LAB 9 – CBIR

Shape Based Features

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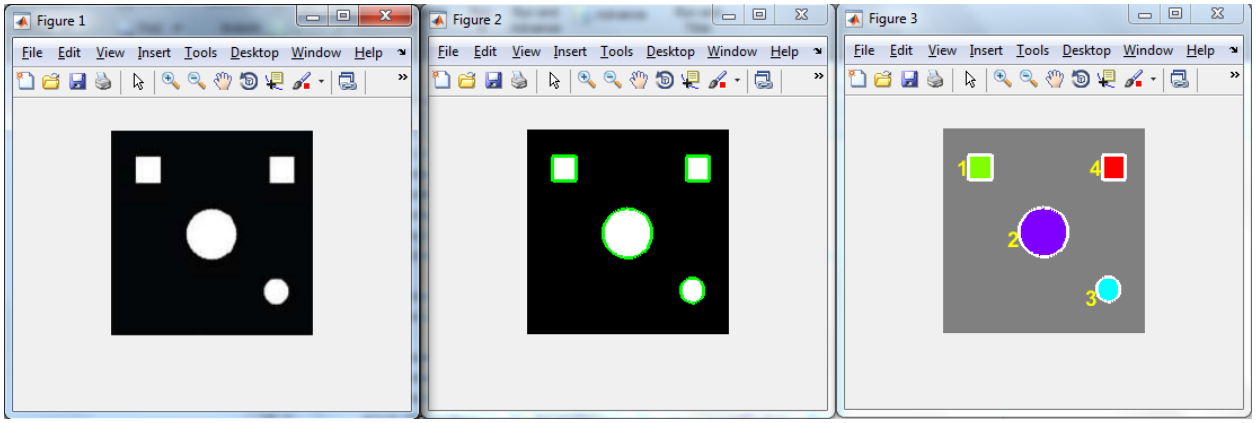
Code:

```
J = imread('TPTest3.png');
imshow(J);
J = im2bw(J,graythresh(J));

[B,L] = bwboundaries(J);
figure; imshow(J); hold on;
for k=1:length(B),
    boundary = B{k};
    plot(boundary(:,2),boundary(:,1),'g','LineWidth',2);
end
[L, N] = bwlabel(J);
RGB = label2rgb(L,'hsv',[.5 .5 .5], 'shuffle');

figure; imshow(RGB); hold on;
for k=1:length(B),
    boundary = B{k};
    plot(boundary(:,2),boundary(:,1),'w','LineWidth',2);
    text(boundary(1,2)-
11,boundary(1,1)+11,num2str(k),'Color','y','FontSize',14,'FontWeight','bol
d');
end

stats = regionprops(J,'all');
temp = zeros(1,N);
for k=1:N
    %Thinness Ratio
    temp(k) = 4*pi*stats(k,1).Area / (stats(k,1).Perimeter)^2;
    stats(k,1).ThinnessRatio = temp(k);

    %Aspect Ratio
    temp(k) = (stats(k,1).BoundingBox(3))/(stats(k,1).BoundingBox(4));
    stats(k,1).AspectRatio = temp(k);
end

imagefiles = dir('*.jpg');
nfiles = length(imagefiles);

areas = zeros(1,N);
for k=1:N
    areas(k) = stats(k).Area;
end
```

```
TR = zeros(1,N);
for k=1:N
    TR(k) = stats(k).ThinnessRatio;
end

figure(); hold on;
cmap = colormap(lines(16));
for k=1:N
    scatter(areas(k), TR(k), [], cmap(k,:), 'filled'), ylabel('Thinness
Ratio'), xlabel('Area');
    hold on;
end

name = cell(1,N);
for k=1:N
    if (TR(k) >0.9)
        name{1,k} = 'circle';
    else if (TR(k) >0.8)
            name{1,k} = 'square';
        else
            name{1,k} = 'other';
        end
    end
end
```

IMAGE 1 OUTPUT:



Object	Area	Centroid	Orientation	Euler Number	Eccentricity	Aspect Ratio	Perimeter	Thinness Ratio
Top Left Square	509	33.5, 35	90	1	0.29166	0.9565	83.916	0.9036
Big circle	1549	89.645, 92.208	72.066	1	0.070713	0.9778	137.46	0.9030
Small Circle	387	147.06, 142.8	88.543	1	0.035643	0.9130	66.939	1.0302
Top Right Square	483	152,35	90	1	0.40786	0.9130	81.956	1.0853

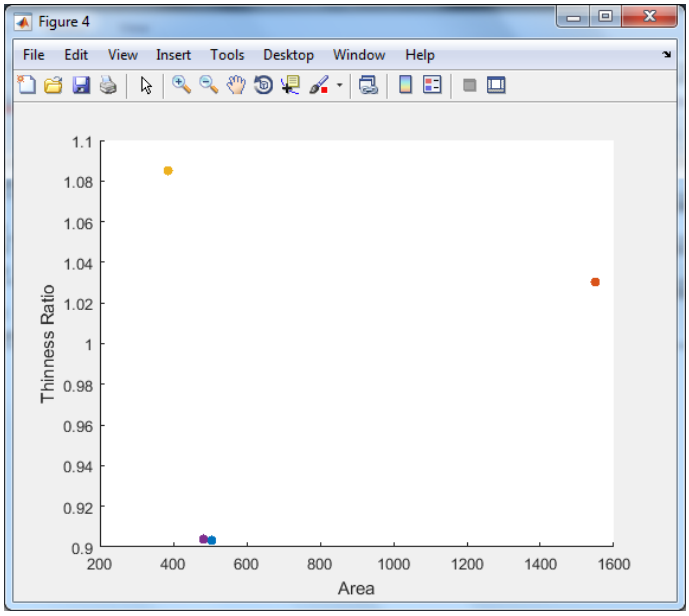
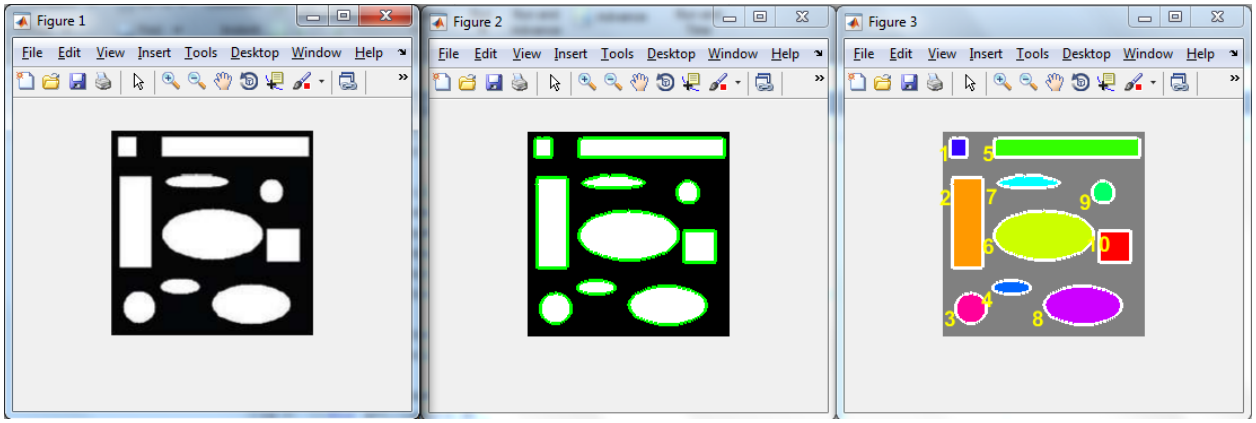


IMAGE 2 OUTPUT:



Object	Area	Centroid	Orientation	Euler Number	Eccentricity	Aspect Ratio	Perimeter	Thinness Ratio
1	284	14.525, 14,62	87.691	1	0.44751	0.8889	61.645	0.9391
2	2267	22.482, 80.985	-89.974	1	0.93831	0.358	208.74	0.6538
3	617	25.446, 156.69	15.501	1	0.20479	1	85.299	1.0656
4	364	61.5, 138.11	0	1	0.92296	2.6154	76.044	0.791
5	2334	110.55, 14.522	0.01869	1	0.99036	7.2222	284.32	0.3628
6	3111	90.221, 92.176	0.028166	1	0.86667	1.9778	213.95	0.8541
7	526	76.549, 44.996	0.044423	1	0.97485	4.6667	115.67	0.4949
8	1906	124.72, 154.01	-0.12915	1	0.86286	2	166.34	0.8657
9	331	142.56, 53.961	-67.974	1	0.1089	1	61.679	1.0934
10	841	153, 102	0	1	0	1	109.4	0.8831

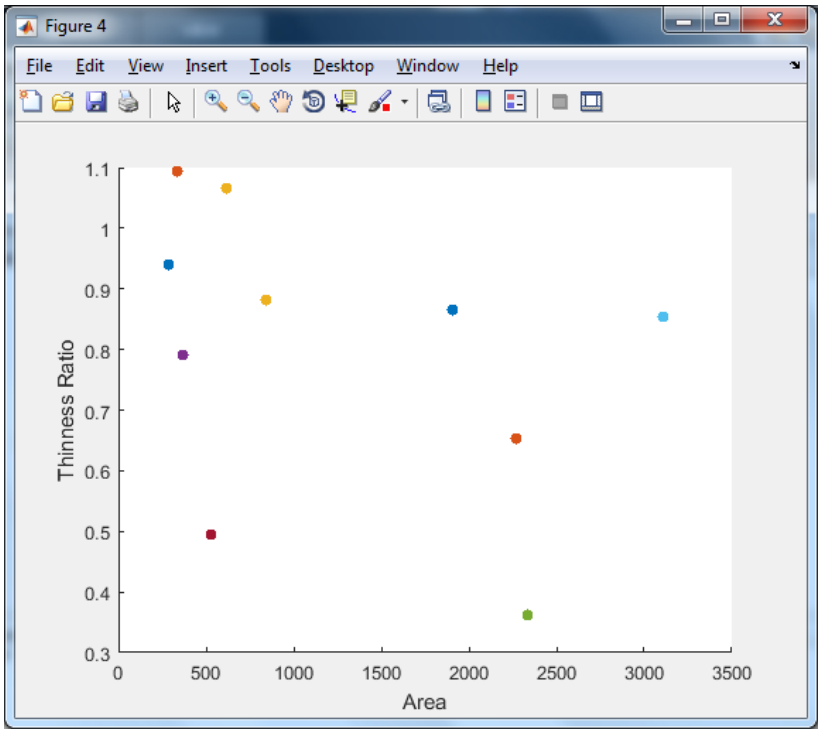
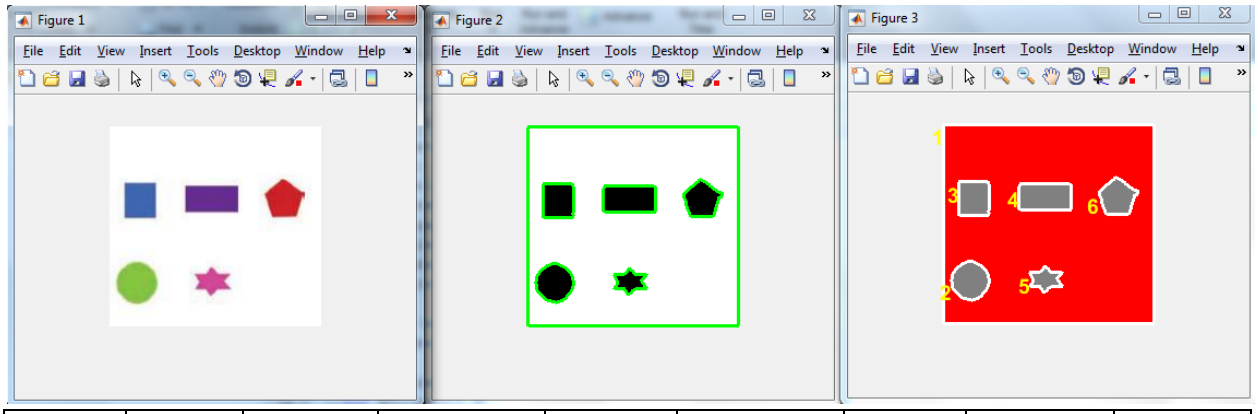


IMAGE 3 OUTPUT:



Object	Area	Centroid	Orientation	Euler Number	Eccentricity	Aspect Ratio	Perimeter	Thinness Ratio
Top Left Square	31033	100.21, 91.986	-28.741	-4	0.28933	1.0601	734.64	0.7226

Questions for Image 1

1. What is the value of N returned by bwlabel? Does it make sense to you?
   Answer: 4. Yes, it is the count of shapes/ regions in the image.

2. Do the results obtained for the extracted features correspond to your expectations? Explain.
   Answer: Yes, these results corresponds my expectations as they give the details about the shape based features of the regions.

3. Which of the extracted features have the best discriminative power to help tell squares from circles? Explain.
   Answer: Thinness Ratio. As it shows the irregularity of the region. Hence it's value is 1 for a perfect circle which is a regular shape.

4. Which of the extracted features have the worst discriminative power to help tell squares from circles? Explain.
   Answer: Area. As this is completely shape invariant.

5. Which of the extracted features are ST invariant, that is, robust to changes in size and translation? Explain.
   Answer: Aspect Ratio. This ratio would not depend on the size of the object.

6. If you had to use only one feature to distinguish squares from circles, in a ST-invariant way, which feature would you use? Why?
   Answer: Eccentricity. It is 0 for perfect circle and close to 1 for square.