Introduction to Image Processing

Programme: B.Tech. (ECE, CCE) Year: 4th Semester: VII
Course: Program Elective for ECE, CCE Credits: 3 Hours: 40

Course Context and Overview (100 words):

This course will introduce the analytical tools and methods which are currently used in digital image processing as applied to image information for human viewing. There is a substantial body of scientific knowledge about computer processing of visual information and the future promises even greater developments. The course is cross-disciplinary, drawing on mathematics and statistics, information theory, as well as computer science, and has many applications including remote sensing, space exploration, security, surveillance, manufacturing, robotics, and medicine.

Prerequisites Courses:

Signals and Systems, Digital Signal Processing

Course outcomes(COs):

On completion of this course, the students will have the ability to:
CO1: Understand image formation and the role human visual system plays in perception of gray and color image data.
CO2: Understand the spatial filtering techniques, including linear and nonlinear methods used in image processing.
CO3: Understand the 2D Fourier transform concept, including the 2D DFT, FFT, DCT and their use in frequency domain filtering.
CO4: Analyse the signal processing algorithms and technique in image enhancement such as histogram modification, contrast manipulation, and edge detection.
CO5: Be able to conduct independent study and analysis of image processing problems and techniques.

Course Topics:

Topics	Lecture Hours	
UNIT – I **Digital Image Fundamentals**		**4**
Human visual system and image perception, applications of image processing, pixels, coordinate conventions, image geometry, perspective projection, sampling and quantization.		
UNIT – II **Spatial domain filtering**		**8**

Gray-level transformations, contrast stretching, histogram equalization, correlation and convolution, smoothening filters, sharpening filters, gradient and Laplacian.		
UNIT – III **Image filtering in frequency domain**		**8**
2D DFT, 2D DFT for image matching, FFT, 2D DCT, correlation, convolution, KLT/PCA, SVD, Hamhard transform, Haar transform, Slant transform.		
UNIT – IV **Image restoration**		**7**
Image deformation, classification of image restoration technique, image restoration model, blind deconvolution, image denoising, noise restoration filters (inverse filtering, Weiner filtering).		
UNIT – V **Morphological image processing**		**6**
Basic operations- dilation, erosion, opening, closing, Hit-Miss transformations, boundary extraction, region filling, connected components, convex hull, thinning, thickening, skeletons, pruning.		
UNIT – VI **Image segmentation**		**4**
Point, line, edge detection, edge linking, Hough transform, Watershed algorithm.		
UNIT – VII **Applications**		**3**
Panoramic image stitching, image morphing, watermarking, object detection, face recognition, gesture recognition.		

Textbook references (IEEE format):

Text Book:

[1] R. C. Gonzalez and R.E. Woods, "Digital Image Processing", Pearson Education, 2008.

Reference books:

[1] A. K. Jain, "Fundamentals of Digital Image Processing", Pearson Education, 2009.
[2] W. K. Pratt, "Digital Image Processing", John Wiley & Sons, 2006.
[3] S. Chanda and D. Dutta Majumdar, "Digital Image Processing and Applications", Prentice Hall of India, 2000.
[4] S. Ahmed, "Image Processing", McGraw-Hill, 1994.

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.):

http://nptel.ac.in/courses/117105079/, https://www.coursera.org/learn/digital#

Evaluation Methods:

Evaluation criteria will be shared by the concerned course instructor.

Prepared By:
Last Update: 28-07-2017