



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020**

COURSE NAME : VISION SYSTEM
COURSE CODE : BEH 41902
PROGRAMME CODE : BEJ
EXAMINATION DATE : JULY 2020
DURATION : 2 HOUR AND 30 MINUTES
INSTRUCTION : ANSWERS ALL QUESTIONS.
OPEN BOOK EXAMINATION

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 You have been given a task to pre-processing and to segment out object of interest from image A and image B as shown in **Figure Q1**. For segmentation, the global method shall be executed using OTSU between class variance while the local method using *mean-C* with 3×3 kernel and $C = 150$.

(a) Your first task is to segment out foreground using optimal threshold value.

(i) By supporting with tangible fact, investigate the suitable segmentation method for separating foreground from background of image A and image B respectively.

(6 marks)

(ii) Analyse the optimal threshold value of image A .

(21 marks)

(iii) From the threshold value obtained in Q1 (ii), construct an edge map of image A by using Sobel operator given by:

$$dx = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}, \quad dy = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$$

(8 marks)

(b) Your second task is to improve image quality prior to segmentation.

(i) Examine image A and image B quality in term of illumination condition and contrast.

(6 marks)

(ii) Image B will be undergoing series of consecutive pre-processing steps as follow:

- 1st: Global illumination correction by gamma with $\gamma = 0.3$
- 2nd: Contrast correction using histogram equalization

Compare the differences between processed image and the original image in term of illumination condition and its contrast for every stage of step.

(16 marks)

(iii) If threshold value of the improved image quality is set to 190, determine foreground object's perimeter and area.

(3 marks)

- Q2** By referring to Convolutional Neural Network (CNN) code in **Figure Q2**:
- (a) Illustrate the model structure with details of layer labelling (3 marks)
- (b) Analyze image output shape and its total trainable parameters for each stack of the CNN layer. (17 marks)
- Q3** An engineer has been given a task to develop a system to automatically differentiate shape of objects by using Moment Invariant (MI) and sample of image is as depicted in **Figure Q3**. Calculate m_{00} , m_{01} , m_{10} , x , y , μ_{00} , $\bar{\mu}_{02}$, μ_{20} , and μ_{11} . (14 marks)
- Q4** You have been given a stereo vision system with two cameras aligned as shown in **Figure Q4**. Determine the equation for relating the real 3D coordinate with the pixel locations in the left and right camera images. Eventually, determine the relation between Z_w and the disparity. (6 marks)

- END OF QUESTION -

FINAL EXAMINATION

SEMESTER/SESSION : SEM II/2019/2020
 COURSE NAME : VISION SYSTEM

PROGRAMME CODE : BEJ
 COURSE CODE : BEH 41902

120	120	120	120	120	120	120	120
140	140	130	180	180	180	130	130
140	140	130	180	180	180	130	130
140	170	170	180	180	180	130	130
50	150	170	170	170	180	130	130

Image A

120	120	120	120	120	120	120	120
140	140	130	180	180	180	130	130
140	140	130	180	180	180	130	130
140	170	170	180	180	180	130	130
150	150	170	170	170	180	130	130

Image B

Figure Q1

```

cnn_model = models.Sequential()
cnn_model.add(layers.Conv2D(32, (3, 3), activation='relu', input_shape=(150, 150, 3)))
cnn_model.add(layers.MaxPooling2D((2, 2)))
cnn_model.add(layers.Conv2D(64, (3, 3), activation='relu'))
cnn_model.add(layers.MaxPooling2D((2, 2)))
cnn_model.add(layers.Conv2D(128, (3, 3), activation='relu'))
cnn_model.add(layers.MaxPooling2D((2, 2)))
cnn_model.add(layers.Conv2D(128, (3, 3), activation='relu'))
cnn_model.add(layers.MaxPooling2D((2, 2)))
cnn_model.add(layers.Flatten())
cnn_model.add(layers.Dense(512, activation='relu'))
cnn_model.add(layers.Dense(1, activation='sigmoid'))
    
```

Figure Q2

FINAL EXAMINATION

SEMESTER/SESSION : SEM II/2019/2020
 COURSE NAME : VISION SYSTEM

PROGRAMME CODE : BEJ
 COURSE CODE : BEH 41902

9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
5	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
3	0	0	0	0	0	0	0	0	1	1	1	0	0	0	
2	0	0	0	0	0	0	0	0	1	1	1	0	0	0	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

Figure Q3

FINAL EXAMINATION

SEMESTER/SESSION : SEM II/2019/2020
COURSE NAME : VISION SYSTEM

PROGRAMME CODE : BEJ
COURSE CODE : BEH 41902

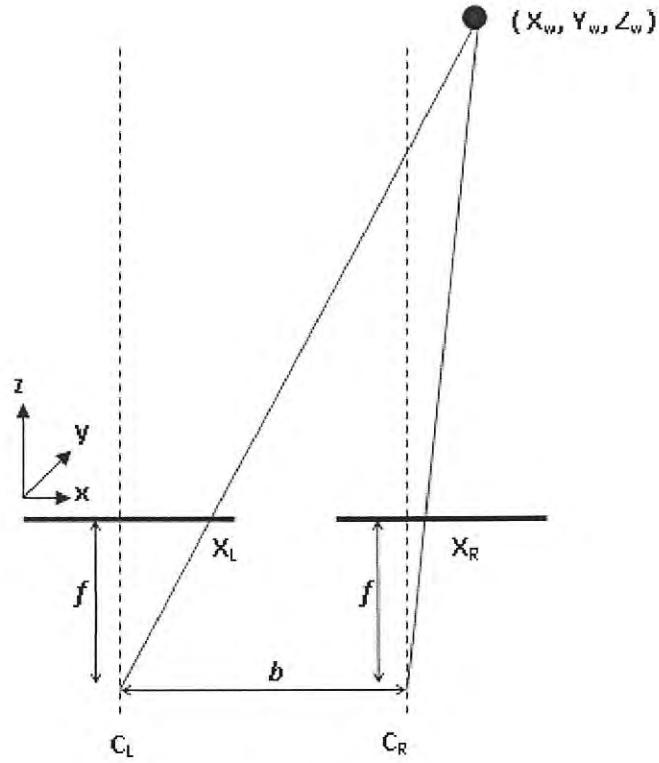


Figure Q4