Assessment Item Briefing Document

Title: CMP9135M Computer Vision Assignment

Indicative Weighting: 100%

Learning Outcomes:

On successful completion of this assessment item a student will have demonstrated competence in the following areas:

• [LO1] Critically evaluate and apply the theories, algorithms, techniques and methodologies involved in computer vision.

• [LO2] Design and implement solutions to a range of computer vision applications and problems, and evaluate their effectiveness.

Requirements:

This assessment comprises three assessed tasks, as detailed in the following page.

1. Food package tray and label image segmentation. Weight: 40% of this component
2. Feature calculation. Weight: 30% of this component
3. Object tracking. Weight: 30% of this component

Deliverable:

Your submission should include a zip file with all the source code and a concise report that describes your work on the above tasks. Please note that, in the report, you also need to include the main source code in the appendix.

Useful Information

This assessment is an individual piece of work. Your work must be presented according to the Lincoln School of Computer Science guidelines for the presentation of assessed written work.

Please make sure you have a clear understanding of the grading principles for this component as detailed in the accompanying Criterion Reference Grid.

If you are unsure about any aspect of this assessment component, please seek the advice of a member of the delivery team.

Note: The maximum page limit of the report for this assessment is 6 pages (excluding the appendix).
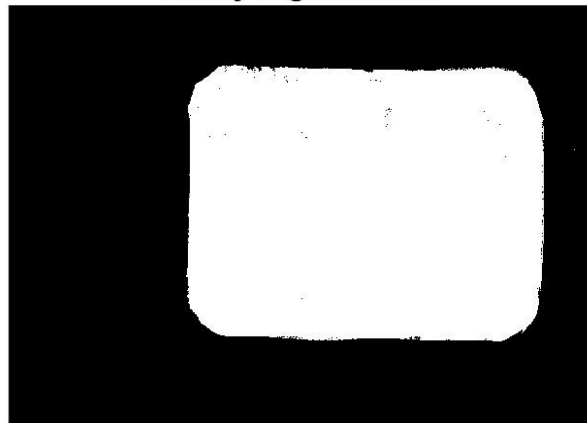
Task 1: Image Segmentation

Download two food packaging images (Topimage0000.bmp and Topimage0013.bmp) from Blackboard. This task is to, for each packaging image, use image processing techniques to segment: 1) tray object (Fig. 1(c)) and 2) label object (Fig. 1(d)). Please note that you are encouraged to develop one method with similar parameter settings for both images.

(a)   (b)

(c)   (d)

Fig.1 Food package segmentation

For each food packaging image, the output should include: binary tray mask shown in (b), segmented tray shown in (c) and segmented label shown in (d). Please also write code to create one

figure containing original image, and all the three outputs. You are also required to put the final output images in your report and briefly describe the implementation steps.

Task 2: Feature Calculation

Download the Image (ImgPIA.jpeg) from Blackboard. This part of the assignment will deal with the area of Feature Extraction, in both the Frequency and Spatial domains.

Task 1: Read the image (ImgPIA.jpeg), and select the features for both radius and direction as described in the Spectral Approach session of the Feature Extraction lecture. For additional marks you can change the values of radius and angle, and present those values in a plot or table.

Task 2: Read the image (ImgPIA.jpeg), and select features from the image histogram (i.e. 1st order), and at least six (6) features from the co-occurance matrix (the original paper by Haralick has also made available to you). Please note that the co-occurance based features can be directional and as a function of distance between pixel co-ordinates. For additional marks you can change the bit-depth of the image (i.e. 8, 6, 4 bit), and recalculate the features presenting them as a plot or table.

For both tasks analysis and discussion of your findings is expected.

Task 3: Object Tracking

Download from Blackboard the data files 'x.csv' and 'y.csv', which contain the real coordinates [x,y] of a moving target, and the files 'a.csv' and 'b.csv', which contain their noisy version [a,b] provided by a generic video detector (e.g. frame-to-frame image segmentation of the target).

Implement a Kalman filter with a software application that accepts as input the noisy coordinates [a,b] and produces as output the estimated coordinates [x*,y*]. For this, you should use a Constant Velocity motion model F with constant time intervals $\Delta t = 0.1$ and a Cartesian observation model H. The covariance matrices Q and R of the respective noises are the following:

$$Q = \begin{bmatrix} 0.1 & 0 & 0 & 0 \\ 0 & 0.2 & 0 & 0 \\ 0 & 0 & 0.1 & 0 \\ 0 & 0 & 0 & 0.2 \end{bmatrix} \qquad R = \begin{bmatrix} 0.3 & 0 \\ 0 & 0.3 \end{bmatrix}$$

1) You should plot the estimated trajectory of coordinates [x*,y*], together with the real [x,y] and the noisy ones [a,b] for comparison.

2) You should also assess the quality of the tracking by calculating the mean and standard deviation of the absolute error and the Root Mean Squared error (estimated vs. noisy coordinates).