

Branch Name:	Artificial Intelligence & Data Science
Program Code:	108
Subject Title:	Computer Vision and Image Processing
Subject Code:	1ET1080602
Pre-Requisite:	Basic of mathematics: calculus, linear algebra and probability. Ability to program in C/C++/MATLAB and algorithms. , Some background knowledge of image

Course Objective:

1. To make the students aware and have some expertise with various facets of advance research in computer vision in various subareas such as reconstruction, segmentation and grouping, object and activity recognition, scene understanding, and vision and language.
2. To present various learning approaches from image and video data will be covered and include topics from convolutional neural networks, recurrent neural networks, structured predictions and others.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
03	-	02	04	70	30	30	20	150

Subject Contents

Sr. No	Topic	Total Hours	Weight (%)
1	Introduction to Computer Vision: History, Area of applications, Three 'R's of Computer Vision – reconstruction, recognition and (re)organization, 3D from images	4	10
2	Image Formation and Filtering: Light and Color, Convolution, Image Pyramids, Image Filtering and Hybrid Images, Thinking in Frequency	6	10
3	Feature Detection and Matching: Edge Detection, Interest Points and Corners, Local Image Features, Feature Matching, Model Fitting and RANSAC	7	10

4	Cameras, Multiple Views and Motion: Cameras and Optics, Stereo : Introduction, Camera Calibration, Epipolar Geometry and Structure from Motion, Feature Tracking and Optical Flow	8	20
5	Recognition: Recognition Overview and Bag of Features, Large-scale Instance Recognition, Large-scale Category Recognition and Advanced Feature Encoding, Detection with Sliding Windows: Viola Jones and Dalal Triggs, Pascal VOC and Big Data, Human Computation and Crowd sourcing, Modern Boundary Detection and Sketches, Context, Spatial Layout, and Scene Parsing	5	20
6	Image Processing Fundamentals: Introduction of Image Processing, Components of Image Processing system, Elements of visual perception, light and the electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, basic relationships between Pixels, Classification of image processing operations	4	20
7	Image Restoration and Colour Image processing: Various noise models, image restoration using spatial domain filtering, image restoration using frequency domain filtering, Estimating the degradation function, Inverse filtering, Colour fundamentals, Colour models, Colour transformation, Smoothing and Sharpening, Colour segmentation.	8	15

Course Outcome:

After learning the course, the students should be able to:

1. Object and scene recognition and categorization from images.
2. Practically hands on aspects of computing with images.
3. Geometric relationships between 2D images and the 3D world.
4. Understand to image formation, measurement, and analysis.
5. Image matching methods.

List of References:

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Computer Vision: A Modern Approach by Forsyth and Ponce.
3. Probabilistic Graphical Models by Koller and Friedman.
4. Dictionary of Computer Vision and Image Processing, by Fisher et al.
5. Deep Learning, by Goodfellow, Bengio, and Courville.
6. Machine Learning: A Probabilistic Perspective by Murphy.

E-Resources / Web Links

1. <http://szeliski.org/Book/>
2. <http://www.cs.rochester.edu/u/cxu22/t/577F16/>
3. <http://cs.brown.edu/courses/csci1430/>
4. <http://luthuli.cs.uiuc.edu/~daf/CV2E-site/cv2eindex.html>
5. http://www.siue.edu/~sumbaug/438_syl.html
6. <http://luthuli.cs.uiuc.edu/~daf/CV2E-site/cv2eindex.html>
7. <http://www.cs.ubc.ca/~murphyk/MLbook/>
8. <http://pgm.stanford.edu/>

List of Experiments:

1. Introduction to CVIP lab/ OpenCV.
2. Two-dimensional fast transforms - Fourier (FFT), cosine (DCT), Haar, Walsh, Hadamard, wavelet transforms.
3. Feature extraction - binary, RST-invariant, histogram, spectral and texture object features.
4. Pattern classification - nearest neighbor, K-nearest neighbor and nearest centroid.

5. Edge/Line detection and edge linking - Kirsch, pyramid, Sobel, Prewitt, Roberts, Laplacian, FreiChen, Hough transform.
6. Histogram Thresholding Segmentation
7. Image segmentation - fuzzyc mean, histogram thresholding, median-cut, principal components transform/median cut, spherical coordinate transform/center split, gray level quantization, split and merge.
8. Histogram-based image enhancement - histogram equalization, histogram slide, histogram shrink/stretch, local equalization, histogram hyperbolization, histogram specification, adaptive contrast filters (standard, logarithmic, exponential), gray-scale piecewise linear modification.
9. Morphological filters - binary iterative morphology, gray-scale and color erosion, dilation, opening, and closing.
10. Open Experiment (Student have to identify the simple problem and try to implement it-if possible)

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand and master basic knowledge, theories and methods in image processing and computer vision	1 Remembering 2 Understanding
CLO2	Analyse, evaluate and examine existing practical computer vision systems.	2 Understanding 4 Analyze
CLO3	Design and develop practical and innovative image processing and computer vision applications or systems	3 Applying
CLO4	Learn depth understanding of Understand Image formation process and develop computer vision applications.	3 Applying
CLO5	Learn depth understanding of color transformation and color segmentation.	2 Understanding 3 Applying

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1	H	M	H	L	L	M			L				H	L		
CLO2		L	M	H	L	L					L	L	M	L		
CLO3	M	H	M	L	M	H		M		L			M	L		
CLO4	M	M	L	L	M	H		M	L				M	L		
CLO5	M	L	L	L	M	H		M		L			H	L		

H: High, M: Medium, L: Low