SCSV3213

FUNDAMENTAL OF IMAGE PROCESSING

SEM1- 20202021

Your Lecturer

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  - PhD and Master by Research (Speech Processing)
    - Universiti Teknologi Malaysia
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INTRODUCTION TO THE COURSE

WHAT ARE GOING TO BE TAUGHT

(You can upload the LI at the e-learning page)

SYNOPSIS FROM L1

This course is designed to expose to students about techniques of digital image processing. It includes how digital images; starting from reading the image file and then convert the image format to another type are processed. The images will be manipulated and further enhanced to improve the quality. Different types of manipulation and enhancement techniques will be covered. At the end of the course, students are expected to implement concepts of image processing, generate and manipulate images.

CQI : Why omit the conversion type

- With today technology, types of images are easily read and converted onto other types through usage of tools.
- However, the images format is going to be taught so that student understand the pixel representation of the image prior learning the enhancement and processing of the image.
- The saved time will be used to focus on tutorial on programming languages used in the class.

Objective as in L1

1. Describe and explain fundamental knowledge and understanding of digital image construction by digital computer.
2. Investigate and demonstrate the manipulation of digital image in various image processing operations and construct programs that read and save various digital image data file
3. Analyze the components of a digital image processing system to construct and present medium scale to complex image processing application using the techniques and algorithms learned.

Weekly Schedule

See L1

Week1 : Introduction to IP

1.1 What is digital image Processing?

1.2 Application areas of Image Processing

1.3 Fundamental steps in Digital Image Processing

1.4 Components of an Image Processing System

Week 2: Image Sensing, Acquisition, Sampling and Quantization

2.1 Introduction to image sensing devices, how it works.
2.2 Image acquisition process
2.3 Image sampling and quantization
    2.3.1 Basic concept in Sampling and Quantization
    2.3.2 Representing digital image
    2.3.3 Spatial and intensity resolution
2.4 An introduction to the mathematical Tools used in Digital Image Processing
    2.4.1 Arithmetic operations
    2.4.2 Vector and Matrix operations
    2.4.3 Image transformation

Week 3: Programming with Image

3.1 Matlab Tutorial
3.2 OpenCV Tutorial

Week 4- 6 : Image Enhancement in Spatial Domain

4.1 Introduction to Image Enhancement
4.2 Point Processing
4.3 Histogram Processing
- 4.3.1 Histogram stretching
- 4.3.2 Histogram sliding
- 4.3.3 Histogram shrinking
- 4.3.4 Histogram equalization

4.4 Fundamental of spatial filtering
- 4.4.1 Spatial correlation and convolution
- 4.4.2 Linear filtering
- 4.4.3 Generating spatial filter mask

4.5 Smoothing Spatial Filter
- 4.5.1 Smoothing linear filter
- 4.5.2 Order-statistic(nonlinear) filters

4.6 Sharpening Spatial Filters
- 4.6.1 The laplacian filter
- 4.6.2 Unsharp masking and highboost filtering

Week 7: Image Enhancement in Frequency Domain

5.1 Introduction to Fourier Series
5.2 Some properties of the 2-D Discrete Fourier Transformation
- 5.2.1 Translation and rotation
- 5.2.2 Symmetry properties
- 5.2.3 Fourier spectrum and phase angle

5.3 The 2-D convolution theorem

Week 8-9: Segmentation

6.1 Fundamentals
6.2 Point, Line, and edge detection
- 6.2.1 Background
- 6.2.2 Detection of isolated point
- 6.2.3 Line detection
- 6.2.4 Edge models
- 6.2.5 edge detection

6.3 Thresholding
- 6.3.1 Foundation
- 6.3.2 Basic global thresholding
- 6.3.3 Multiple thresholding

6.4 Region-based segmentation
- 6.4.1 Region growing
- 6.4.2 Region splitting and merging

Week 10-11: Morphological Image Processing

7.1 Preliminaries
7.2 Erosion and Dilation
- 7.2.1 Applications of erosion and dilation

7.3 Opening and Closing
- 7.3.1 Applications of closing and opening

7.4 Some basic morphological algorithms
- 7.4.1 Boundary extraction
- 7.4.2 Hole filling
- 7.4.3 Thinning
- 7.4.4 Skeletonization
- 7.4.5 Pruning

Week 12-13: Image Representation and Description

8.1 Representation
- 8.1.1 Boundary(border) following
- 8.1.2 Chain codes
- 8.1.3 Signatures
- 8.1.4 Boundary segments
- 8.1.5 Skeleton

8.2 Boundary Descriptors
- 8.2.1 Some simple descriptors
- 8.2.2 Fourier descriptors
- 8.2.3 Statistical moments

8.3 Regional Descriptors
- 8.3.1 Some simple descriptors
- 8.3.2 Texture
- 8.3.3 Moment invariants

8.4 Use of Principal Component for Description

Week 14

Project Presentation

References

- Books
  - Gonzalez R.C. and Woods R.E., Digital Image Processing, 3rd Edition 2008.Pearson Addison-Wesley.
  - Pratt W.K., Digital Image Processing. John Wiley & Sons,1991
  - Jain A.K., Fundamentals of Digital Image Processing. Prentice Hall, 1988
  - Russ J.C., The Image Processing Handbook. Springer-Verlag Berlin and Heidelberg, 1998
  - Any books on Image Processing (there are a lots out there)
- Journals
  - IEEE Transactions on Pattern Analysis and Machine Intelligence
  - Computer Vision, Graphics and Image Processing
  - IEEE Transactions on Image Processing
  - Journal of Visual Communication and Image Representation

Grading as in LI

No.	Assessment	Number	% each	% Total
1	Assignment	3	4	12
2	Quiz	3	4	12
3	Project	1	15	15
4	Presentation	1	6	6
5	Test 1	1	20	20
6	Final Exam	1	35	35
	TOTAL			100

Adapted Grading

No.	Assessment	Number	% each	% Total
1	Assignment	3	5	15
2	Quiz	3	5	15
3	Project	1	15	15
4	Presentation	1	6	6
5	Test 1	0	0	0
	Tutorial	4	3.5	14
6	Final Exam	1	35	35
	TOTAL			100

Assignment (Group of 3)

1. Report on Application of IP in Industry
2. Image Enhancement (to be revised)
3. Image Manipulation (to be revised)

Project (Group)

- You will be given some tasks on image processing applications / problems. You need to develop a solution using image processing methods you have learned in class.
- Write a report and present the solution.

LAB

- Lab will conducted using Matlab.
- Project task is suggested to use Matlab or OpenCV tools.
- Matlab and OpenCV tutorial will be taught in class.

End Introduction to the
Fundamental of Image Processing
SCSV 3213 Course