(dir))[2]

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)
    resizedIM = cv2.resize(IM, dim, interpolation = cv2.INTER_NEAREST)
    return resizedIM
```

In [4]:
```
# Mount drive
from google.colab import drive
drive.mount('/content/gdrive')
```

```
Drive already mounted at /content/gdrive; to attempt to forcibly remount, call drive.mount("/content/gdrive", force_rem
ount=True).
```

In [5]:
```
path_Data = "/content/gdrive/MyDrive/University Learning/Documents/Bien Hinh va Xu Ly Anh (Image Segmentation)/Object Seg
checkPath = os.path.isdir(path_Data)
print("The path and file are valid or not :", checkPath)
```

```
The path and file are valid or not : True
```

In [6]:
```
all_names = get_subfiles(path_Data)
print("Number of Images:", len(all_names))
IMG = []
for i in range(len(all_names)):
    tmp = cv2.imread(path_Data + all_names[i])
    IMG.append(tmp)

ImageDB = IMG.copy()
NameDB = all_names
```

```
Number of Images: 28
```

In [7]:
```
NameDB
```

Out[7]:
```
['Lung.png',
 'Iris.jpg',
 'Melanoma.jpg',
 'Retina.jpg',
 'Face.jpg',
 'Fire.jpg',
 'Mask.jpg',
 'Sign.jpg',
 'Cross.jpg',
 'Shelf.jpg',
 'Brain.jpg',
 'Tumor.png',
 'Hand.jpg',
 'Chest.jpg',
 'Bone.jpg',
 'Gesture.jpg',
 'Emotion.jpg',
 'Car.jpg',
 'Activities.jpeg',
 'Crack.jpg',
 'Code.jpg',
 'Dust.jpg',
 'Barcode.png',
 'QR.jpg',
 'Leaf.jpg',
 'Cloths.jpg',
 'Writing.png',
 'Defect.jpg']
```

Useful Functions

In [8]:
```
def SegmentColorImageByMask(IM, Mask):
    Mask = Mask.astype(np.uint8)
    result = cv2.bitwise_and(IM, IM, mask = Mask)
    return result

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 [9]:
```
def FillHoles(Mask):
    Result = ndi.binary_fill_holes(Mask)
    return Result

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 [10]:

```
def ReArrangeIndex(image_index):
  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_index_rearrange = image_index * 0
  for idx in sort_index:
      image_index_rearrange[image_index == idx] = index
      index = index + 1
  return image_index_rearrange

def KmeansSegmentation(img, K = 3):
  if(len(img.shape) == 3):
    vectorized = img.reshape((-1,3))
  else:
    vectorized = IM.reshape(-1)

  vectorized = np.float32(vectorized)
  criteria = (cv2.TERM_CRITERIA_EPS + cv2.TERM_CRITERIA_MAX_ITER, 10, 1.0)
  attempts=10
  ret,label,center=cv2.kmeans(vectorized,K,None,criteria,attempts,cv2.KMEANS_PP_CENTERS)
  center = np.uint8(center)
  res = center[label.flatten()]
  result_label = label.reshape((img.shape[:2]))
  result_image = res.reshape((img.shape))

  return center, result_label, result_image
```

In [11]:

```
def LabelObjectByMask(image_orig, 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)
  bounding_boxes = []
  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 == "BBox"):
      cv2.rectangle(image_output, left_top, right_bottom, color ,thick)

    bounding_boxes.append(np.array([left_top[1], right_bottom[1], left_top[0], right_bottom[0]]))

  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')

  return image_output, np.array(bounding_boxes)
```

In [12]:
```
def crop_and_resize_image(image, bounding_boxes, scale=0, size=None):
  img_input = image.copy()
  cropped_images = []
  for box in bounding_boxes:
    img = img_input.copy()
    box = box + np.array([-scale, scale, -scale, scale])
    if box[0] < 0:
      box[0] = 0
    if box[2] < 0:
      box[2] = 0
    if box[1] > image.shape[0]:
      box[1] = image.shape[0]
    if box[3] > image.shape[1]:
      box[3] = image.shape[1]
    cropped_img = img[box[0]: box[1], box[2]: box[3]]
    if size is None:
      cropped_images.append(ResizeImage(cropped_img, (box[3]-box[2])*5, (box[1]-box[0])*5))
    else:
      cropped_images.append(ResizeImage(cropped_img, size[0], size[1]))
  return cropped_images
```

In [13]:
```
def SelectLargestRegion(Mask):
  import pandas as pd
  from skimage.measure import label, regionprops

  mask = Mask.copy()
  mask_output = mask * 0
  label_img = label(mask)
  regions = regionprops(label_img)
  max_area = 0
  ilabel = 0
  for props in regions:
    area = props.area
    if(area > max_area):
      max_area = area
      ilabel = props.label

  mask_output = mask_output + (label_img == ilabel).astype(int)
  return mask_output
```

In [14]:
```
def adjust_gamma(image, gamma=1.0):
    # build a lookup table mapping the pixel values [0, 255] to
    # their adjusted gamma values
    invGamma = 1.0 / gamma
    table = np.array([((i / 255.0) ** invGamma) * 255
        for i in np.arange(0, 256)]).astype("uint8")
    # apply gamma correction using the lookup table
    return cv2.LUT(image, table)
```

WaterShed Segmentation

In [15]:
```
def waterShed_Segment(image_org, image_seg, denoised_radius=2, gradient_radius=5, threshold=10, max_area=0):
  image = image_seg.copy()
  # denoise image
  denoised = rank.median(image, disk(denoised_radius))

  # find continuous region (low gradient -
  # where less than threshold for this image) --> markers
  # disk(5) is used here to get a more smooth image
  markers = rank.gradient(denoised, disk(gradient_radius)) < threshold
  markers = ndi.label(markers)[0]
  # local gradient (disk(2) is used to keep edges thin)
  gradient = rank.gradient(denoised, disk(2))

  # process the watershed
  labels = watershed(gradient, markers)

  ilabel = 0
  for i in range(1,markers.max()): # 0  is background not care in range
    area = (markers == i).sum()
    if(area > max_area):
      max_area = area
      ilabel = i

  max_mask = (markers == ilabel).astype(int)
  mask_to_process = FillHoles(max_mask) - max_mask
  image_to_process = SegmentColorImageByMask(image_org, mask_to_process)

  return markers, gradient, labels, max_mask, mask_to_process, image_to_process
```

Split and Merging Regions

In [16]:

```
from skimage import data, io, segmentation, color
from skimage.future import graph

def _weight_mean_color(graph, src, dst, n):
    """Callback to handle merging nodes by recomputing mean color.

    The method expects that the mean color of `dst` is already computed.

    Parameters
    ----------
    graph : RAG
        The graph under consideration.
    src, dst : int
        The vertices in `graph` to be merged.
    n : int
        A neighbor of `src` or `dst` or both.

    Returns
    -------
    data : dict
        A dictionary with the `"weight"` attribute set as the absolute
        difference of the mean color between node `dst` and `n`.
    """

    diff = graph.nodes[dst]['mean color'] - graph.nodes[n]['mean color']
    diff = np.linalg.norm(diff)
    return {'weight': diff}


def merge_mean_color(graph, src, dst):
    """Callback called before merging two nodes of a mean color distance graph.

    This method computes the mean color of `dst`.

    Parameters
    ----------
    graph : RAG
        The graph under consideration.
    src, dst : int
        The vertices in `graph` to be merged.
    """
```

```
    graph.nodes[dst]['total color'] += graph.nodes[src]['total color']
    graph.nodes[dst]['pixel count'] += graph.nodes[src]['pixel count']
    graph.nodes[dst]['mean color'] = (graph.nodes[dst]['total color'] /
                                      graph.nodes[dst]['pixel count'])
```

Yêu cầu 1.

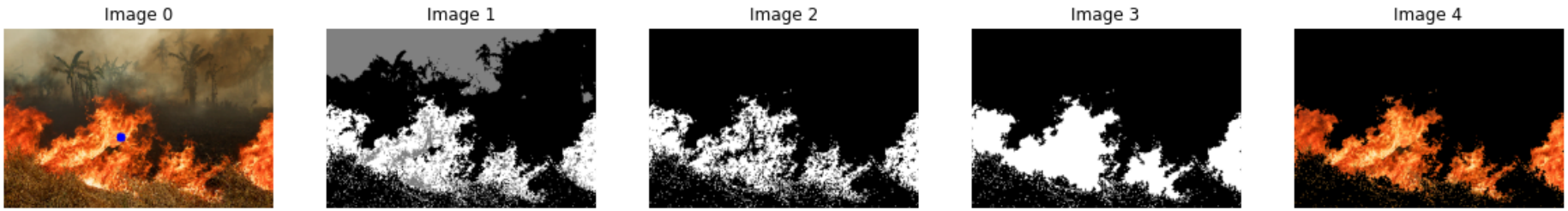
Thực hiện lại các thao tác trong phần hướng dẫn và tìm cách hoàn thiện phần Segmentation sau :

1. Segment tất cả vị trí lửa trong hình và sau đó trích các phần của lửa - tâm lửa và không phải tâm lửa.

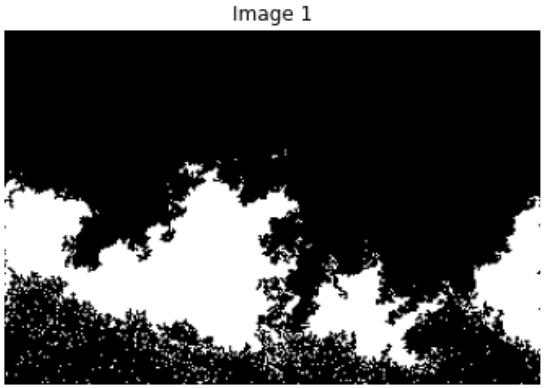
In [17]:
```
FileName = 'Fire.jpg'
idx = NameDB.index(FileName)
print("Selected Image : ", "\nIndex ", idx, "\nName ", NameDB[idx])

image_orig = ImageDB[idx]
image_orig = ResizeImage(image_orig, 300, 0)
img = cv2.cvtColor(image_orig,cv2.COLOR_BGR2RGB)
image_gray = cv2.cvtColor(image_orig,cv2.COLOR_BGR2GRAY)
image_hsv = cv2.cvtColor(image_orig, cv2.COLOR_BGR2HSV)
image_ycbcr = cv2.cvtColor(image_orig, cv2.COLOR_BGR2YCR_CB)
ShowImage([image_orig, img, image_gray, image_hsv, image_ycbcr], 1, 5)
```

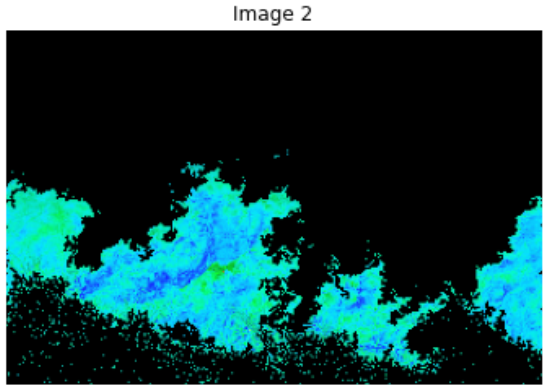
```
Selected Image :
Index  5
Name  Fire.jpg
```

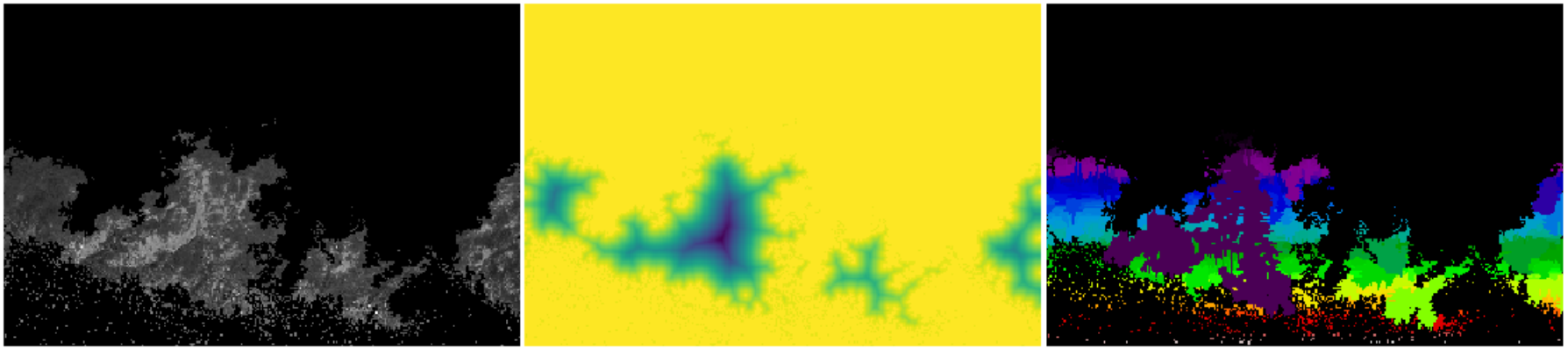
In [18]:
```
center, result_label, result_image = KmeansSegmentation(img, K = 3)
result_label = ReArrangeIndex(result_label)

rpoint = 120
cpoint = 130
img_select = img.copy()
cv2.circle(img_select,(cpoint,rpoint), 5, (0,0,255), -1)

idx = result_label[rpoint, cpoint]
orig_mask = result_label == idx
fill_mask = FillHoles(orig_mask)
# max_mask = SelectLargestRegion(fill_mask)
image_max_mask = SegmentColorImageByMask(img, fill_mask)

ShowImage([img_select, result_label, orig_mask, fill_mask, image_max_mask], 1, 5)
```



In [19]:
```
image_to_process = SegmentColorImageByMask(image_hsv, fill_mask)
mask_to_process = fill_mask.copy()
ShowImage([img, mask_to_process, image_to_process], 1, 3)

image = image_to_process[:,:,0].copy()
distance = ndi.distance_transform_edt(image)
local_maxi = peak_local_max(distance, indices=False, footprint=np.ones((3, 3)), labels=image)
markers = ndi.label(local_maxi)[0]
labels = watershed(-distance, markers, mask=image)

fig, ax = plt.subplots(1, 3, figsize=(15.5, 3.5))
# plt.subplot(131)
ax[0].imshow(image, cmap='gray', interpolation='nearest')
ax[0].axis('off')
# plt.subplot(132)
ax[1].imshow(-distance, interpolation='nearest')
ax[1].axis('off')
# plt.subplot(133)
ax[2].imshow(labels, cmap='nipy_spectral', interpolation='nearest')
ax[2].axis('off')

plt.subplots_adjust(hspace=0.01, wspace=0.01, top=1, bottom=0, left=0,right=1)
plt.show()
```



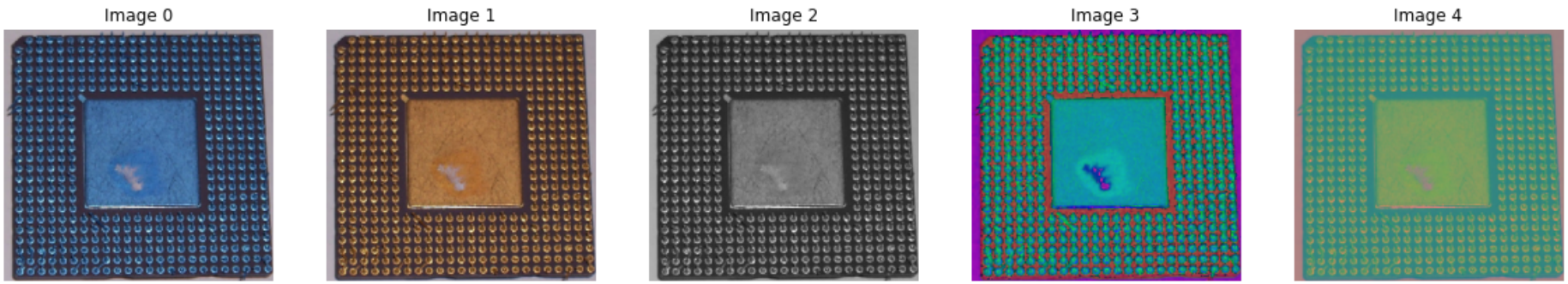




2. Đóng khung vị trí lỗi sau đó crop lỗi ra. Trên anh crop tiến hành resize cho nó bự ra và dùng watershed để phân tích các phần lõi và biên của lỗi.

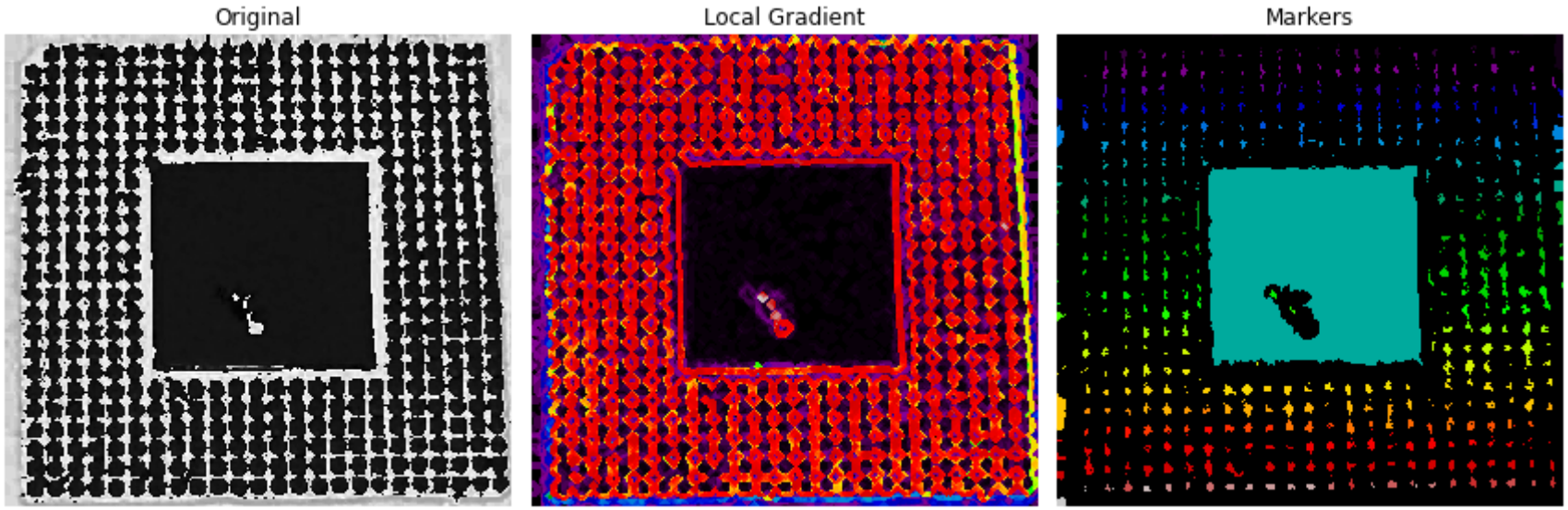
In [20]:
```
FileName = 'Dust.jpg'
idx = NameDB.index(FileName)
print("Selected Image : ", "\nIndex ", idx, "\nName ", NameDB[idx])

image_orig = ImageDB[idx]
image_orig = ResizeImage(image_orig, 300, 0)
img = cv2.cvtColor(image_orig,cv2.COLOR_BGR2RGB)
image_gray = cv2.cvtColor(image_orig,cv2.COLOR_BGR2GRAY)
image_hsv = cv2.cvtColor(image_orig, cv2.COLOR_BGR2HSV)
image_ycbcr = cv2.cvtColor(image_orig, cv2.COLOR_BGR2YCR_CB)
ShowImage([image_orig, img, image_gray, image_hsv, image_ycbcr], 1, 5)
```

```
Selected Image :
Index  21
Name  Dust.jpg
```

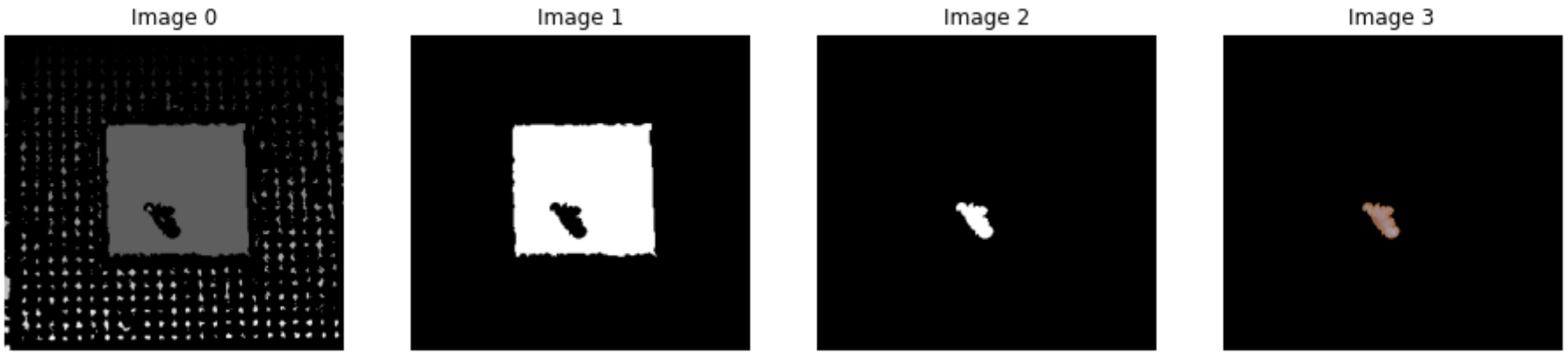


In [21]:
```
image_input = image_hsv[:,:,0]
markers, gradient, _, max_mask, mask_to_process, image_to_process = waterShed_Segment(img, image_input, denoised_radius=
```

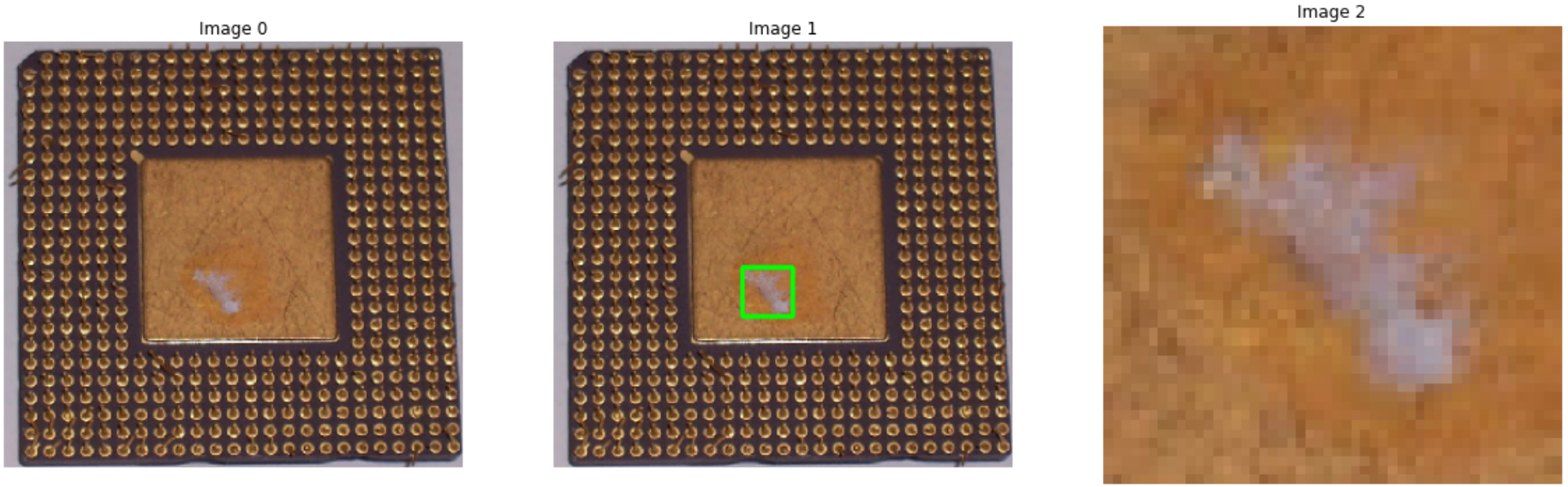
In [22]:
```
# display results
fig, axes = plt.subplots(nrows=1, ncols=3, figsize=(12, 12), sharex=True, sharey=True)
ax = axes.ravel()

ax[0].imshow(image_input, cmap=plt.cm.gray, interpolation='nearest')
ax[0].set_title("Original")

ax[1].imshow(gradient, cmap=plt.cm.nipy_spectral, interpolation='nearest')
ax[1].set_title("Local Gradient")

ax[2].imshow(markers, cmap=plt.cm.nipy_spectral, interpolation='nearest')
ax[2].set_title("Markers")

for a in ax:
    a.axis('off')

fig.tight_layout()
plt.show()
```



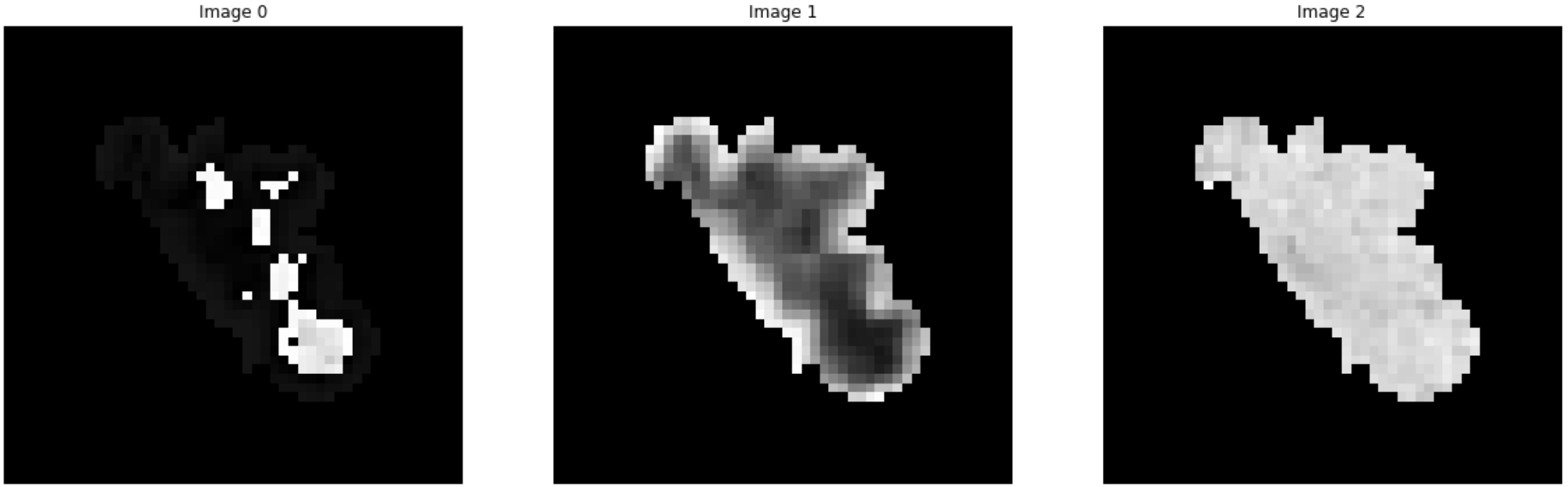
In [23]:
```
ShowImage([markers, max_mask, mask_to_process, image_to_process], 1, 5)
```



In [24]:
```
image_output2, bounding_boxes = LabelObjectByMask(img, mask_to_process, type = "BBox", color = (0,255,0), thick = 2)
cropped_images = crop_and_resize_image(img, bounding_boxes, scale=10, size=(50,50))
cropped_img = cropped_images[0]
ShowImage([img, image_output2, cropped_img], 1, 3)
```

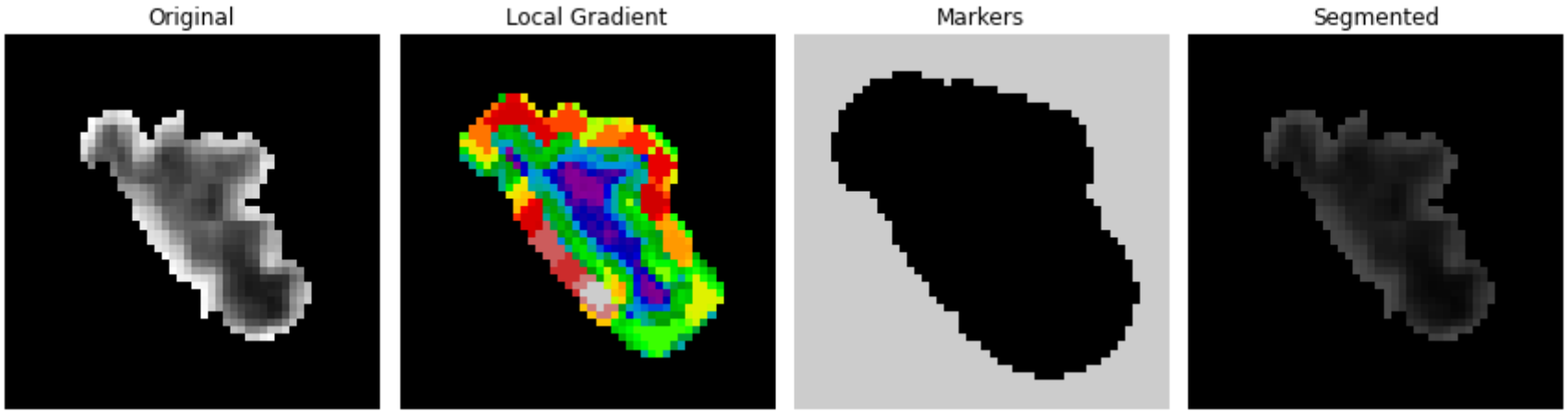


In [25]:
```
image_to_process = SegmentColorImageByMask(image_hsv, mask_to_process)
cropped_images1 = crop_and_resize_image(image_to_process, bounding_boxes, scale=10, size=(50,50))
cropped_img1 = cropped_images1[0]
ShowImage([cropped_img1[:,:,0], cropped_img1[:,:,1], cropped_img1[:,:,2]], 1, 3)
```



In [26]:

```
image_input1 = cropped_img1[:,:,1]
markers1, gradient1, labels1, max_mask1, mask_to_process1, image_to_process1 = waterShed_Segment(cropped_img1, image_inpu
# display results
fig, axes = plt.subplots(nrows=1, ncols=4, figsize=(12, 12),
                         sharex=True, sharey=True)
ax = axes.ravel()

ax[0].imshow(image_input1, cmap=plt.cm.gray, interpolation='nearest')
ax[0].set_title("Original")

ax[1].imshow(gradient1, cmap=plt.cm.nipy_spectral, interpolation='nearest')
ax[1].set_title("Local Gradient")

ax[2].imshow(markers1, cmap=plt.cm.nipy_spectral, interpolation='nearest')
ax[2].set_title("Markers")

ax[3].imshow(image_input1, cmap=plt.cm.gray, interpolation='nearest')
ax[3].imshow(labels1, cmap=plt.cm.nipy_spectral, interpolation='nearest', alpha=.7)
ax[3].set_title("Segmented")

for a in ax:
    a.axis('off')

fig.tight_layout()
plt.show()
```

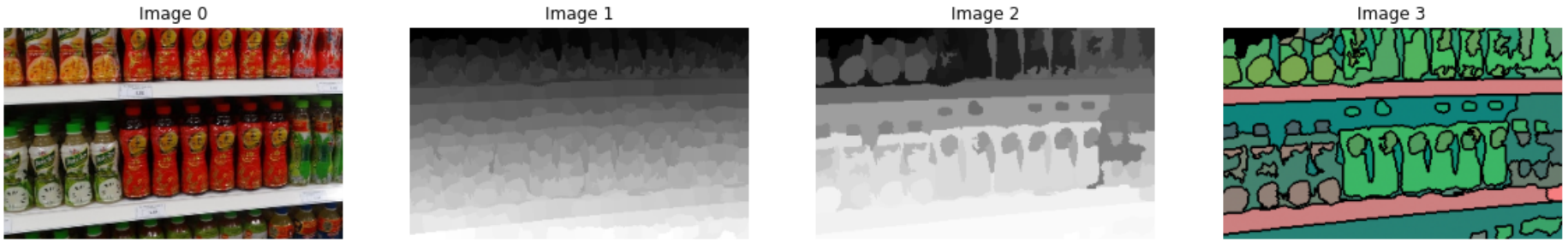


3. Đóng khung vị trí lỗi sau đó crop lỗi ra. Trên anh crop tiến hành resize cho nó bự ra và dùng watershed để trích riêng từng chai nước Dr Thanh màu đỏ.

In [27]:
```
FileName = 'Shelf.jpg'
idx = NameDB.index(FileName)
print("Selected Image : ", "\nIndex ", idx, "\nName ", NameDB[idx])

image_orig = ImageDB[idx]
image_orig = adjust_gamma(image_orig, gamma=1)
image_orig = ResizeImage(image_orig, 300, 0)
img = cv2.cvtColor(image_orig,cv2.COLOR_BGR2RGB)
image_gray = cv2.cvtColor(image_orig,cv2.COLOR_BGR2GRAY)
image_hsv = cv2.cvtColor(image_orig, cv2.COLOR_BGR2HSV)
image_ycbcr = cv2.cvtColor(image_orig, cv2.COLOR_BGR2YCR_CB)
ShowImage([image_orig, img, image_gray, image_hsv, image_ycbcr], 1, 5)
```

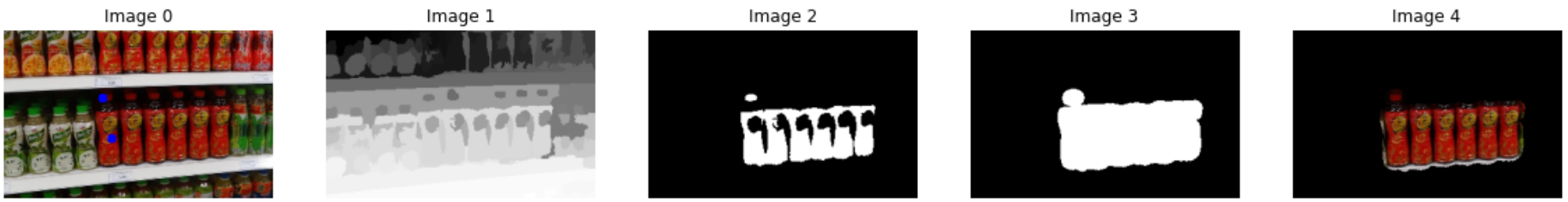
```
Selected Image :
Index  9
Name  Shelf.jpg
```

In [28]:
```
orig_labels = segmentation.slic(image_ycbcr, compactness=20, n_segments=400) # Slic based on Kmeans
g = graph.rag_mean_color(image_ycbcr, orig_labels)

merge_labels = graph.merge_hierarchical(orig_labels, g, thresh=30, rag_copy=False,
                                        in_place_merge=True,
                                        merge_func=merge_mean_color,
                                        weight_func=_weight_mean_color)

image_merge_labels = color.label2rgb(merge_labels, image_ycbcr, kind='avg', bg_label=0)
image_merge_labels = segmentation.mark_boundaries(image_merge_labels, merge_labels, (0, 0, 0))
ShowImage([img, orig_labels, merge_labels, image_merge_labels], 1, 4)
```



In [29]:

```
img_select = img.copy()
result_label = merge_labels.copy()
points = np.array([[120,120], [110, 75]])
masks = []
for point in points:
  cv2.circle(img_select,(point[0], point[1]), 5, (0,0,255), -1)

  idx = result_label[point[1], point[0]]
  masks.append(result_label == idx)

orig_mask = sum(masks)


dilation_mask = morphology(orig_mask, 6)
fill_mask = FillHoles(dilation_mask)
max_mask = SelectLargestRegion(fill_mask)
image_max_mask = SegmentColorImageByMask(img, max_mask)

ShowImage([img_select, result_label, orig_mask, fill_mask, image_max_mask], 1, 5)
```



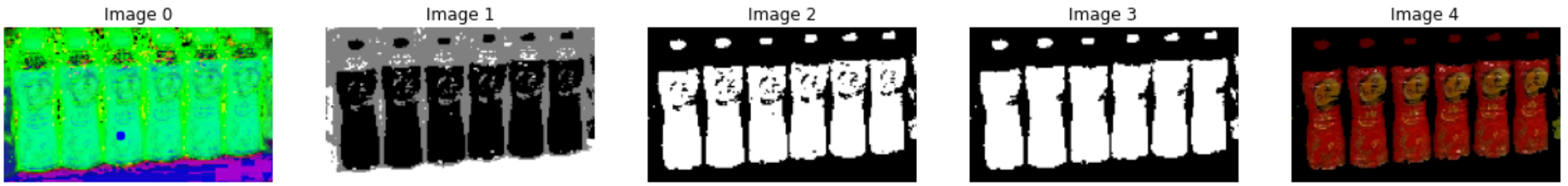
In [30]:
```
image_output2, bounding_boxes = LabelObjectByMask(img, max_mask, type = "BBox", color = (0,255,0), thick = 2)
cropped_images = crop_and_resize_image(img, bounding_boxes, size=(300,0))
cropped_img1 = cropped_images[0]
ShowImage([img, image_output2, cropped_img1], 1, 4)
```

Image 0

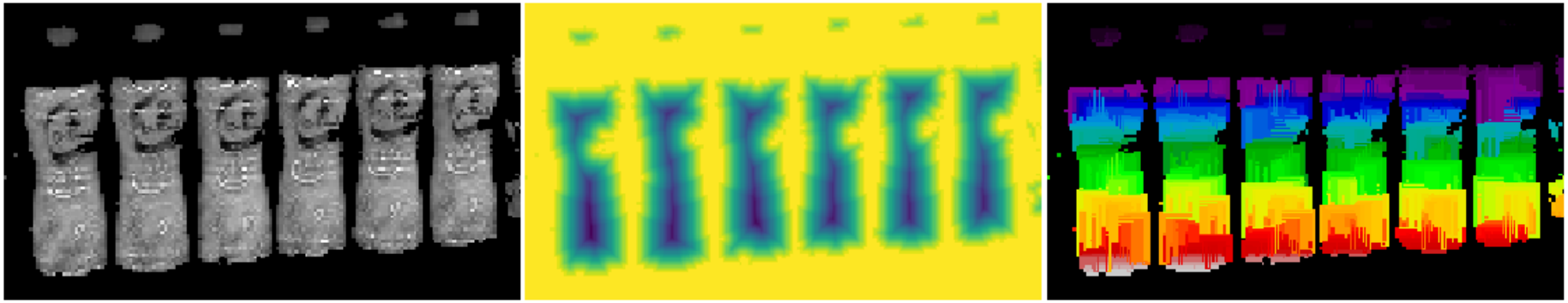
Image 1

Image 2

In [31]:
```
cropped_img2 = adjust_gamma(cropped_img1, gamma=0.8)
cropped_img1_hsv = cv2.cvtColor(cropped_img2, cv2.COLOR_RGB2HSV)

img = cropped_img1_hsv.copy()
center, result_label, result_image = KmeansSegmentation(img, K = 3)
result_label = ReArrangeIndex(result_label)

rpoint = 120
cpoint = 130
img_select = img.copy()
cv2.circle(img_select,(cpoint,rpoint), 5, (0,0,255), -1)

idx = result_label[rpoint, cpoint]
orig_mask = result_label == idx
fill_mask = FillHoles(orig_mask)
# max_mask = SelectLargestRegion(fill_mask)
image_max_mask = SegmentColorImageByMask(cropped_img2, fill_mask)

ShowImage([img_select, result_label, orig_mask, fill_mask, image_max_mask], 1, 5)
```



In [32]:
```
image = image_max_mask[:,:,0].copy()
distance = ndi.distance_transform_edt(image)
local_maxi = peak_local_max(distance, indices=False, footprint=np.ones((3, 3)), labels=image)
markers = ndi.label(local_maxi)[0]
labels = watershed(-distance, markers, mask=image)

fig, ax = plt.subplots(1, 3, figsize=(15.5, 3.5))
# plt.subplot(131)
ax[0].imshow(image, cmap='gray', interpolation='nearest')
ax[0].axis('off')
# plt.subplot(132)
ax[1].imshow(-distance, interpolation='nearest')
ax[1].axis('off')
# plt.subplot(133)
ax[2].imshow(labels, cmap='nipy_spectral', interpolation='nearest')
ax[2].axis('off')

plt.subplots_adjust(hspace=0.01, wspace=0.01, top=1, bottom=0, left=0,right=1)
plt.show()
```



Yêu cầu 2.

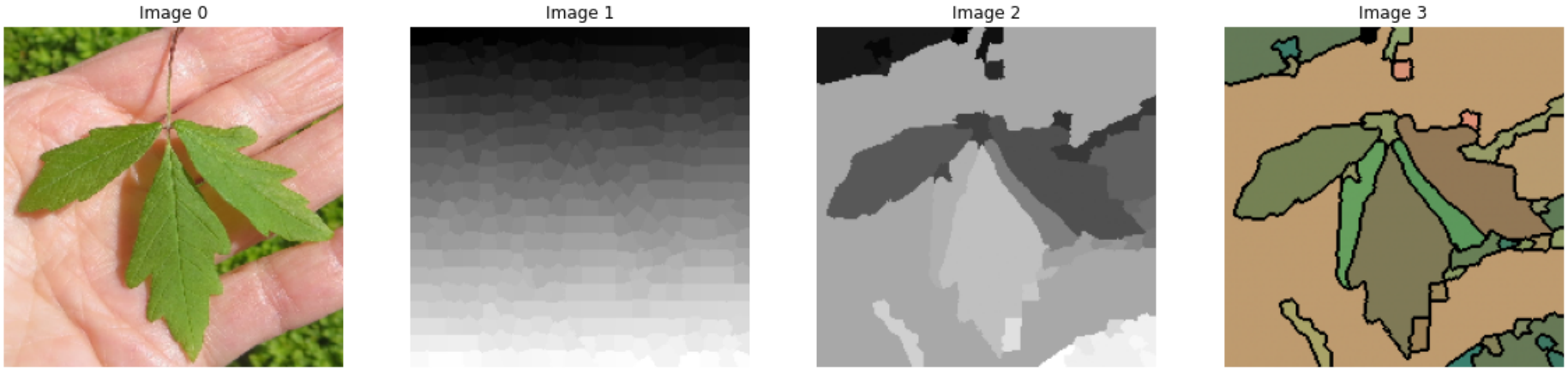
Chọn thêm 2 ví dụ khác trong danh sách hình và định nghĩa object cần segment trong các hình là gì và thực hiện segmentation tốt nhất bằng watershed và merging regions.

Ví dụ 1: Segment Leaf

In [33]:
```
FileName = 'Leaf.jpg'
idx = NameDB.index(FileName)
print("Selected Image : ", "\nIndex ", idx, "\nName ", NameDB[idx])

resize_w = 200
resize_h = 200

image_orig = ImageDB[idx]
image_orig = ResizeImage(image_orig, resize_w, resize_h)
img = cv2.cvtColor(image_orig,cv2.COLOR_BGR2RGB)
image_gray = cv2.cvtColor(image_orig,cv2.COLOR_BGR2GRAY)
image_hsv = cv2.cvtColor(image_orig, cv2.COLOR_BGR2HSV)
image_ycbcr = cv2.cvtColor(image_orig, cv2.COLOR_BGR2YCR_CB)
ShowImage([image_orig, img, image_gray, image_hsv, image_ycbcr], 1, 5)
```

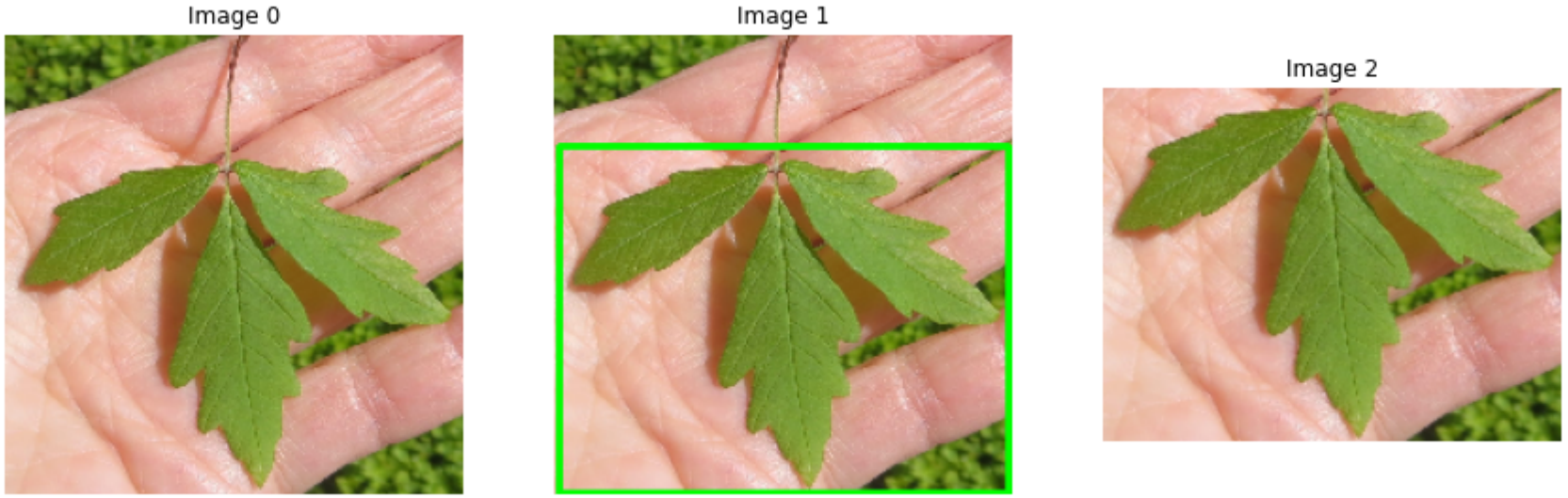
```
Selected Image :
Index  24
Name  Leaf.jpg
```

In [34]:
```
orig_labels = segmentation.slic(image_ycbcr, compactness=30, n_segments=400) # Slic based on Kmeans
g = graph.rag_mean_color(image_ycbcr, orig_labels)

merge_labels = graph.merge_hierarchical(orig_labels, g, thresh=23, rag_copy=False,
                                        in_place_merge=True,
                                        merge_func=merge_mean_color,
                                        weight_func=_weight_mean_color)

image_merge_labels = color.label2rgb(merge_labels, image_ycbcr, kind='avg', bg_label=0)
image_merge_labels = segmentation.mark_boundaries(image_merge_labels, merge_labels, (0, 0, 0))
ShowImage([img, orig_labels, merge_labels, image_merge_labels], 1, 4)
```

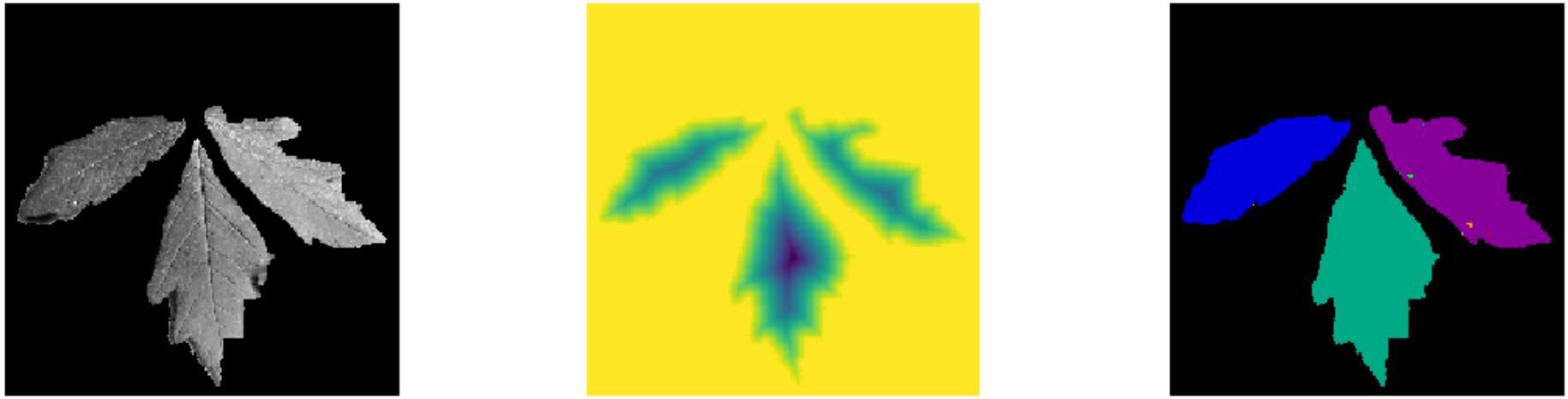


In [35]:
```
img_select = img.copy()
result_label = merge_labels.copy()
points = np.array([[150, 100], [100, 100], [50, 80]])
masks = []
for point in points:
  cv2.circle(img_select,(point[0], point[1]), 5, (0,0,255), -1)

  idx = result_label[point[1], point[0]]
  masks.append(result_label == idx)

orig_mask = sum(masks)


dilation_mask = morphology(orig_mask, 4)
fill_mask = FillHoles(dilation_mask)
max_mask = SelectLargestRegion(fill_mask)
image_max_mask = SegmentColorImageByMask(img, orig_mask)

ShowImage([img_select, result_label, orig_mask, fill_mask, image_max_mask], 1, 5)
```

In [36]:
```
image_output2, bounding_boxes = LabelObjectByMask(img, max_mask, type = "BBox", color = (0,255,0), thick = 2)
cropped_images = crop_and_resize_image(img, bounding_boxes)
cropped_img1 = cropped_images[0]
ShowImage([img, image_output2, cropped_img1], 1, 4)
```



In [37]:
```
image = image_max_mask[:,:,1].copy()
distance = ndi.distance_transform_edt(image)
local_maxi = peak_local_max(distance, indices=False, footprint=np.ones((3, 3)), labels=image)
markers = ndi.label(local_maxi)[0]
labels = watershed(-distance, markers, mask=image)

fig, ax = plt.subplots(1, 3, figsize=(15.5, 3.5))
# plt.subplot(131)
ax[0].imshow(image, cmap='gray', interpolation='nearest')
ax[0].axis('off')
# plt.subplot(132)
ax[1].imshow(-distance, interpolation='nearest')
ax[1].axis('off')
# plt.subplot(133)
ax[2].imshow(labels, cmap='nipy_spectral', interpolation='nearest')
ax[2].axis('off')

plt.subplots_adjust(hspace=0.01, wspace=0.01, top=1, bottom=0, left=0,right=1)
plt.show()
```

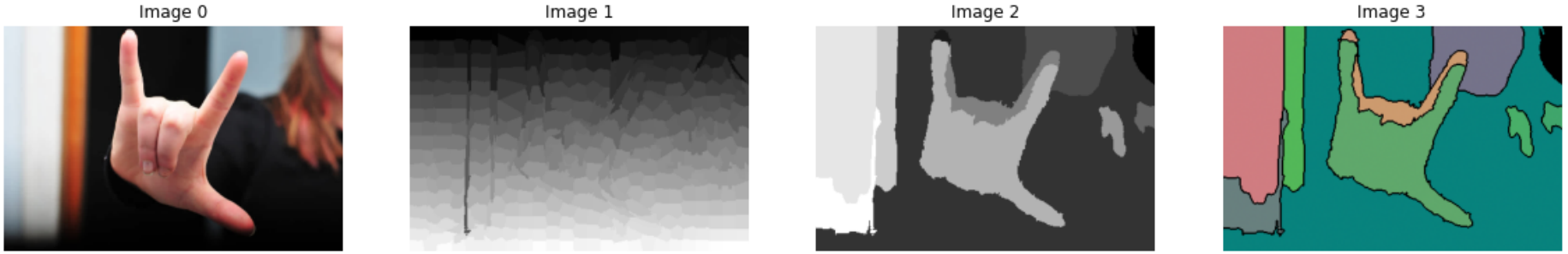


Ví dụ 2: Segment Gesture

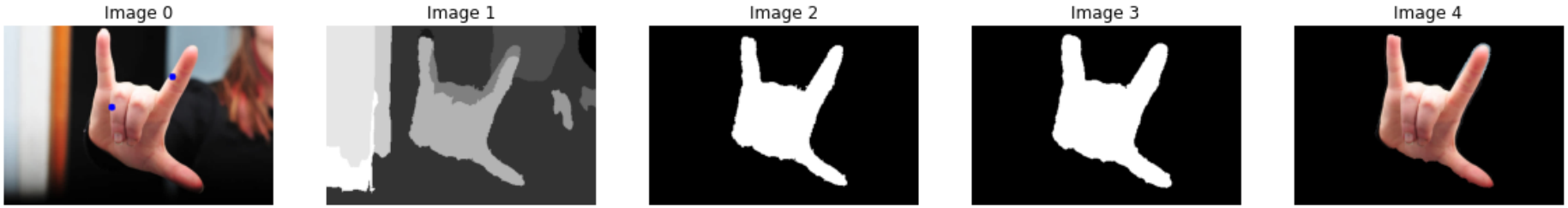
In [38]:
```
FileName = 'Gesture.jpg'
idx = NameDB.index(FileName)
print("Selected Image : ", "\nIndex ", idx, "\nName ", NameDB[idx])

resize_w = 400
resize_h = 0

image_orig = ImageDB[idx]
image_orig = ResizeImage(image_orig, resize_w, resize_h)
img = cv2.cvtColor(image_orig,cv2.COLOR_BGR2RGB)
image = adjust_gamma(image_orig, gamma=0.6)
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)
ShowImage([img, image, image_gray, image_hsv, image_ycbcr], 1, 5)
```

```
Selected Image :
Index  15
Name  Gesture.jpg
```

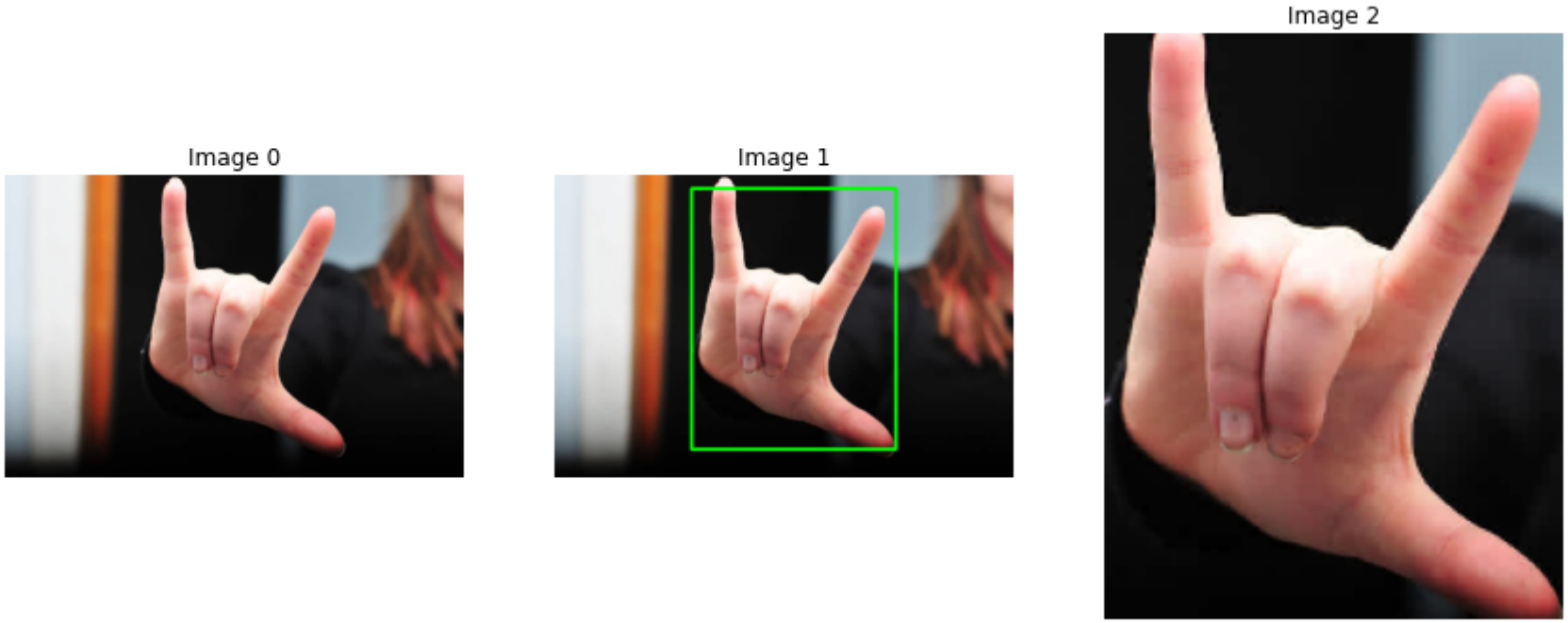
In [39]:
```
orig_labels = segmentation.slic(image_hsv, compactness=25, n_segments=400) # Slic based on Kmeans
g = graph.rag_mean_color(image_ycbcr, orig_labels)

merge_labels = graph.merge_hierarchical(orig_labels, g, thresh=60, rag_copy=False,
                                        in_place_merge=True,
                                        merge_func=merge_mean_color,
                                        weight_func=_weight_mean_color)

image_merge_labels = color.label2rgb(merge_labels, image_ycbcr, kind='avg', bg_label=0)
image_merge_labels = segmentation.mark_boundaries(image_merge_labels, merge_labels, (0, 0, 0))
ShowImage([img, orig_labels, merge_labels, image_merge_labels], 1, 4)
```



In [40]:
```
img_select = img.copy()
result_label = merge_labels.copy()
points = np.array([[160,120], [250, 75]])
masks = []
for point in points:
  cv2.circle(img_select,(point[0], point[1]), 5, (0,0,255), -1)

  idx = result_label[point[1], point[0]]
  masks.append(result_label == idx)

orig_mask = sum(masks)


dilation_mask = morphology(orig_mask, 3)
fill_mask = FillHoles(dilation_mask)
max_mask = SelectLargestRegion(fill_mask)
image_max_mask = SegmentColorImageByMask(img, dilation_mask)

ShowImage([img_select, result_label, orig_mask, fill_mask, image_max_mask], 1, 5)
```



In [41]:
```
image_output2, bounding_boxes = LabelObjectByMask(img, max_mask, type = "BBox", color = (0,255,0), thick = 2)
cropped_images = crop_and_resize_image(img, bounding_boxes)
cropped_img1 = cropped_images[0]
ShowImage([img, image_output2, cropped_img1], 1, 4)
```



In [42]:

```
image = image_max_mask[:,:,0].copy()
distance = ndi.distance_transform_edt(image)
local_maxi = peak_local_max(distance, indices=False, footprint=np.ones((3, 3)), labels=image)
markers = ndi.label(local_maxi)[0]
labels = watershed(-distance, markers, mask=image)

fig, ax = plt.subplots(1, 3, figsize=(15.5, 3.5))
# plt.subplot(131)
ax[0].imshow(image, cmap='gray', interpolation='nearest')
ax[0].axis('off')
# plt.subplot(132)
ax[1].imshow(-distance, interpolation='nearest')
ax[1].axis('off')
# plt.subplot(133)
ax[2].imshow(labels, cmap='nipy_spectral', interpolation='nearest')
ax[2].axis('off')

plt.subplots_adjust(hspace=0.01, wspace=0.01, top=1, bottom=0, left=0,right=1)
plt.show()
```