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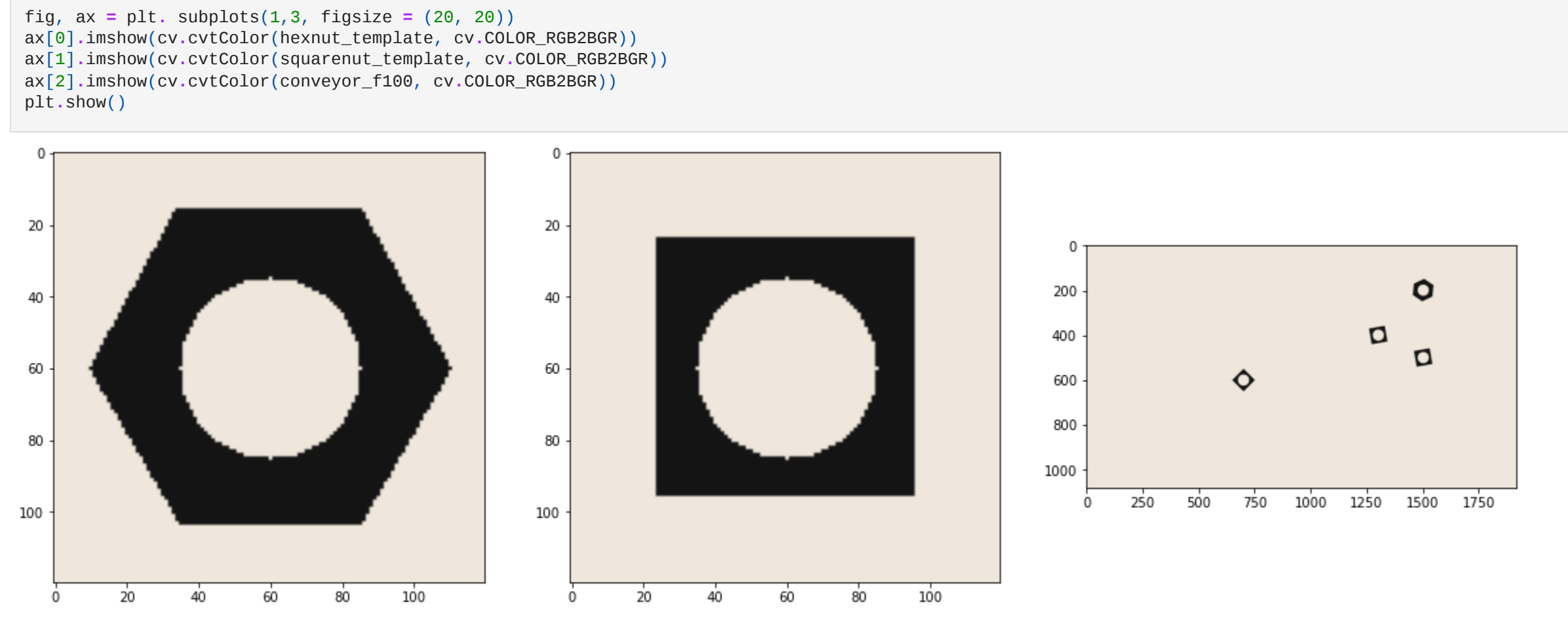
EN2550: Assignment 03 on Object Counting on a Conveyor Belt

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

Connected Component Analysis

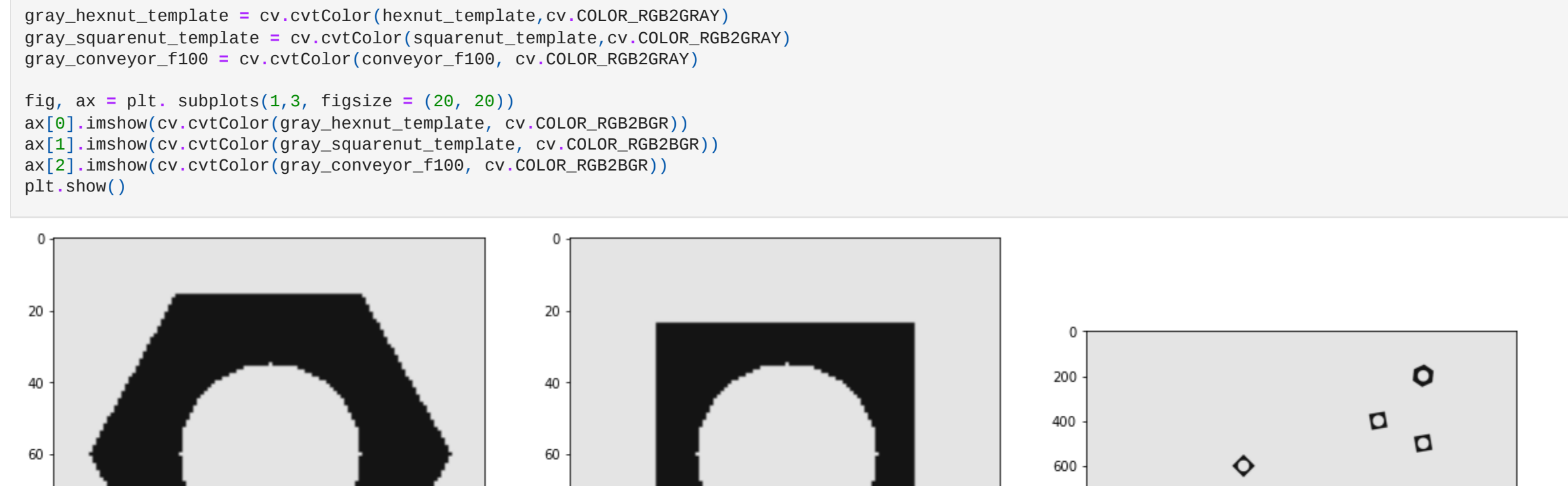
(01)

```python
hexnut_template = cv.imread(r"E:\#####ACCA folders\acca 4 th sem\Fundamentals of Image Processing and Machine Vision\Assignment 03\hexnut_template.png", cv.IMREAD_COLOR)
squarenut_template = cv.imread(r"E:\#####ACCA folders\acca 4 th sem\Fundamentals of Image Processing and Machine Vision\Assignment 03\squarenut_template.png", cv.IMREAD_COLOR)
conveyor_f100 = cv.imread(r"E:\#####ACCA folders\acca 4 th sem\Fundamentals of Image Processing and Machine Vision\Assignment 03\conveyor_f100.png", cv.IMREAD_COLOR)


fig, ax = plt. subplots(1,3, figsize = (20, 20))
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()
```



(02)

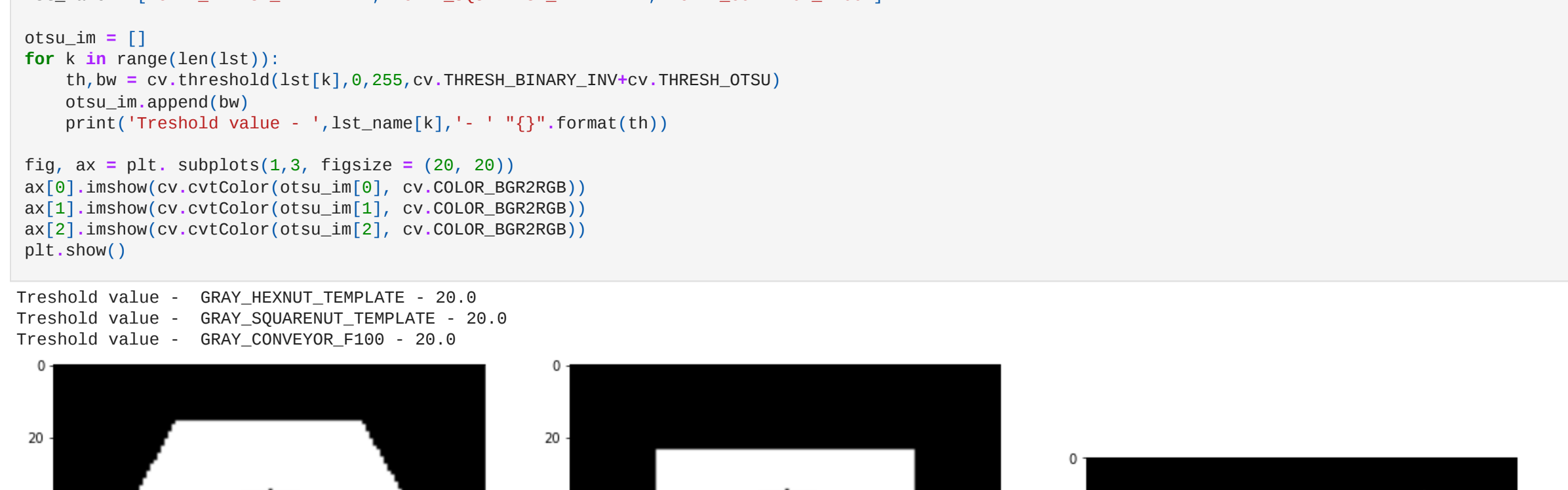
```python
gray_hexnut_template = cv.cvtColor(hexnut_template,cv.COLOR_RGB2GRAY)
gray_squarenut_template = cv.cvtColor(squarenut_template,cv.COLOR_RGB2GRAY)
gray_conveyor_f100 = cv.cvtColor(conveyor_f100, cv.COLOR_RGB2GRAY)

fig, ax = plt. subplots(1,3, figsize = (20, 20))
ax[0].imshow(cv.cvtColor(gray_hexnut_template, cv.COLOR_RGB2BGR))
ax[1].imshow(cv.cvtColor(gray_squarenut_template, cv.COLOR_RGB2BGR))
ax[2].imshow(cv.cvtColor(gray_conveyor_f100, cv.COLOR_RGB2BGR))
plt.show()
```



(03)

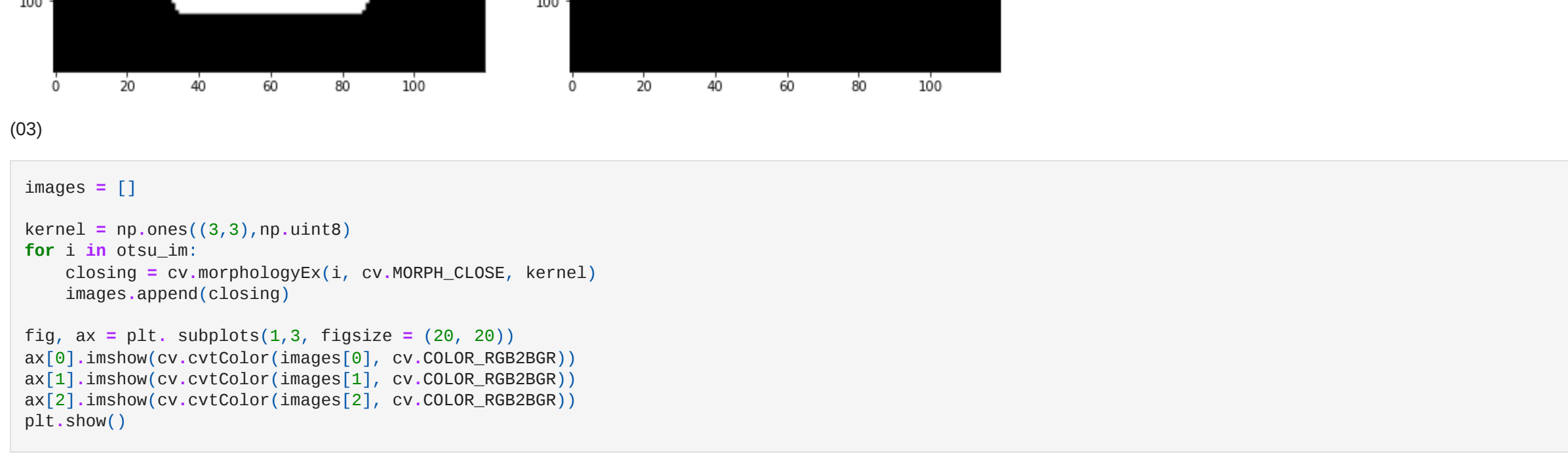
```python
lst = [gray_hexnut_template, gray_squarenut_template, gray_conveyor_f100]
lst_name = ["GRAY_HEXNUT_TEMPLATE", "GRAY_SQUARENUT_TEMPLATE", "GRAY_CONVEYOR_F100"]

otsu_im = []
for k in range(len(lst)):
    th,bw = cv.threshold(lst[k],0,255,cv.THRESH_BINARY_INV+cv.THRESH_OTSU)
    otsu_im.append(bw)
    print('Treshold value - ',lst_name[k],'- ' "{}".format(th))

fig, ax = plt. subplots(1,3, figsize = (20, 20))
ax[0].imshow(cv.cvtColor(otsu_im[0], cv.COLOR_BGR2RGB))
ax[1].imshow(cv.cvtColor(otsu_im[1], cv.COLOR_BGR2RGB))
ax[2].imshow(cv.cvtColor(otsu_im[2], cv.COLOR_BGR2RGB))
plt.show()
```

```
Treshold value -  GRAY_HEXNUT_TEMPLATE - 20.0
Treshold value -  GRAY_SQUARENUT_TEMPLATE - 20.0
Treshold value -  GRAY_CONVEYOR_F100 - 20.0
```



(03)

```python
images = []

kernel = np.ones((3,3),np.uint8)
for i in otsu_im:
    closing = cv.morphologyEx(i, cv.MORPH_CLOSE, kernel)
    images.append(closing)

fig, ax = plt. subplots(1,3, figsize = (20, 20))
ax[0].imshow(cv.cvtColor(images[0], cv.COLOR_RGB2BGR))
ax[1].imshow(cv.cvtColor(images[1], cv.COLOR_RGB2BGR))
ax[2].imshow(cv.cvtColor(images[2], cv.COLOR_RGB2BGR))
plt.show()
```



(04)

```python
lst_name = ["GRAY_HEXNUT_TEMPLATE", "GRAY_SQUARENUT_TEMPLATE", "GRAY_CONVEYOR_F100"]

for k in range(len(images)):
    print('\n\n'+lst_name[k], '\n')
    im = images[k]

    retval,labels,stats,centroides = cv.connectedComponentsWithStats(im, 4, cv.CV_32S)
    print('Number of connected components =',retval, '\n')

    for i in range(1, retval):
        area = stats[i, cv.CC_STAT_AREA]

        if i == 0:
            text = "examining component {}/{} (background)".format(i + 1, retval)
        else:
            text = "examining component {}/{}".format( i + 1, retval,'\n')

        print("[INFO] {}".format(text))
        colormapped = cv.applyColorMap((labels/np.amax(labels)*255).astype("uint8"),cv.COLORMAP_PARULA)

        x = stats[i, cv.CC_STAT_LEFT]
        y = stats[i, cv.CC_STAT_TOP]
        w = stats[i, cv.CC_STAT_WIDTH]
        h = stats[i, cv.CC_STAT_HEIGHT]
        (C1, C2) = centroides[i]

        print("\n[Statistics - Left] {}".format(x))
        print("[Statistics - Top] {}".format(y))
        print("[Statistics - Width] {}".format(w))
        print("[Statistics - Height] {}".format(h))
        print("[Statistics - Centroid] {}".format((C1, C2)))
        print('\n')

    Z=720
    f=8
    for i,s in enumerate(stats):
        if i!=0:
            print('\nItem',i,', area in pixels=',s[4])
            print('Item',i,', area in mm^2=',s[4]*(2.2e-3)**2*(Z*Z)/(f*f))

    print('\n')

    fig, ax = plt. subplots(1,2, figsize = (20, 20))
    ax[0].imshow(cv.cvtColor(im, cv.COLOR_BGR2RGB))
    ax[0].axis('off')
    ax[1].imshow(cv.cvtColor(colormapped, cv.COLOR_BGR2RGB))
    ax[1].axis('off')
    plt.show()
```

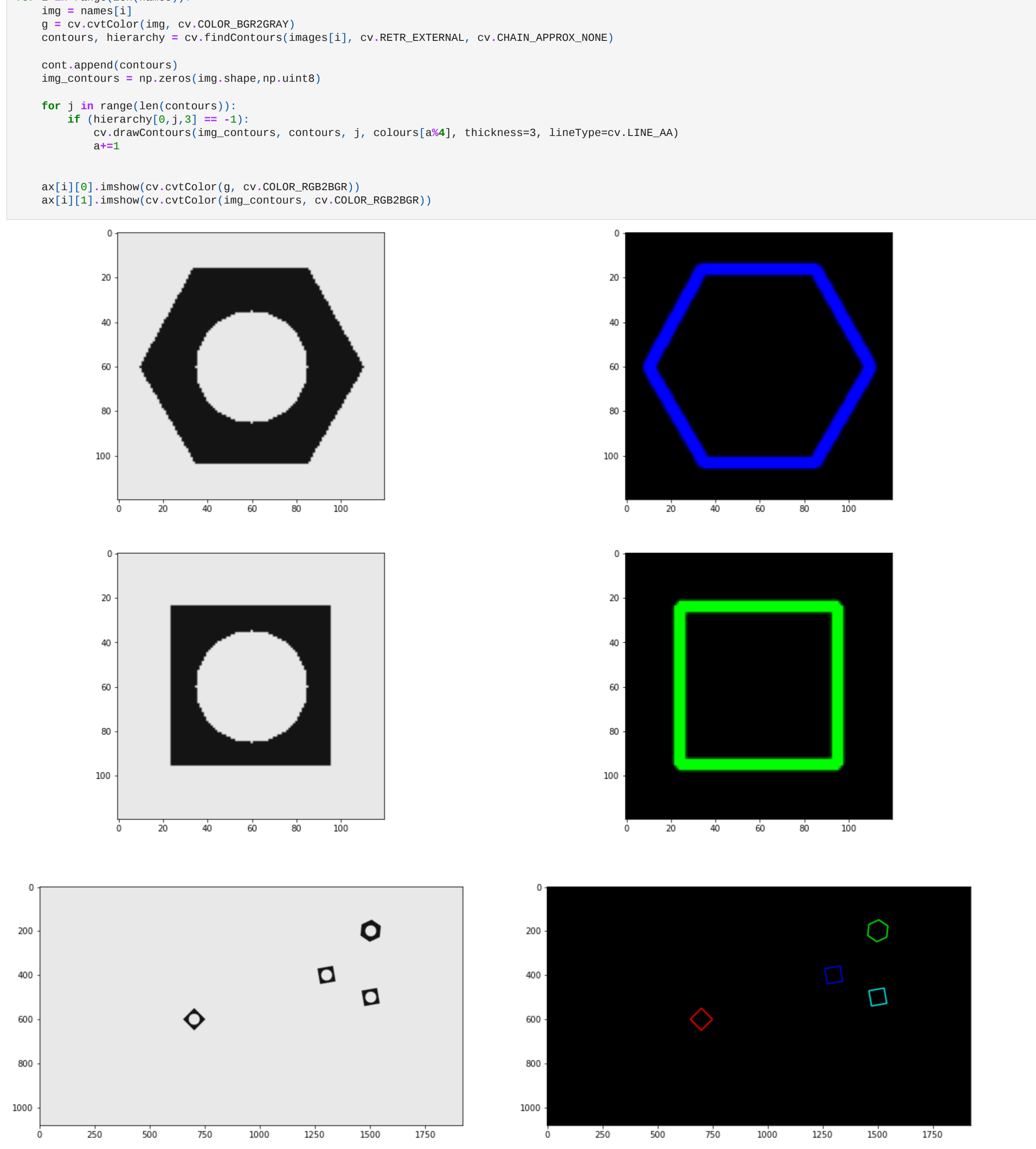
```
GRAY_HEXNUT_TEMPLATE

Number of connected components = 2

[INFO] examining component 2/2

[Statistics - Left] 10
[Statistics - Top] 16
[Statistics - Width] 101
[Statistics - Height] 88
[Statistics - Centroid] (59.83375634517766, 59.22356175972927)


Item 1 , area in pixels= 4728
Item 1 , area in mm^2= 185.356512
```

```
GRAY_SQUARENUT_TEMPLATE

Number of connected components = 2

[INFO] examining component 2/2

[Statistics - Left] 24
[Statistics - Top] 24
[Statistics - Width] 72
[Statistics - Height] 72
[Statistics - Centroid] (59.196777192438795, 59.196777192438795)


Item 1 , area in pixels= 3227
Item 1 , area in mm^2= 126.51130800000001
```

```
GRAY_CONVEYOR_F100

Number of connected components = 5

[INFO] examining component 2/5

[Statistics - Left] 1454
[Statistics - Top] 150
[Statistics - Width] 92
[Statistics - Height] 100
[Statistics - Centroid] (1499.2420189818808, 199.28515962036238)


[INFO] examining component 3/5

[Statistics - Left] 1259
[Statistics - Top] 359
[Statistics - Width] 82
[Statistics - Height] 82
[Statistics - Centroid] (1299.1830255911889, 399.1830255911889)


[INFO] examining component 4/5

[Statistics - Left] 1459
[Statistics - Top] 459
[Statistics - Width] 82
[Statistics - Height] 82
[Statistics - Centroid] (1499.1830255911889, 499.1830255911889)


[INFO] examining component 5/5

[Statistics - Left] 650
[Statistics - Top] 550
[Statistics - Width] 101
[Statistics - Height] 101
[Statistics - Centroid] (700.0, 600.0)



Item 1 , area in pixels= 4636
Item 1 , area in mm^2= 181.74974400000002

Item 2 , area in pixels= 3087
Item 2 , area in mm^2= 121.022748

Item 3 , area in pixels= 3087
Item 3 , area in mm^2= 121.022748

Item 4 , area in pixels= 3144
Item 4 , area in mm^2= 123.25737600000001
```

(05)

```python
cont = []
colours = [(255,0,0), (0,255,0), (0,0,255), (255,255,0), (255,0,255)]
names = [hexnut_template, squarenut_template, conveyor_f100]
a = 0

fig, ax = plt. subplots(3,2, figsize = (20, 20))

for i in range(len(names)):
    img = names[i]
    g = cv.cvtColor(img, cv.COLOR_BGR2GRAY)
    contours, hierarchy = cv.findContours(images[i], cv.RETR_EXTERNAL, cv.CHAIN_APPROX_NONE)

    cont.append(contours)
    img_contours = np.zeros(img.shape,np.uint8)

    for j in range(len(contours)):
        if (hierarchy[0,j,3] == -1):
            cv.drawContours(img_contours, contours, j, colours[a%4], thickness=3, lineType=cv.LINE_AA)
            a+=1


    ax[i][0].imshow(cv.cvtColor(g, cv.COLOR_RGB2BGR))
    ax[i][1].imshow(cv.cvtColor(img_contours, cv.COLOR_RGB2BGR))
```



(06) - Detecting Objects on a Synthetic Conveyor

```python
cv.namedWindow('Conveyor', cv.WINDOW_NORMAL)
cap = cv.VideoCapture(r"E:\#####ACCA folders\acca 4 th sem\Fundamentals of Image Processing and Machine Vision\Assignment 03\conveyor.mp4")
f = 0
frame = []

while cap.isOpened():
    ret, frame = cap.read()
    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.
```

(07)

```python
cn1 = cont[0][0]
conveyor_f100 =  names[2]

count = 0
for i in cont[2]:
    ret = cv.matchShapes(cn1, i, 1, 0.0)
    if ret<0.001:
        count += 1
        x, y, w, h = cv.boundingRect(i)
        cv.rectangle(conveyor_f100, (x,y), (x+w,y+h), (0,0,255), 2)
print("Matching Elements = ", count)

fig, ax = plt. subplots(figsize = (20,20))
ax.imshow(cv.cvtColor(conveyor_f100, cv.COLOR_BGR2RGB))
plt.show()
```

```
Matching Elements =  1
```

(08)

```python
cv.namedWindow('Conveyor', cv.WINDOW_NORMAL)
cap = cv.VideoCapture(r"E:\#####ACCA folders\acca 4 th sem\Fundamentals of Image Processing and Machine Vision\Assignment 03\conveyor.mp4")

f = 0
frame = []
n = 0
n1 = 0
n2 = 0
count = 0
count_hex = 0
count_square = 0

frame_array = []
shape = (1080, 1920, 3)

out = cv.VideoWriter(r"E:\#####ACCA folders\acca 4 th sem\Fundamentals of Image Processing and Machine Vision\Assignment 03\conveyor_result_190663R.mp4",cv.VideoWriter_fourcc(*'h26

while cap.isOpened():
    ret, frame = cap.read()
    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, (0,200,0), 1, cv.LINE_AA)

    gray_frame = cv.cvtColor(frame, cv.COLOR_BGR2GRAY)
    th, bw = cv.threshold(gray_frame, 0, 255, cv.THRESH_BINARY_INV+cv.THRESH_OTSU)

    kernel = np.ones((3,3),np.uint8)
    closing = cv.morphologyEx(bw, cv.MORPH_CLOSE, kernel)

    contours, hierarchy = cv.findContours(closing, cv.RETR_EXTERNAL, cv.CHAIN_APPROX_NONE)


    pn = n
    pn1 = n1
    pn2 = n2
    n = 0
    n1 = 0
    n2 = 0

    for cnt in contours:
        area = cv.contourArea(cnt)
        ret1 = cv.matchShapes(cont[0][0], cnt, 1, 0.0)
        ret2 = cv.matchShapes(cont[1][0], cnt, 1, 0.0)

        if ret1 <= 0.001 and area > 4000:
            (x, y, w, h) = cv.boundingRect(cnt)
            cv.rectangle(frame, (x, y), (x + w, y + h), (0, 0, 255), 2)
            n += 1
            n1 += 1

        if ret2 <= 0.001 and area > 4000:
            (x, y, w, h) = cv.boundingRect(cnt)
            cv.rectangle(frame, (x, y), (x + w, y + h), (150, 200, 0), 2)
            n += 1
            n2 += 1

    if pn < n:
        count += 1
    if pn1 < n1:
        count_hex +=1
    if pn2 < n2:
        count_square += 1

    text = 'Current Frame Count:' + str(n)
    cv.putText(frame,text, (300, 100), cv.FONT_HERSHEY_COMPLEX, 1, (200, 0, 155), 1, cv.LINE_AA)
    text = 'Total Count:' + str(count)
    cv.putText(frame,text, (730, 100), cv.FONT_HERSHEY_COMPLEX, 1, (0, 150, 50), 1, cv.LINE_AA)
    text = 'Total Hexnut Count:' + str(count_hex)
    cv.putText(frame,text, (980, 100), cv.FONT_HERSHEY_COMPLEX, 1, (0, 0, 255), 1, cv.LINE_AA)
    text = 'Total Squarenut Count:' + str(count_square)
    cv.putText(frame,text, (1380, 100), cv.FONT_HERSHEY_COMPLEX, 1, (150, 200, 0), 1, cv.LINE_AA)

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

cap.release()
out.release()
cv.destroyAllWindows()
```

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