DIGITAL IMAGE PROCESSING (ICS 802)

Teacher Name:

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Course Structure

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Prerequisite:

Course Content:

Unit-1:

Introduction and Fundamentals Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization. Image Enhancement in Spatial Domain Introduction; Basic Gray Level Functions– Piecewis e-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations–Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.

Unit-2:

Image Enhancement in Frequency Domain Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters–Gaussian Lowpass Filters; Sharpening Frequency Domain Filters – Gaussian Highpass Filters; Homomorphic Filtering. Image Restoration A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering– Bandpass Filters; Minimum Mean-square Error Restoration.

Unit-3:

Color Image Processing Color Fundamentals, Color Models, converting Colors to different models, Color Transformation, Smoothing and Sharpening, Color Segmentation, Morphological Image

Processing Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms–Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening

Unit-4:

Registration Introduction, Geometric Transformation – Plane to P lane transformation, Mapping, Stereo Imaging – Algorithms to Establish Correspondence, Algorithms to Recover Depth Segmentation Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.

Unit-5:

Feature Extraction Representation, Topological Attributes, Geometric Attributes Description Boundary-based Description, Region-based Description, Relationship, Object Recognition Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching.

Text and Reference Books:

1. Digital Image Processing 2nd Edition, Rafael C. Gonzalvez and Richard E. Woods. Published by: Pearson Education.
2. Digital Image Processing and Computer Vision, R.J. Schalkoff Published by: John Wiley and Sons, NY.
3. Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall, Upper Saddle River, NJ.

Course Outcomes:

1. Apply sampling and quantization techniques for conversion of an analog image into digital form. (Apply)
2. Enhance the image using various types of filtering, segmentation and edge detection techniques. (Apply)
3. Analyze and interpret the effects of high pass and low pass filter in an image. (Analyse)
4. Restore the image in the presence of noise by using modern restoration software. (Apply)
5. Use the techniques of morphological image processing, image registration and image recognition. (Apply)
6. Apply various tools and techniques in multidisciplinary engineering and medical fields like embedded programming, CAD, web applications, MRI, CT-Scan, Angiography etc. (Apply)

Lesson Plan

Unit	Topic	No. of Lecture required
1	Introduction and Fundamentals: Motivation and Perspective, Applications	**1**
	Components of Image Processing System	**1**
	Element of Visual Perception, A Simple Image Model	**1**
	Sampling and Quantization	**1**
	Image Enhancement in Frequency Domain: Fourier Transform and the Frequency Domain	**1**
	Basis of Filtering in Frequency Domain, Filters –Low-pass, High-pass;	**1**
	Correspondence Between Filtering in Spatial and Frequency Domain, Smoothing Frequency Domain Filters – Gaussian Lowpass Filters	**1**
	Sharpening Frequency Domain.	**1**
	Filters – Gaussian Highpass Filters; Homomorphic Filtering	**1**
	Summary	**1**
2	Image Enhancement in Spatial Domain: Introduction	**1**
	Basic Gray Level Functions – Piecewise-Linear Transformation Functions: Contrast Stretching	**1**
	Histogram, Histogram Equalization	**1**
	Histogram Specification, Local Enhancement	**1**
	Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging	**1**
	Basics of Spatial Filtering	**1**
	Smoothing - Mean filter, Ordered Statistic Filter,Sharpening – The Laplacian	**1**
3	Image Restoration: A Model of Restoration Process	**1**
	Noise Models	**1**

	Restoration in the presence of Noise only-Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter	**1**
	Order Statistic Filters – Median Filter, Max and Min filters	**1**
	Periodic Noise Reduction by Frequency Domain Filtering –Bandpass Filters	**1**
	Notch Filter	**1**
	Minimum Mean-square Error Restoration	**1**
	Revision	**1**
4	Morphological Image Processing: Introduction	**1**
	Logic Operations involving Binary Images, Dilation and Erosion	**1**
	Opening and Closing	**1**
	Morphological Algorithms – Boundary Extraction	**1**
	Region Filling, Extraction of Connected Components	**1**
	Convex Hull, Skeleton*, Hit Miss transformation*	**1**
	Thinning, Thickening, summray	**1**
5	Registration: Introduction, Geometric Transformation – Plane to Plane transformation	**1**
	Mapping, Stereo Imaging –Algorithms to Establish Correspondence.	**1**
	Algorithms to Recover Depth,	**1**
	Segmentation: Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach	**3**
	Edge and Line Detection: Edge Detection, Edge Operators	**2**
	Pattern Fitting Approach, Edge Linking and Edge Following	**1**
	Edge Elements Extraction by Thresholding, Edge Detector Performance	**2**
	Line Detection, Corner Detection	**2**
Beyond the syllabus coverage	a. Inverse filtering	**2**
	b. Theorems in filtering	
	c. Sources of noise	**2**
	d. Band reject filters	

Assignments

Subject: Digital Image Processing

Unit-I

Assignment 1

Q1. Describe in detail the elements of digital image processing system. & write note on Sampling and Quantization?

Q2. Explain about fundamental steps in digital image processing? Explain the components of an Image Processing system?

Q3. Distinguish between digital image, and binary image. Give suitable example to each type of images.

Q4. What is m-connectivity among pixels? Give an example.

Q5 What do you mean sampling? State Explain this into image processing?

Q6.Explain resolution with image processing .Also writes on spatial level resolution.

Q 7. What are the different elements of DIP system?

Q8. Explain with example a) Neighbors of pixel b) Connectivity.

Unit-II

Assignment 2

.Q1. Discuss Image smoothing with the following (a) Low pass spatial filtering (b) Median filtering.

Q2. Discuss in detail about Histogram Processing?

Q3. Write a note on a) Gray Level Transformations b) Combining Spatial Enhancement Method

Q4. Distinguish between spatial domain techniques and frequency domain techniques of Image enhancement

Q5. Show that a high pass-filtered image in the frequency domain can be obtained by using the method of subtracting a low pass filtered image from the original.

Q 6. Describe the concept of Histogram specifications and Histogram modification for image enhancement.

Q7. Explain process of image smoothing using Median filtering?

Q8.How first and second derivative enhance the image? Explain which is more enhanced?

Unit-III

Assignment 3

Q1. What are the different mean filters used for restoration?

a)Gray Level Transformations

b)Spatial Enhancement Method

Q2 (a) Explain the image degradation model for continuous functions (b) Discuss about unconstrained, constrained restorations.

Q3.Draw the block diagram of Image restoration system & explain each block critically?

Q4. Explain the spatial transformation in DIP.

Q5. Write in detail gray level interpolation based on the nearest neighbor concept.

Q6. Explain the use of motion in segmentation?

Q7. Write about various edge Detectors available in function edge?

Unit-IV

Assignment 4

Q1.Explain briefly a) Region based segmentation b) Use of Motion in segmentation

Q2. What is Thresholding? Explain about Global Thresholding.

Q3. Discuss about Region growing by pixel aggregation. 12. Discuss about unconstrained, constrained restorations.

Q4. What is meant by image segmentations?

Q5. What is meant by discontinuities in an image? Discuss about point detection, line detection?

Unit-V

Assignment 5

Q1. What are the different techniques for detection of discontinuous? Explain advantageous one only.

Q2 What are the gradient operation? What are the various operators used for image segmentation based on edge detection?

Q3. What do you understand by dialation and erosion operation in morphological operation? Explain in brief?

Q4. Prove that dilation and erosion are reversible.

Q5. How we can extract the boundary of an image?