Assignment 03

Index No: 190108X

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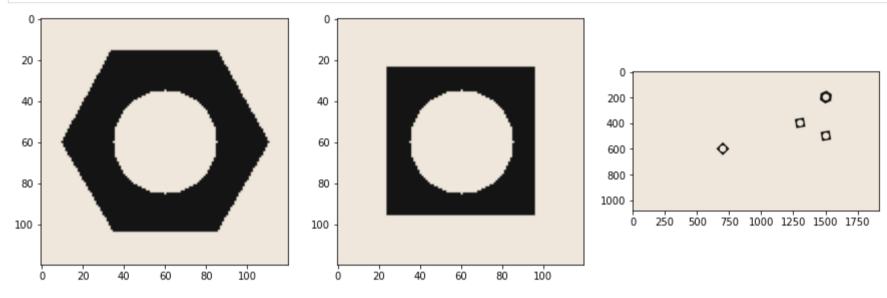
GitHub link: https://github.com/ChathurangaMMP/EN2550_Image_Processing_Exercises/tree/master/Assignment%203

Connected Component Analysis

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

hexnut_template = cv.imread('hexnut_template.png', cv.IMREAD_COLOR)
squarenut_template = cv.imread('squarenut_template.png', cv.IMREAD_COLOR)
conveyor_f100 = cv.imread('conveyor_f100.png', cv.IMREAD_COLOR)

fig, ax = plt. subplots(1,3,figsize=(15,15))
ax[0].imshow(cv.cvtColor(hexnut_template, cv.COLOR_RGB2BGR))
ax[1].imshow(cv.cvtColor(squarenut_template, cv.COLOR_RGB2BGR))
ax[2].imshow(cv.cvtColor(conveyor_f100, cv.COLOR_RGB2BGR))
plt.show()
```



Otsu's thresholding

```
In [8]:
    hexnut_gray = cv.cvtColor(hexnut_template, cv.COLOR_BGR2GRAY)
    squarenut_gray=cv.cvtColor(squarenut_template, cv.COLOR_BGR2GRAY)
    conveyor_gray=cv.cvtColor(conveyor_f100, cv.COLOR_BGR2GRAY)

    th1,hext = cv.threshold(hexnut_gray,0,255,cv.THRESH_BINARY+cv.THRESH_OTSU)
    th2,squaret = cv.threshold(squarenut_gray,0,255,cv.THRESH_BINARY+cv.THRESH_OTSU)
    th3,belt = cv.threshold(conveyor_gray,0,255,cv.THRESH_BINARY+cv.THRESH_OTSU)

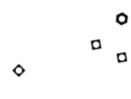
    print('Threshold value for hexnut template:',th1)
    print('Threshold value for squarenut template:',th2)
    print('Threshold value for conveyor belt:',th3)
```

Threshold value for hexnut template: 20.0 Threshold value for squarenut template: 20.0 Threshold value for conveyor belt: 20.0

```
In [10]:
    fig,ax=plt.subplots(1,3,figsize=(15,15))
    ax[0].imshow(cv.cvtColor(hext,cv.COLOR_RGB2BGR))
    ax[0].axis('off')
    ax[1].imshow(cv.cvtColor(squaret,cv.COLOR_RGB2BGR))
    ax[1].axis('off')
    ax[2].imshow(cv.cvtColor(belt,cv.COLOR_RGB2BGR))
    ax[2].axis('off')
    plt.show()
```







Morphological closing

```
In [16]:
          hex_binary = cv.threshold(hexnut_gray, 127, 255, cv.THRESH_BINARY)[1]
          sqr_binary = cv.threshold(squarenut_gray, 127, 255, cv.THRESH_BINARY)[1]
          belt_binary = cv.threshold(conveyor_gray, 127, 255, cv.THRESH_BINARY)[1]
          kernel = np.ones((3,3),np.uint8)
          hex_closing = cv.morphologyEx(np.invert(hex_binary), cv.MORPH_CLOSE, kernel)
          square_closing = cv.morphologyEx(np.invert(sqr_binary), cv.MORPH_CLOSE, kernel)
          belt_closing = cv.morphologyEx(np.invert(belt_binary), cv.MORPH_CLOSE, kernel)
In [18]:
          fig,ax=plt.subplots(1,3,figsize=(15,15))
          ax[0].imshow(cv.cvtColor(np.invert(hex_closing),cv.COLOR_RGB2BGR))
          ax[0].axis('off')
          ax[1].imshow(cv.cvtColor(np.invert(square_closing),cv.COLOR_RGB2BGR))
          ax[1].axis('off')
          ax[2].imshow(cv.cvtColor(np.invert(belt_closing),cv.COLOR_RGB2BGR))
          ax[2].axis('off')
          plt.show()
```







Connected components analysis for Hexnut template

```
In [19]:
         connectivity = 4
         hex_num_labels,hex_labels,hex_stat,hex_cent = cv.connectedComponentsWithStats(hext, connectivity, cv.CV_32S)
         print('There are {} connected components in Hexnut template.'.format(hex_num_labels))
         print('Statistics:')
         print(hex_stat)
         print()
         print('Centroids:')
         print(hex_cent)
         There are 3 connected components in Hexnut template.
         Statistics:
         [[ 10 16 101 88 4724]
            0 0 120 120 7715]
         [ 35 35 51 51 1961]]
         Centroids:
         [[59.83361558 59.22290432]
         [59.16863253 59.54257939]
```

Connected components analysis for Squarenut template

```
In [20]:
         connectivity = 4
         sqr_num_labels,sqr_labels,sqr_stat,sqr_cent = cv.connectedComponentsWithStats(squaret, connectivity, cv.CV_32S)
         print('There are {} connected components in Squarenut template.'.format(sqr_num_labels))
         print('Statistics:')
         print(sqr_stat)
         print()
          print('Centroids:')
         print(sqr_cent)
         There are 3 connected components in Squarenut template.
         Statistics:
         [[ 24 24 72 72 3223]
         [ 0 0 120 120 9216]
         [ 35 35 51 51 1961]]
        Centroids:
         [[59.19578033 59.19578033]
                   59.5
         [60.
                      60.
                                ]]
```

Connected components analysis for Conveyor belt

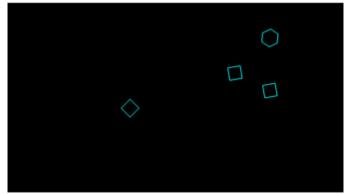
```
connectivity = 4
belt_num_labels,belt_labels,belt_stat,belt_cent = cv.connectedComponentsWithStats(belt, connectivity, cv.CV_32S)
print('There are {} connected components in Conveyor belt.'.format(belt_num_labels))
print('Statistics:')
print(belt_stat)
```

```
print()
          print('Centroids:')
          print(belt cent)
         There are 6 connected components in Conveyor belt.
         Statistics:
                       150
                               896
                                       501 13938]
         [[
               650
                              1920
                                      1080 2051818]
              1475
                       175
                                51
                                              1961]
              1275
                       375
                                51
                                              1961]
              1475
                       475
                                51
                                        51
                                              1961]
                                51
                                        51
               675
                       575
                                              1961]]
         Centroids:
         [[1274.92050509 400.1106328]
          [ 956.24678115 540.8845999 ]
          [1500.
                          200.
          [1300.
                          400.
          [1500.
                          500.
          [ 700.
                          600.
                                      ]]
In [25]:
          fig,ax=plt.subplots(1,3,figsize=(15,15))
          ax[0].imshow(hex_labels)
          ax[0].axis('off')
          ax[1].imshow(sqr_labels)
          ax[1].axis('off')
          ax[2].imshow(belt_labels)
          ax[2].axis('off')
          plt.show()
```

Contour analysis

```
In [10]:
    black_img=np.zeros(conveyor_f100.shape)
    contours, hierarchy = cv.findContours(belt, cv.RETR_TREE, cv.CHAIN_APPROX_SIMPLE)
    cnt = [contours[i] for i in range(1,9,2)]
    cv.drawContours(black_img, cnt, -1, (0,255,150), 3)
    plt.imshow(black_img)
    plt.axis('off')
    plt.show()
```

Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).



Detecting Objects on a Synthetic Conveyor

```
In [11]:
    cv.namedWindow('Conveyor', cv.WINDOW_NORMAL)
    cap = cv.VideoCapture('conveyor.mp4')
    f = 0
    frames=[]
    frame = []
    while cap.isOpened():
        ret, frame = cap.read()
        frames.append(frame)
        if not ret:
            print("Can't receive frame (stream end?). Exiting.")
            break

    f += 1
        text = 'Frame:' + str(f)
        cv.putText(frame,text , (100, 100), cv.FONT_HERSHEY_COMPLEX, 1, (0,250,0), 1, cv.LINE_AA)
```

```
cv.imshow('Conveyor', frame)
    if cv.waitKey(1) == ord('q'):
        break

cap.release()
    cv.destroyAllWindows()

Can't receive frame (stream end?). Exiting.

In [12]: # Count the number of matching hexagonal nuts in conveyor_f100.png
    total_matches=0
    for i in range(len(contours)):
```

Number of matching hexagonal nuts = 1

total_matches+=1

if ret==0.0:

ret = cv.matchShapes(contours[i],contours[7],1,0.0)

print('Number of matching hexagonal nuts = ',total_matches)

```
In [15]:
          total_nuts=0
          frame_count=0
          detected=[]
          for frm in frames[:-1]:
              frame_total=0
              img_gray = cv.cvtColor(frm,cv.COLOR_BGR2GRAY)
              ret_f,thresh = cv.threshold(img_gray,0,255,cv.THRESH_BINARY+cv.THRESH_OTSU)
              contours_frame,hierarchy_frame = cv.findContours(thresh,cv.RETR_TREE, cv.CHAIN_APPROX_SIMPLE)
              for cnt in contours_frame:
                  ret_count = cv.matchShapes(cnt,contours[7],1,0.0)
                  if ret_count<=0.006 and abs(cv.contourArea(cnt)-cv.contourArea(contours[7]))<=800:</pre>
                      temp=0
                      for c in detected:
                           if np.sum(c)-np.sum(cnt)<75000:</pre>
                              temp=1
                      if temp==0:
                           detected.append(cnt)
                           total_nuts+=1
                      frame_total+=1
              print('Number of matching hexagonal nuts in frame {} is {}'.format(frame_count+1,frame_total))
              print('Total number of matching hexagonal nuts upto frame {} is {}'.format(frame_count+1,total_nuts))
              frame_count+=1
              in_text= 'In frame : '+str(frame_total)
              upto text='Upto frame : '+str(total nuts)
              cv.putText(img=frm, text=in_text, org=(50, 70), fontFace=cv.FONT_HERSHEY_TRIPLEX, fontScale=2, color=(0, 0, 255),thickness=1)
              cv.putText(img=frm, text=upto_text, org=(50, 150), fontFace=cv.FONT_HERSHEY_TRIPLEX, fontScale=2, color=(0, 0, 255),thickness=
```

Total number of matching hexagonal nuts upto frame 1 is 0 Number of matching hexagonal nuts in frame 2 is 0 Total number of matching hexagonal nuts upto frame 2 is 0 Number of matching hexagonal nuts in frame 3 is 0 Total number of matching hexagonal nuts upto frame 3 is 0 Number of matching hexagonal nuts in frame 4 is 0 Total number of matching hexagonal nuts upto frame 4 is 0 Number of matching hexagonal nuts in frame 5 is 0 Total number of matching hexagonal nuts upto frame 5 is 0 Number of matching hexagonal nuts in frame 6 is 0 Total number of matching hexagonal nuts upto frame 6 is 0 Number of matching hexagonal nuts in frame 7 is 0 Total number of matching hexagonal nuts upto frame 7 is 0 Number of matching hexagonal nuts in frame 8 is 0 Total number of matching hexagonal nuts upto frame 8 is 0 Number of matching hexagonal nuts in frame 9 is 0 Total number of matching hexagonal nuts upto frame 9 is 0 Number of matching hexagonal nuts in frame 10 is 0 Total number of matching hexagonal nuts upto frame 10 is 0 Number of matching hexagonal nuts in frame 11 is 0 Total number of matching hexagonal nuts upto frame 11 is 0 Number of matching hexagonal nuts in frame 12 is 0 Total number of matching hexagonal nuts upto frame 12 is 0 Number of matching hexagonal nuts in frame 13 is 0 Total number of matching hexagonal nuts upto frame 13 is 0 Number of matching hexagonal nuts in frame 14 is 0 Total number of matching hexagonal nuts upto frame 14 is 0 Number of matching hexagonal nuts in frame 15 is 0 Total number of matching hexagonal nuts upto frame 15 is 0 Number of matching hexagonal nuts in frame 16 is 0 Total number of matching hexagonal nuts upto frame 16 is 0 Number of matching hexagonal nuts in frame 17 is 0 Total number of matching hexagonal nuts upto frame 17 is 0 Number of matching hexagonal nuts in frame 18 is 0 Total number of matching hexagonal nuts upto frame 18 is 0 Number of matching hexagonal nuts in frame 19 is 0 Total number of matching hexagonal nuts upto frame 19 is 0 Number of matching hexagonal nuts in frame 20 is 0 Total number of matching hexagonal nuts upto frame 20 is 0 Number of matching hexagonal nuts in frame 21 is 0

Number of matching hexagonal nuts in frame 1 is 0

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In [14]: # Writing the video

frame_array = frames[:-1]
    shape = (1080, 1920, 3)

# Your code here

out = cv.VideoWriter('./conveyor_result_190108X.mp4',cv.VideoWriter_fourcc(*'h264'), 30, (shape[1], shape[0]))

for i in range(len(frame_array)):
    cv.imshow('Frame', frame_array[i])
    if cv.waitKey(1) == ord('q'):
        break
    out.write(frame_array[i])
```

out.release()
cv.destroyAllWindows()