

In [14]:

```

import cv2
import numpy as np
import matplotlib.pyplot as plt
import argparse

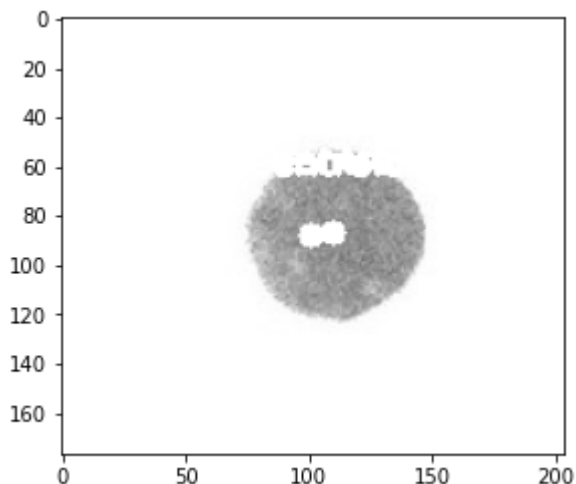
# img = cv2.imread(args["ipimage"]) r'foo55.jpg'
img = cv2.imread('test0401.jpg')#GRAYSCALE
gray_image = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
ret,thresh = cv2.threshold(gray_image,220,255,0)
plt.imshow(thresh)
print('plt thresh')
cv2.waitKey(0)
# find contours in the binary image
contours, hierarchy = cv2.findContours(thresh,cv2.RETR_TREE,cv2.CHAIN_APPROX_SIMPLE)
# https://github.com/facebookresearch/maskrcnn-benchmark/issues/339
for c in contours:
    M = cv2.moments(c)
    if M["m00"] != 0:
        cX = int(M["m10"] / M["m00"])
        cY = int(M["m01"] / M["m00"])
    else:
        cX, cY = 0, 0
    # cX = int(M["m10"] / M["m00"])
    # cY = int(M["m01"] / M["m00"])
    print(cX,cY)
    cv2.circle(img, (cX, cY), 5, (255, 255, 255), -1)
    cv2.putText(img, "centroid", (cX - 25, cY - 25),cv2.FONT_HERSHEY_SIMPLEX, 0.5, (
    plt.imshow(img)
# cv2.imshow("Image", img)
cv2.waitKey(0)
print('finish')

```

```

plt thresh
101 88
finish
110 87
finish

```



In [1]:

```

# https://blog.csdn.net/qq_36387683/article/details/80557434
# https://www.daimajiaoliu.com/daima/4fd168a60900418
import cv2 as cv
import numpy as np
from matplotlib import pyplot as plt
import matplotlib.pyplot as plt

img = cv.imread('foo00.jpg')

```

```

img = cv.resize(img, (int(img.shape[1]*0.2), int(img.shape[0]*0.2)))
gray = cv.cvtColor(img, cv.COLOR_BGR2GRAY)
gray = np.float32(gray)

dst = cv.cornerHarris(gray, 2, 3, 0.04)
dst = cv.dilate(dst, None)
ret, dst = cv.threshold(dst, 0.01*dst.max(), 255, cv.THRESH_BINARY)
dst = np.uint8(dst)
# cv.imwrite('img/thresh3.png', dst)
plt.imshow(dst)
ret, labels, stats, centroids = cv.connectedComponentsWithStats(dst)
...

connectedComponentsWithStats(image, labels=None, stats=None, centroids=None, connect
ret: 返回的标签的数量
labels: 输入图像的大小的矩阵, 其中每个元素的值都等于其标签
Stats is a matrix of the stats that the function calculates. It has a length equal t
stats: 函数计算的统计信息的矩阵。它的行等于标签的数量, 列数等于统计到的信息数量 (5个)。
    每个标签的统计输出, 包括背景标签。
    输出格式为[cv2.CC_STAT_LEFT, CV.CC_STAT_TOP, CV.CC_STAT_WIDTH, CV.CC_STAT_HEI
    CV.CC_STAT_LEFT: 最左边的 (x) 坐标, 它是水平方向上边界框的包含开始
    CV.CC_STAT_TOP: 最上边的 (y) 坐标, 它是垂直方向上边界框的包含开始
    CV.CC_STAT_WIDTH: 边界框的水平大小
    CV.CC_STAT_HEIGHT: 边界框的垂直大小
    CV.CC_STAT_AREA: 连接组件的总面积 (以像素为单位)
    可以通过stats[label, column]访问
centroids: 具有每个质心的x和y位置的矩阵。此矩阵中的行对应于标签号。
...

print(ret)
# print(labels)
# print(labels[2])
print(stats.shape)
print('this is centroids')
print(centroids)
print('this is centroids')

#定义停止和细化角点的标准
criteria = (cv.TERM_CRITERIA_EPS + cv.TERM_CRITERIA_MAX_ITER, 100, 0.001)

corners = cv.cornerSubPix(gray, np.float32(centroids), (5, 5), (-1, -1), criteria)
...

cornerSubPix(image, corners, winSize, zeroZone, criteria)
image: 8位单通道的灰度图像。
corners: 为整数值的像素位置
winSize: 指定了等式产生的窗口尺寸。
zeroZone: 定义了一个禁区 (与win相似, 但通常比win小), 这个区域在方程组以及自相关矩阵中不被
criteria: 终止条件。可以是最大迭代次数cv.TERM_CRITERIA_MAX_ITER, 或者设定的精度cv.TERM
...

print(corners)
res = np.hstack((centroids, corners))
res = np.int0(res)
print(res)

img[res[:, 1], res[:, 0]] = [0, 0, 255]
img[res[:, 3], res[:, 2]] = [0, 255, 0]

# cv.imwrite('img/subpixel2.png', img)
plt.imshow(img)
cv.waitKey(0)
cv.destroyAllWindows()

```

```

12
(12, 5)
this is centroids
[[199.5421501 200.07026369]

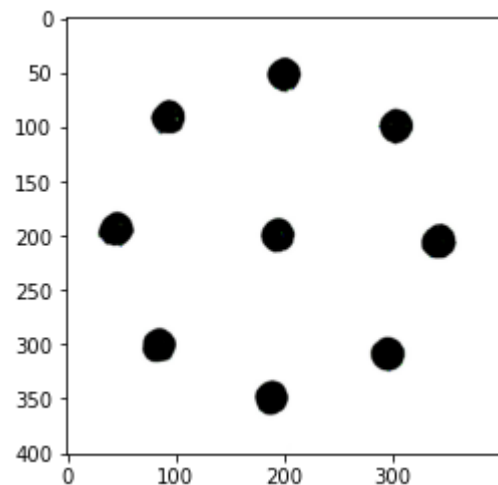
```

```
[193.          65.          ]
[209.          65.5         ]
[203.86956522  67.82608696]
[102.07407407  93.59259259]
[288.5         101.         ]
[ 85.14634146 105.56097561]
[ 33.          204.         ]
[ 50.          210.         ]
[336.          220.         ]
[308.          318.         ]
[297.          324.         ]]
```

this is centroids

```
[[198.32878 198.30916 ]
 [192.17691  65.210205]
 [207.96916  65.918144]
 [203.09146  67.475494]
 [102.07407  93.59259 ]
 [287.46976 100.34766 ]
 [ 85.882095 106.28104 ]
 [ 29.401463 200.24837 ]
 [ 50.26733  209.71112 ]
 [335.32382  220.38077 ]
 [308.27948  318.19046 ]
 [296.5008   324.80594 ]]
```

[[199 200 198 198]
 [193 65 192 65]
 [209 65 207 65]
 [203 67 203 67]
 [102 93 102 93]
 [288 101 287 100]
 [85 105 85 106]
 [33 204 29 200]
 [50 210 50 209]
 [336 220 335 220]
 [308 318 308 318]
 [297 324 296 324]]



In [7]:

```
# https://blog.csdn.net/weixin_45645281/article/details/105542473
import cv2 as cv
import numpy as np
import matplotlib.pyplot as plt
if __name__=='__main__':
    img=cv.imread("Improved108.jpg")
    gray_img=cv.cvtColor(img,cv.COLOR_BGR2GRAY)
    result_img=img.copy()
    #Shi-Tomasi角点检测
    corners=cv.goodFeaturesToTrack(gray_img,100,0.01,10,blockSize=3,useHarrisDetector=False)
    #迭代算法模板 (1.类型 2.迭代次数 3.阈值)
    criteria=(cv.TermCriteria_EPS+cv.TermCriteria_MAX_ITER,30,0.01)
    #亚像素角点检测
```

```

corners2=cv.cornerSubPix(gray_img,corners,(5,5),(-1,-1),criteria)
j=0
for i in corners2:
    x,y=i.ravel()
    j=j+1
    cv.circle(result_img,(x,y),10,(255,0,0),2)
    print("角点坐标"+str(j)+":",(x,y))
#     cv.imshow("original image", img)
#     cv.imshow("result image",result_img)
plt.imshow(result_img)
cv.imwrite("ma.jpg",result_img)
cv.waitKey(0)
cv.destroyAllWindows()

```

<ipython-input-7-3d7f993fc361>:19: DeprecationWarning: an integer is required (got type numpy.float32). Implicit conversion to integers using __int__ is deprecated, and may be removed in a future version of Python.

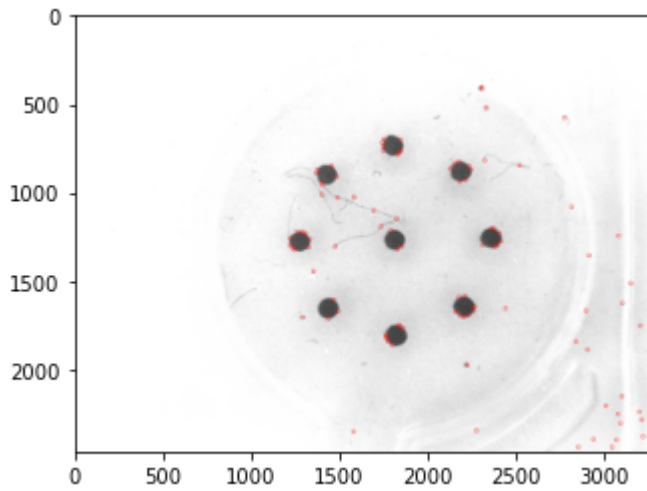
```
cv.circle(result_img,(x,y),10,(255,0,0),2)
```

```

角点坐标1: (1324.643, 1263.537)
角点坐标2: (2255.5857, 1643.0579)
角点坐标3: (1447.3413, 850.3718)
角点坐标4: (1301.3375, 1231.1438)
角点坐标5: (2175.8396, 1697.4265)
角点坐标6: (2166.6958, 826.1445)
角点坐标7: (1838.2777, 704.6945)
角点坐标8: (1818.4545, 786.91693)
角点坐标9: (1226.3448, 1312.3066)
角点坐标10: (1389.488, 945.8978)
角点坐标11: (2220.6868, 1694.9019)
角点坐标12: (1215.5428, 1298.5918)
角点坐标13: (2841.7124, 2436.3894)
角点坐标14: (1826.3085, 1749.8126)
角点坐标15: (2205.8054, 929.035)
角点坐标16: (3066.5469, 2250.666)
角点坐标17: (1760.0, 1826.0)
角点坐标18: (2367.6152, 1306.6051)
角点坐标19: (2298.412, 415.97507)
角点坐标20: (2172.7217, 939.10394)
角点坐标21: (1430.0, 1712.0)
角点坐标22: (1734.0, 718.0)
角点坐标23: (2223.8608, 850.89606)
角点坐标24: (2165.0, 1590.0)
角点坐标25: (2402.2563, 1277.9404)
角点坐标26: (2396.4412, 1229.9487)
角点坐标27: (1818.5192, 1320.6536)
角点坐标28: (2318.0, 523.0)
角点坐标29: (2250.1946, 1665.1794)
角点坐标30: (2201.1636, 1584.8668)
角点坐标31: (1478.9578, 910.4206)
角点坐标32: (1238.9906, 1323.6432)
角点坐标33: (3032.0625, 2436.5715)
角点坐标34: (1685.5038, 1102.4589)
角点坐标35: (1215.0, 1258.0)
角点坐标36: (3185.5525, 2237.803)
角点坐标37: (2143.2017, 836.45996)
角点坐标38: (1461.9393, 1606.8315)
角点坐标39: (1840.0, 765.0)
角点坐标40: (3068.7812, 1245.47)
角点坐标41: (3270.919, 1631.2523)
角点坐标42: (2383.7974, 1301.6279)
角点坐标43: (2802.1267, 1081.4219)
角点坐标44: (2997.6328, 2203.3958)

```

角点坐标45: (1346.523, 1444.1422)
角点坐标46: (2236.7002, 872.7076)
角点坐标47: (1284.1938, 1705.8718)
角点坐标48: (2295.7378, 406.2851)
角点坐标49: (2892.7734, 1887.1511)
角点坐标50: (1844.8684, 1304.1426)
角点坐标51: (2902.8384, 1355.7631)
角点坐标52: (2926.2437, 2392.3809)
角点坐标53: (1318.0636, 1309.3954)
角点坐标54: (1255.8785, 1226.047)
角点坐标55: (1481.8846, 1029.6351)
角点坐标56: (2266.2573, 2343.654)
角点坐标57: (1851.8794, 1766.1976)
角点坐标58: (1744.6431, 700.04266)
角点坐标59: (3087.2566, 2151.6953)
角点坐标60: (2118.2456, 866.4044)
角点坐标61: (1727.8748, 1191.8901)
角点坐标62: (1766.137, 1842.7583)
角点坐标63: (2214.5369, 1976.2881)
角点坐标64: (1739.0, 764.0)
角点坐标65: (1576.693, 1027.321)
角点坐标66: (3206.0264, 2377.3284)
角点坐标67: (1831.3998, 779.4448)
角点坐标68: (1362.0, 891.0)
角点坐标69: (1572.9082, 2348.2588)
角点坐标70: (1815.5271, 1148.0199)
角点坐标71: (2510.5867, 846.6388)
角点坐标72: (2828.552, 1840.4541)
角点坐标73: (2884.1619, 1667.2598)
角点坐标74: (3192.5012, 1752.7312)
角点坐标75: (2764.0, 578.0)
角点坐标76: (1791.68, 1860.684)
角点坐标77: (1367.8086, 872.7035)
角点坐标78: (1740.6055, 741.59094)
角点坐标79: (1280.9779, 1222.8352)
角点坐标80: (1397.1072, 959.8476)
角点坐标81: (2301.5847, 1296.5663)
角点坐标82: (1393.323, 1012.0725)
角点坐标83: (3090.8645, 1624.4686)
角点坐标84: (1485.6964, 1668.663)
角点坐标85: (2353.1958, 1201.0604)
角点坐标86: (1468.4331, 1304.7697)
角点坐标87: (2148.86, 1674.5309)
角点坐标88: (2312.0972, 819.53357)
角点坐标89: (1781.641, 1214.7058)
角点坐标90: (3255.3662, 1898.354)
角点坐标91: (3199.3152, 2281.1973)
角点坐标92: (1754.0061, 1813.5304)
角点坐标93: (2429.5317, 1654.0314)
角点坐标94: (3057.1848, 2395.7634)
角点坐标95: (1754.572, 1804.5288)
角点坐标96: (3137.9968, 1512.2108)
角点坐标97: (1835.3601, 1753.6586)
角点坐标98: (2366.2292, 1205.402)
角点坐标99: (3079.69, 2302.5745)
角点坐标100: (2194.3472, 1701.2706)



In [24]:

```
# https://codeleading.com/article/56385214025/
import time
import matplotlib.pyplot as plt
import cv2
import numpy as np
import datetime

start = time.process_time()

kernels_Num = 8
kernels = ['_' for i in range(kernels_Num)]
kernels[0] = np.array([[1, 2, 1], [0, 0, 0], [-1, -2, -1]], dtype=int)
kernels[1] = np.array([[2, 1, 0], [1, 0, -1], [0, -1, -2]], dtype=int)
kernels[2] = np.array([[1, 0, -1], [2, 0, -2], [1, 0, -1]], dtype=int)
kernels[3] = np.array([[0, -1, -2], [1, 0, -1], [2, 1, 0]], dtype=int)
kernels[4] = np.array([[-1, -2, -1], [0, 0, 0], [1, 2, 1]], dtype=int)
kernels[5] = np.array([[-2, -1, 0], [-1, 0, 1], [0, 1, 2]], dtype=int)
kernels[6] = np.array([[-1, 0, 1], [-2, 0, 2], [-1, 0, 1]], dtype=int)
kernels[7] = np.array([[0, 1, 2], [-1, 0, 1], [-2, -1, 0]], dtype=int)

img = cv2.imread('test01.jpg')
img_RGB = cv2.cvtColor(img, cv2.COLOR_BGR2RGB) # 转成RGB 方便后面显示
# 灰度化处理图像
grayImage = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

gradients = ['_' for i in range(kernels_Num)]
for i in range(kernels_Num):
    gradients[i] = cv2.filter2D(grayImage, cv2.CV_16S, kernels[i])
    """
    显示梯度图像 代码
    """

# cv2.normalize(gradients[i],gradients[i],0,255,cv2.NORM_MINMAX)
# abs = cv2.convertScaleAbs(gradients[i])
# cv2.imshow(str(i),abs)
# cv2.imshow('222',img)
# cv2.waitKey(0)

angle_list = [270, 315, 0, 45, 90, 135, 180, 225]
amplitude = np.full(grayImage.shape,0)
angle = np.full(grayImage.shape,-64)

for r in range(grayImage.shape[0]):
    pAmp = amplitude[r]
    pAng = angle[r]

    pGrad = ['_' for i in range(kernels_Num)]
    for i in range(kernels_Num):
```

```

        pGrad[i] = gradients[i][r]
    for c in range(grayImage.shape[1]):
        for i in range(kernels_Num):
            if (pAmp[c] < pGrad[i][c]):
                pAmp[c] = pGrad[i][c]
                pAng[c] = angle_list[i]

"""
显示幅值图像 代码
"""

# cv2.normalize(amplitude,amplitude,0,255,cv2.NORM_MINMAX)
# abs = cv2.convertScaleAbs(amplitude)
# cv2.imshow('amplitude',abs)
# cv2.imshow('222',img)
# cv2.waitKey(0)

"""
显示角度图像 代码
"""

# cv2.normalize(angle,angle,0,255,cv2.NORM_MINMAX)
# abs = cv2.convertScaleAbs(angle)
# cv2.imshow('angle',abs)
# cv2.imshow('222',img)
# cv2.waitKey(0)

edge = np.full(grayImage.shape,0)
edge.astype('uint8')
thres = 100 #國值 设置最小幅度值
for r in range(1, grayImage.shape[0]-1):
    pAmp1 = amplitude[r-1]
    pAmp2 = amplitude[r]
    pAmp3 = amplitude[r+1]

    pAng = angle[r]
    pEdge = edge[r]
    for c in range(1, grayImage.shape[1]-1):

        if (pAmp2[c] < thres):
            continue
        if pAng[c] == 270:
            if pAmp2[c] > pAmp1[c] and pAmp2[c] >= pAmp3[c]:
                pEdge[c] = 255
        elif pAng[c] == 90:
            if pAmp2[c] >= pAmp1[c] and pAmp2[c] > pAmp3[c]:
                pEdge[c] = 255
        elif pAng[c] == 315:
            if pAmp2[c] > pAmp1[c - 1] and pAmp2[c] >= pAmp3[c + 1]:
                pEdge[c] = 255
        elif pAng[c] == 135:
            if pAmp2[c] >= pAmp1[c - 1] and pAmp2[c] > pAmp3[c + 1]:
                pEdge[c] = 255
        elif pAng[c] == 0:
            if pAmp2[c] > pAmp2[c - 1] and pAmp2[c] >= pAmp2[c + 1]:
                pEdge[c] = 255
        elif pAng[c] == 180:
            if pAmp2[c] >= pAmp2[c - 1] and pAmp2[c] > pAmp2[c + 1]:
                pEdge[c] = 255
        elif pAng[c] == 45:
            if pAmp2[c] >= pAmp1[c + 1] and pAmp2[c] > pAmp3[c - 1]:
                pEdge[c] = 255
        elif pAng[c] == 225:
            if pAmp2[c] > pAmp1[c + 1] and pAmp2[c] >= pAmp3[c - 1]:
                pEdge[c] = 255

```

显示单像素图像

"""

```
# edge = cv2.convertScaleAbs(edge)
# cv2.imshow('edge',edge)
# cv2.imwrite('edge.png', edge)
# cv2.waitKey(0)
plt.imshow(edge)
```

"""

亚像素处理

"""

```
root2 = np.sqrt(2.0)
tri_list = [[0,0,0,0,0,0,0,0],[0,0,0,0,0,0,0,0]]
for i in range(kernels_Num):
    tri_list[0][i] = np.cos(angle_list[i] * np.pi / 180.0)
    # sin前面的负号非常关键, 因为图像的y方向和直角坐标系的y方向相反
    tri_list[1][i] = -np.sin(angle_list[i] * np.pi / 180.0)
vPts = []
for r in range(1, grayImage.shape[0]-1):
    pAmp1 = amplitude[r - 1]
    pAmp2 = amplitude[r]
    pAmp3 = amplitude[r + 1]

    pAng = angle[r]
    pEdge = edge[r]
    for c in range(1, grayImage.shape[1]-1):
        if (pEdge[c]):
            nAngTmp = 0
            dTmp = 0
            if pAng[c] == 270:
                nAngTmp = 0
                dTmp = (pAmp1[c] - pAmp3[c]) / (pAmp1[c] + pAmp3[c] - 2 * pAmp2[c])
                # print([c + dTmp * tri_list[0][nAngTmp],r + dTmp * tri_list[1][nAngTmp])
            elif pAng[c] == 90:
                nAngTmp = 4
                dTmp = -(pAmp1[c] - pAmp3[c]) / (pAmp1[c] + pAmp3[c] - 2 * pAmp2[c])
            elif pAng[c] == 315:
                nAngTmp = 1
                dTmp = (pAmp1[c - 1] - pAmp3[c + 1]) / (pAmp1[c - 1] + pAmp3[c + 1])
            elif pAng[c] == 135:
                nAngTmp = 5
                dTmp = -(pAmp1[c - 1] - pAmp3[c + 1]) / (pAmp1[c - 1] + pAmp3[c + 1])
            elif pAng[c] == 0:
                nAngTmp = 2
                dTmp = (pAmp2[c - 1] - pAmp2[c + 1]) / (pAmp2[c - 1] + pAmp2[c + 1])
            elif pAng[c] == 180:
                nAngTmp = 6
                dTmp = -(pAmp2[c - 1] - pAmp2[c + 1]) / (pAmp2[c - 1] + pAmp2[c + 1])
            elif pAng[c] == 45:
                nAngTmp = 3
                dTmp = (pAmp3[c - 1] - pAmp1[c + 1]) / (pAmp1[c + 1] + pAmp3[c - 1])
            elif pAng[c] == 225:
                nAngTmp = 7
                dTmp = -(pAmp3[c - 1] - pAmp1[c + 1]) / (pAmp1[c + 1] + pAmp3[c - 1])

            x = c + dTmp * tri_list[0][nAngTmp]
            y = r + dTmp * tri_list[1][nAngTmp]
            vPts.append([x,y])
            print(x,y)
```

"""

输出亚像素坐标

"""

```
# for x,y in vPts:
    print(x,y)
```



```
endtime = time.process_time()  
print (str(endtime - start) + 's')
```

```
234.0 27.416158536585368  
235.0 27.331029185867894  
236.0 27.21517027863777  
237.0 27.083333333333332  
238.0 27.027377521613833  
239.0 27.026086956521738  
240.0 27.003607503607505  
241.0 26.929787234042553  
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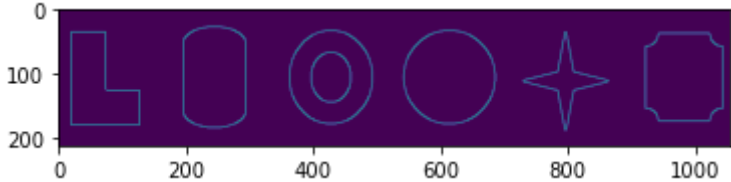
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