THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
LEVEL 5
FINAL EXAMINATION 2008/2009
MEX5271 – MACHINE VISION
DATE : 18th MARCH 2009
TIME : 0930HRS TO 1230HRS
DURATION : THREE HOURS [3 hrs]

READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE ANSWERING THE QUESTION PAPER

- This question paper has eight questions.
- Answer five questions only.

Question 01:

Vision systems play a significant role in industry automation.

a. Explain the advantages of adopting vision based systems to industrial applications.

b. "Adoption of factory automation techniques must be done in careful manner". Comment on this statement.

c. Briefly explain architecture of a machine vision system integrated in to a product assembly line of a manufacturing environment.

d. Briefly explain the situations where

   i. Human vision

   ii. Machine vision

   provides more accurate and reliable results.

(20 marks)

Question 02:

Presence of noise in digital images is one of the major barriers which make image analysis process difficult.

a. Give three reasons for presence of noise in digital images.

b. Name three mechanisms which can be used to remove noise.

c. Compare and contrast the methods mentioned in ***question 2 part b.***

d. Name a suitable noise reduction technique which can be used in real time image processing. Justify your answer.

e. Write an outline of an algorithm to remove noise in digital images.

(20 marks)

Question 03:

You are assigned to develop vision based inspection system to use for quality process of a Bolts and Nuts manufacturing company. The system should be able to identify the Nuts are according to the standard size or not based on images taken by a Digital Camera. Picture of a NUT given below.

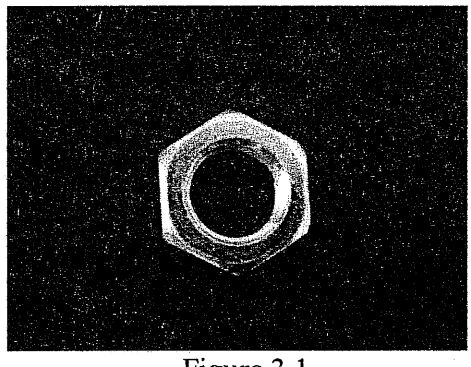


Figure 3.1

a. State what are possible separate modules that you can identify in this system?

b. Explain the functionality of each module briefly.

c. Explain how this system can be effect the productivity of the company.

d. Following image is taken with a black background. Discuss the suitability of this background during the image processing methods you are expecting to use in the system. If possible suggest a different colour for the background and justify your answer.

(20 marks)

Question 04:

Edge detection is a fundamental tool used in most image processing applications to obtain information from the frames as a precursor step to feature extraction and object segmentation.

a. Briefly explain the importance of edge detections in image processing context.

b. Define an edge (with respect to digital images).

c. Name three techniques which can be used for edge detection and explain two of them.

d. Compare and contrast the Canny's operator (Canny's edge detector) with other edge detection methods?

e. Explain the main components of Canny's operator.

(20 marks)

Question 05:

In image processing context, the histogram of an image refers to a histogram of the pixel's intensity values. This histogram is a graph showing the number of pixels in an image at each different intensity value found in that image.

a. Explain usefulness of intensity histograms in image processing context.

b. Draw sample histograms for following cases. When a source image is a,

   i. Dark image

   ii. Low contrast image

   iii. High contrast image

   iv. High intensity image

c. Explain two histogram based techniques which can be used to enhance captured images during the pre-processing phase.

d. Suppose that you had a scene of three objects of different distinct intensities against an extremely bright background. What would the corresponding histogram look like?

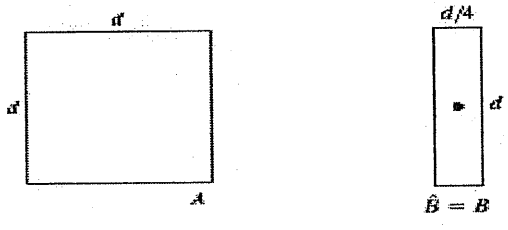
(20 marks)

Question 06:

Most morphological operations are based on simple expanding and shrinking operations. The primary application of morphology occurs in binary images, though it is also used on grey level images. The two basic morphological set transformations are erosion and dilation.

a. Define dilation. State all assumptions clearly.

b. Show the result after dilation of object A by structural element B.



c. Define "Opening" and "Closing". State all assumptions clearly

d. Briefly explain the practical usage of "Opening" and "Closing".

e. Give a brief account on "Hit or Miss Transformation".

(20 marks)

Question 07:

a. Sketch the dilation of a circle of radius r by a circular structuring element of a radius r/4

b. Use above structuring element to dilate a squire of size r x r.

c. User the same structuring element to dilate an equilateral triangle with side of size r.

d. Repeat (a) to (c) for erosion.

(20 marks)

Question 08:

a. Consider a noiseless image of size NxN whose first $N/2$ columns have gray level L_A and its remaining columns have gray level L_B, where $L_B > L_A$. The histogram of this image has only two peaks, of identical height, one located at L_A and the other at L_B. that can be accomplished by a single global threshold located between L_A and L_B. Suppose however, that you multiply the image by a gray scale wedge that varies from a 0 on the left to K on the right, with $K>L_B$. what would the histogram of this new image look like? Label the various part of this histogram clearly.

b. An image is composed of small non-overlapping blobs of mean gray level $m_1=150$ and variance $\sigma_1^2 = 400$ scattered on background of mean $m=25$ and variance $\sigma_2^2 = 625$, All the blobs occupy approximately 20 percent of the image area. Propose a technique based on thresholding. For segmenting the blobs out of the image.

(20 marks)

-End-