

机器视觉 - 第六次作业

计算下图中的圆形物体的位置、面积、近似圆的直径，可以用Opencv自己写算法实现（鼓励尝试对二值图像进行行程编码）、也可以在Halcon里实现。

步骤：

- 1.图像二值化
- 2.形态学开运算
- x.图像行程编码
- 3.连通域
- 4.特征计算选取圆
- 5.参数计算

要求：以Word或pdf的形式提交源码，结果数据及计算时间。

程序

```
for j:=0 to 4 by 1
    read_image(Image, 'img/homework'+j+'.png')
    binary_threshold (Image, Region, 'max_separability', 'light', UsedThreshold)
    closing_circle(Region, RegionClosing, 5)
    connection(RegionClosing, ConnectedRegions)
    region_features(ConnectedRegions, 'roundness', RoundValues)
    region_features(ConnectedRegions, 'area', AreaValues)
    region_features(ConnectedRegions, 'row', RowValues)
    region_features(ConnectedRegions, 'column', ColValues)
    region_features(ConnectedRegions, 'width', WValues)
    region_features(ConnectedRegions, 'height', HValues)
    region_features(ConnectedRegions, 'inner_radius', RValues)

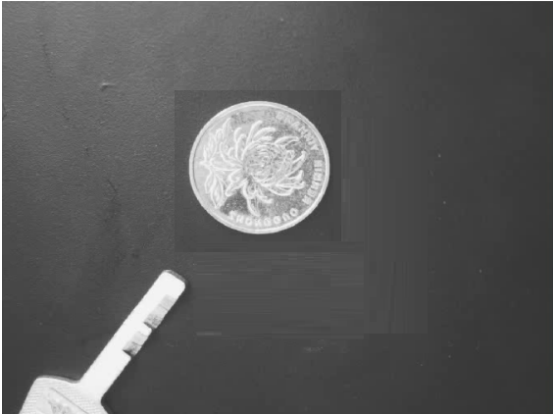
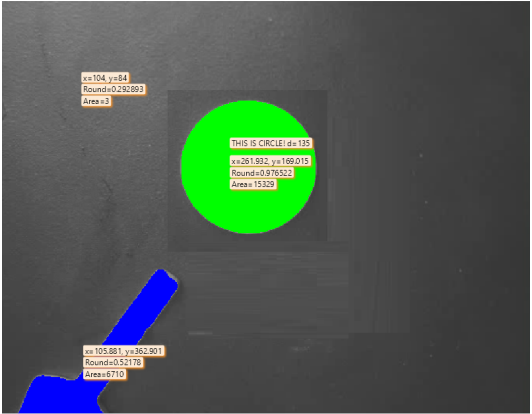
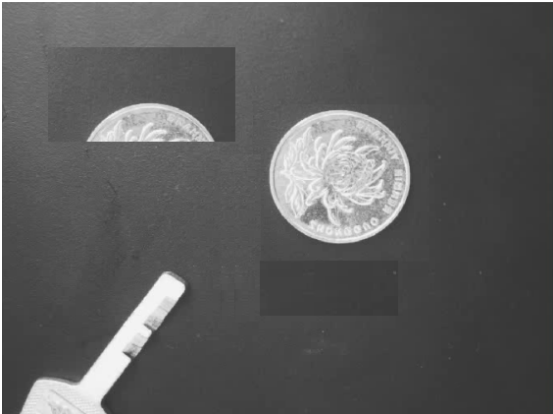
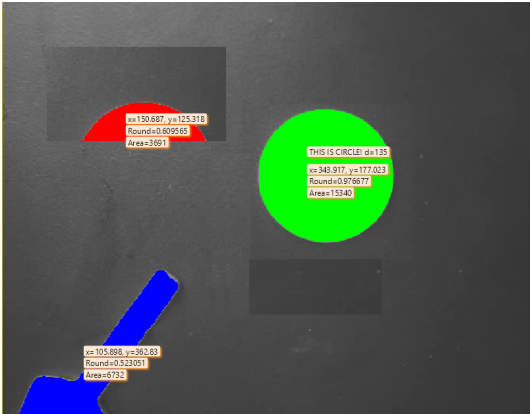

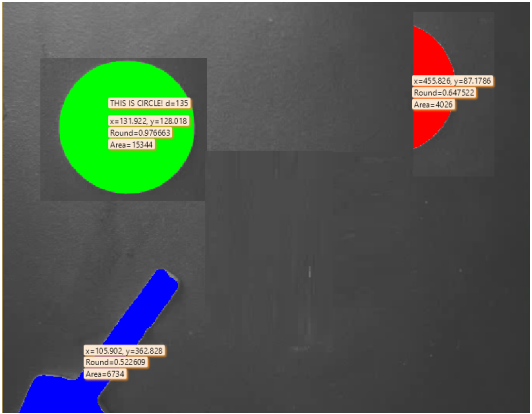
    maxid := 0
    for i:=0 to |RoundValues|-1 by 1
        x := ColValues[i] - 20
        y := RowValues[i]

        if (RoundValues[i] > RoundValues[maxid])
            maxid := i
        endif

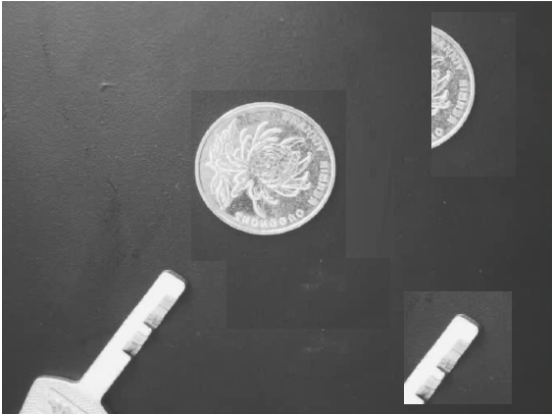
        dev_disp_text('x='+ColValues[i]+' y='+y, 'image', y-12, x, 'black', [],
[])
        dev_disp_text('Round='+RoundValues[i], 'image', y, x, 'black', [], [])
        dev_disp_text('Area='+AreaValues[i], 'image', y+12, x, 'black', [], [])
    endfor
    dev_disp_text('THIS IS CIRCLE! d='+2*RValues[maxid]), 'image',
RowValues[maxid]-30, ColValues[maxid]-20, 'black', [], [])
    stop()
endfor
```

结果及数据

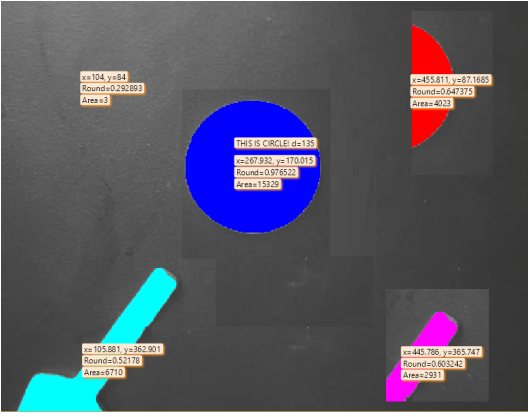
结果如图，图上标有各个连通域的位置、面积，和圆形连通域的直径。

<div>原图1</div> <div></div>	<div>结果图1</div> <div><p>Object 1 (Top Left):</p><ul style="list-style-type: none">x=104, y=84Round=0.290893Area=3<p>Object 2 (Center):</p><ul style="list-style-type: none">THIS IS CIRCLE! d=135x=291.932, y=189.015Round=0.979522Area=153.9<p>Object 3 (Bottom Left):</p><ul style="list-style-type: none">x=105.881, y=362.901Round=0.52176Area=6719</div>
<div>原图2</div> <div></div>	<div>结果图2</div> <div><p>Object 1 (Top Left):</p><ul style="list-style-type: none">x=150.687, y=125.318Round=0.809565Area=3.691<p>Object 2 (Center):</p><ul style="list-style-type: none">THIS IS CIRCLE! d=135x=343.917, y=177.023Round=0.976677Area=153.40<p>Object 3 (Bottom Left):</p><ul style="list-style-type: none">x=105.888, y=362.903Round=0.522051Area=6732</div>
<div>原图3</div> <div></div>	<div>结果图3</div> <div><p>Object 1 (Top Left):</p><ul style="list-style-type: none">THIS IS CIRCLE! d=135x=131.502, y=128.018Round=0.976661Area=153.44<p>Object 2 (Bottom Left):</p><ul style="list-style-type: none">x=105.902, y=362.438Round=0.522809Area=6724<p>Object 3 (Top Right):</p><ul style="list-style-type: none">x=455.626, y=87.1786Round=0.647522Area=40.26</div>

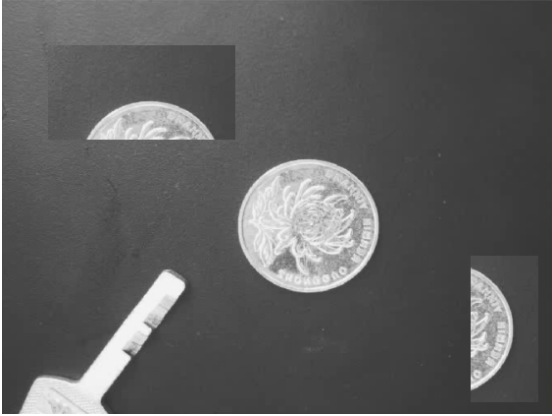
原图4



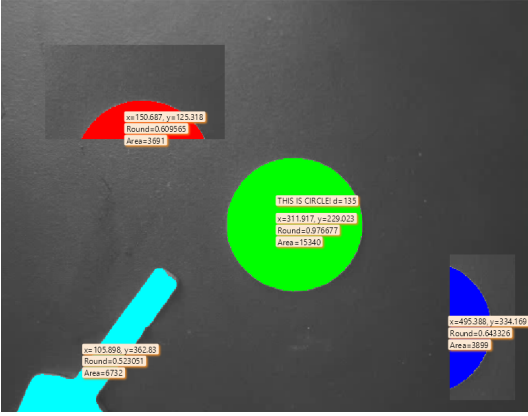
结果图4



原图5



结果图5



代码分析

分析如图，为各行代码的执行时间。

总用时

1 for j:=0 to 4 by 1	1040.107 ms
2 read_image(Image, 'img/homework'+j+'.png')	201.904 ms
3 binary_threshold(Image, Region, 'max_separability', 'light', UsedThreshold)	105.212 ms
4 closing_circle(Region, RegionClosing, 5)	119.313 ms
5 connection(RegionClosing, ConnectedRegions)	122.478 ms
6 region_features(ConnectedRegions, 'roundness', RoundValues)	79.321 ms
7 region_features(ConnectedRegions, 'area', AreaValues)	124.875 ms
8 region_features(ConnectedRegions, 'row', RowValues)	100.983 ms
9 region_features(ConnectedRegions, 'column', ColValues)	77.869 ms
10 region_features(ConnectedRegions, 'width', WValues)	89.181 ms
11 region_features(ConnectedRegions, 'height', HValues)	74.836 ms
12 region_features(ConnectedRegions, 'inner_radius', RValues)	63.290 ms
13	
14 maxid := 0	71.640 ms
15 for i:=0 to RoundValues -1 by 1	239.317 ms
16 x := ColValues[i] - 20	118.068 ms
17 y := RowValues[i]	165.319 ms
18	
19 if (RoundValues[i] > RoundValues[maxid])	0.047 ms
20 maxid := i	68.860 ms
21 endif	0.014 ms
22	
23 dev_disp_text('x='+ColValues[i]+' y='+y, 'image', y-12, x, 'black', [], [])	187.919 ms
24 dev_disp_text('Round='+RoundValues[i], 'image', y, x, 'black', [], [])	62.917 ms
25 dev_disp_text('Area='+AreaValues[i], 'image', y+12, x, 'black', [], [])	176.308 ms
26 endfor	
27 dev_disp_text('THIS IS CIRCLE! d='+2*RValues[maxid], 'image', RowValues[maxid]-30,	98.621 ms
28 stop()	0.018 ms
29 endfor	

平均用时

1 for j:=0 to 4 by 1	171.351 ms
2 read_image(Image, 'img/homework'+j+'.png')	40.381 ms
3 binary_threshold(Image, Region, 'max_separability', 'light', UsedThreshold)	33.042 ms
4 closing_circle(Region, RegionClosing, 5)	23.881 ms
5 connection(RegionClosing, ConnectedRegions)	24.486 ms
6 region_features(ConnectedRegions, 'roundness', RoundValues)	15.864 ms
7 region_features(ConnectedRegions, 'area', AreaValues)	24.815 ms
8 region_features(ConnectedRegions, 'row', RowValues)	20.197 ms
9 region_features(ConnectedRegions, 'column', ColValues)	15.574 ms
10 region_features(ConnectedRegions, 'width', WValues)	17.836 ms
11 region_features(ConnectedRegions, 'height', HValues)	14.567 ms
12 region_features(ConnectedRegions, 'inner_radius', RValues)	12.658 ms
13	
14 maxid := 0	14.330 ms
15 for i:=0 to RoundValues -1 by 1	10.405 ms
16 x := ColValues[i] - 20	6.609 ms
17 y := RowValues[i]	9.184 ms
18	
19 if (RoundValues[i] > RoundValues[maxid])	0.003 ms
20 maxid := i	13.772 ms
21 endif	0.003 ms
22	
23 dev_disp_text('x='+ColValues[i]+' y='+y, 'image', y-12, x, 'black', [], [])	10.440 ms
24 dev_disp_text('Round='+RoundValues[i], 'image', y, x, 'black', [], [])	3.495 ms
25 dev_disp_text('Area='+AreaValues[i], 'image', y+12, x, 'black', [], [])	9.795 ms
26 endfor	
27 dev_disp_text('THIS IS CIRCLE! d='+2*RValues[maxid], 'image', RowValues[maxid]-30,	18.124 ms
28 stop()	0.004 ms
29 endfor	