Uka Tarsadia University

B. Tech.

CSE / CSE (CC) / CE (SE)

Semester VII

Program Elective - V
COMPUTER VISION
AI6015

EFFECTIVE FROM July-2024

Syllabus version: 1.00

Subject Code	Subject Title
AI6015	**Computer Vision**

Teaching Scheme				Examination Scheme				
Hours		Credits		Theory Marks		Practical Marks		Total Marks
Theory	Practical	Theory	Practical	Internal	External	Internal	External	
3	2	3	1	40	60	20	30	150

Objectives of the course:

- To make students understand various image representation stages for digital image processing applications.
- To impart knowledge of various applications for object classification, tracking and detection.

Course outcomes:

Upon completion of the course, the student shall be able to

CO1: Understand need and applications of computer vision along with the fundamentals of image processing.
CO2: Learn various color and texture representations of images.
CO3: Learn various linear filters and local image features.
CO4: Illustrate image segmentation and feature extraction techniques.
CO5: Apply and use different techniques for image classification.
CO6: Develop the practical skills necessary to build computer vision applications.

Sr. No.	Topics	Hours
	Unit – I	
1	**Geometric Camera Models, Light and Shading:** Image formation, Intrinsic and Extrinsic parameters, Geometric camera calibration, Modeling pixel brightness, Inference from shading, Modeling interreflection, Shape from one sided image.	9
	Unit – II	
2	**Color and Texture:** Human color perception, The physics of color, Representing color, A model of image color, Inference from color; Local texture representations using filters, Pooled texture representations by discovering textons, Synthesizing textures and filling holes in images, Image denoising, Shape from texture.	6
	Unit – III	

3	**Linear Filters and Local Image Features:** Linear filters and convolution, Shift invariant linear systems, Spatial frequency and Fourier transforms, Sampling and aliasing, Filters as templates, Technique: Normalized correlation and finding patterns, Technique: Scale and image pyramids; Computing the image gradient, Representing the image gradient, Finding corners and building neighborhoods, Describing neighbors with SIFT and HOG features.	8
Unit – IV		
4	**Segmentation and Feature Extraction:** Applications of segmentation, Image segmentation by clustering pixels, Segmentation, clustering and graphs; Feature extraction - shape, histogram, color, spectral, texture; Feature analysis, Feature vectors, Distance/similarity measures.	8
Unit – V		
5	**Image Classification:** Classification, error and loss; Major classification strategies, Practical methods for building classifiers, Building good features, Classifying images of single objects, Image classification in practice.	6
Unit – VI		
6	**Object Tracking and Object Detection:** The sliding window method, Detecting deformable objects, The state of the art of object detection.	8

Sr. No.	Computer Vision (Practicals)	Hours
1.	Install OpenCV and Eclipse in Ubuntu Linux operating system and to run simple program to read image data and display image.	2
2.	Write and execute spatial domain image processing programs using pixel processing (point processing).	2
3.	Analyze image restoration techniques and to implement median filtering using OpenCV.	2
4.	Write and execute basic image processing programs in OpenCV and Python. Learn installation procedure to use OpenCV library functions in Python.	4
5.	Write a program to detect corners in image.	2
6.	Write a program to detect edges in image.	2
7.	Write a program to apply various segmentation techniques on given image.	4
8.	Write a program to read a colour video and pre-processing on it.	4
9.	Write digital image processing programs using SCILAB.	4
10.	Install OpenCV library in Raspberry PI board for Computer vision experiments. Write and execute basic image processing programs in Raspberry PI board.	

11.	Write and execute program for Object detection and tracking.	4

Text book:

1. Forsyth D. A. and Ponce J. - "Computer Vision – A Modern Approach", Pearson Education.

Reference books:

1. Szeliski R. - "Computer Vision: Algorithms and Applications", Springer.
2. Shapiro L. G. and Stockman G. - "Computer Vision", Prentice Hall.
3. Davies E. R. - "Machine Vision: Theory, Algorithms, Practicalities", Morgan Kaufmann.
4. Rafel C. Gonzalez and Richard E. Woods – "Digital Image Processing", Pearson Education.

Course objectives and Course outcomes mapping:

- To make students understand various image representation stages for digital image processing applications: CO1, CO2, CO3, CO4, CO5
- To impart knowledge of various applications for object classification, tracking and detection: CO5, CO6

Course units and Course outcomes mapping:

Unit No.	Unit Name	Course Outcomes					
		CO1	CO2	CO3	CO4	CO5	CO6
1	Geometric Camera Models, Light and Shading	✓					
2	Color and Texture		✓				
3	Linear Filters and Local Image Features			✓			
4	Segmentation and Feature Extraction				✓		
5	Image Classification					✓	
6	Object Tracking and Object Detection						✓

Programme outcomes:

PO 1: Engineering knowledge: An ability to apply knowledge of mathematics, science, and engineering.

PO 2: Problem analysis: An ability to identify, formulates, and solves engineering problems.

PO 3: Design/development of solutions: An ability to design a system, component, or process to meet desired needs within realistic constraints.

PO 4: Conduct investigations of complex problems: An ability to use the techniques, skills, and modern engineering tools necessary for solving engineering problems.

PO 5: Modern tool usage: The broad education and understanding of new engineering techniques necessary to solve engineering problems.

PO 6: The engineer and society: Achieve professional success with an understanding and appreciation of ethical behaviour, social responsibility, and diversity, both as individuals and in team environments.

PO 7: Environment and sustainability: Articulate a comprehensive world view that integrates diverse approaches to sustainability.

PO 8: Ethics: Identify and demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work.

PO 9: Individual and team work: An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give/receive clear instructions.

PO 11: Project management and finance: An ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: A recognition of the need for, and an ability to engage in life-long learning.

Programme outcomes and Course outcomes mapping:

Programme Outcomes	Course Outcomes					
	CO1	CO2	CO3	CO4	CO5	CO6
PO1	✓	✓	✓	✓	✓	✓
PO2				✓	✓	✓
PO3	✓	✓	✓	✓	✓	✓
PO4				✓	✓	✓
PO5		✓	✓	✓	✓	✓
PO6						
PO7						
PO8						
PO9						
PO10						
PO11				✓	✓	✓
PO12						