GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171113
Semester – VII
Subject Name: Practical Aspects of Computer Vision

Type of course: Open Elective Course

Prerequisite: Basic knowledge of Engineering Mathematics and Programming Language

Rationale: With technological advances there are many applications of Electronics and Communication Engineering, closely coupled with Computer Vision and Image Processing. Therefore, the course is designed with the following objectives: (1) to provide an understanding of computer vision, including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification, scene understanding, etc., and (2) to develop the practical skills necessary to build computer vision applications

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Introduction to machine vision:** Introduction to Machine vision, Fundamentals of Image processing: The human eye-brain system as a model for computer vision, Image formation, Image models, Basic image processing:- Spatial domain operations and Frequency domain operations, Image transforms	03
2	**Local Image Descriptors and Mappings** Harris corner detector ,SIFT - Scale-Invariant Feature Transform, Matching Geotagged Images, Image to Image Mappings, Warping of Images, Creating Panoramas	06
3	**Camera Geometry and Multiple View Geometry:** Transformations in 2D: translation, rotation, scaling, shearing; affine and rigid transformations, Transformations in 3D: translation, rotation about X, Y, Z axis, rotation about arbitrary axis, 3D affine, number of degrees of freedom, Composition of	09

	transformations in 2D and 3D with examples; concept of homogeneous coordinates in 2D and 3D, Concept of pinhole camera, geometry of perspective projection through pinhole camera, Camera Calibration, Epipolar Geometry , Computing with Cameras and 3D Structure,. Multiple View Reconstruction, Stereo Images.	
4	**Machine Learning in computer vision**: Clustering and Searching Images**:** K-means Clustering, Hierarchical Clustering, Spectral Searching Images, content-based Image Retrieval, Visual Words, Indexing Images, Searching the Database for Images, Ranking Results using Geometry Building Demos and Web Applications.	06
5	**Robust methods for classification and segmentation:** Eigen decomposition and PCA, K-Nearest Neighbors, Bayes, Support Vector Machines, Optical Character Recognition , Image Segmentation : Graph Cuts, Segmentation using Clustering.	06
	Total	30

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks (100)					
R Level	U Level	A Level	N Level	E Level	C Level
10	**30**	**30**	**20**	**5**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

[1] Programming computer vision with Python, Jan Erik Solem, Creative commons
[2] Introductory Techniques for 3D Computer Vision", Emanuele Trucco and Alessandro Verri, Prentice Hall.
[3] Robot Vision, by B. K. P. Horn, MIT Press (Cambridge).
[4] Computer Vision: Algorithms and Applications, by Richard Szeliski
[5] Computer Vision: A Modern Approach, Forsyth and Ponce, Pearson Education.

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Course Outcomes:

Sr. No.	CO statement: At the end of this course, students will be able to:	Marks % weightage
CO-1	Comprehend both the theoretical and practical aspects of analysis of images with computers	30 %
CO-2	Analyze and Synthesis the scene with multiple-view geometry	30 %
CO-3	Implement clustering, classification and machine learning techniques in computer vision.	40 %

List of Experiments / Assignments:

Software sources: Python / OpenCV Programming Languages

Suggested List of Practical:

1. Basic Image handling and processing algorithms
2. Algorithms based on Image descriptors like haris cornor detector, SIFT etc
3. Homography and Transformation Algorithms
4. Image Warping algorithms and creating panoramas, RANSAC algorithm
5. 2D- 3D transformation, detection of salient feature points
6. Algorithms for face detection, object detection, image classification etc.

Major Equipment:

Computational lab with computers of latest configurations and the following software or their equivalent:

(1) MATLAB
(2) Python
(3) OpenCV

List of Open Source Software / learning website:

(1) https://www.cse.iitb.ac.in/~ajitvr/CS763_Spring2017/ [Visited on 07-08-2020]
(2) https://nptel.ac.in/courses/106/105/106105216/ [Visited on 07-08-2020]
(3) https://www.python.org/downloads/ [Visited on 07-08-2020]