EE4704 Image Processing and Analysis, CA2

AY23/24 Sem 1

This assignment is to be done with Matlab. Students are required to submit a zip file containing a report and Matlab code.

Part A. Edge and Lines (35 marks)

Given the image **letter.bmp**, please complete the following tasks.

1. Compute the edges in this image. **You may call any off-the-shelf Matlab functions to compute the edge**. [2 Marks]
2. Use Hough Transform to detect straight lines in the image. Please
    - Use slope-intercept representation and implement Hough transform [10 Marks]
    - Use normal representation and implement Hough transform [10 Marks]

    You need to decide the sizes of the bins in your accumulator arrays for both representations. Please note, you have to implement this part yourself. **You cannot call off-the-shelf matlab functions to conduct Hough Transform**. However, you may reuse part of the code shared in the lecture.

3. You may choose either result (slope-intercept or normal representation) obtained from 2. Please complete the following tasks.
    - Plot the straight lines on letter.bmp, and save the new image, with the name letter_line.bmp. [3 Marks]
    - Plot the line segments on letter.bmp, which aligns with the boundary of the object in the image. The line segment should show up only at the object boundary and disappear at the background. Example output is shown below. [10 Marks]

    

4. For this part, there is no need to write your code as functions. You may simply put all your code under run_PartA.m. Please follow the template below.

run_PartA.m

```
%%%%% Part A %%%%%
I = imread('./letter.bmp');
% Continue your code here.
```

Part B. Segment Boundaries (30 marks)

Given the boundary image **K.bmp**, please complete the following tasks.

1. Calculate the $r - \theta$ values and plot the graph. [rtheta.m]. Please follow the template below. [15 Marks]

rtheta.m

```
% To compute the r-theta plot;
% input is a boundary image 'K.bmp'
% output is the array containing the r-theta value
function [r, theta] = rtheta(Iin)
%
% put your code here
%
end
```

2. Calculate the chain code with starting point normalization for the object (i.e., the leaf) in the image. [ChainCode.m]. Please follow the template below. [15 Marks]

ChainCode.m

```
function [my_code] = ChainCode(Iin)
%
% put your code here
%
end
```

Part C. Segmentation Features (35 marks)

Given the input image **I.bmp**, please complete the following tasks.

1. Implement the intermeans algorithm to calculate the threshold T and use it to threshold the input image. The output image is $I1$. [intermeans.m]. [15 Marks]

intermeans.m

```
% To calculate the intermeans threshold;
function [T,Iout] = intermeans(Iin)
%
% put your code here
%
end
```

2. Use image $I1$ as input. Calculate these features:
    1. perimeter,
    2. area,
    3. compactness,
    4. centroid,
    5. invariant moment ϕ_1. [features.m]. [4 * 5 = 20 Marks]

Note that:

(a) You can check your implementation intermeans.m by testing it on image "letter.bmp". The calculated threshold value should be 87.
(b) Perimeter and area – calculate using the method given in the notes or employ some other method that gives more accurate results.
(c) Centroid – calculate from the moment values.

features.m

```
% To compute the features;
function [Per1, Area1, Com1, Cen1, InvMoment1] = features(Iin)
%
% put your code here
%
end
```

Report

1. Your report should focus on the results, observations, explanations and discussion. Relevant images should be included.
2. If you use any algorithms that are not from the lecture, you should explain how they work.
3. The softcopy of the report (pdf file) and the Matlab m-files are to be zipped and submitted to the "CA2-submission" folder on the EE4704 module Canvas website.
4. The file is to be named as follows:
   matric number_full name.zip (e.g., A010134J_Tan_Shu_King.zip).
5. ***The results and report must entirely be your own work. Plagiarism is a serious offence.***