RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Artificial Intelligence & Data Science, VII-Semester

AD-701 AI for Computer Vision

Course Objectives:

1. To understand the fundamental concepts related to Image formation and processing.
2. To learn feature detection, matching and detection.
3. To become familiar with feature based alignment and motion estimation.
4. To develop skills on 3D reconstruction.
5. To understand image based rendering and recognition.

Course Outcomes:

After the completion of this course, the students will be able to:

1: Understand basic knowledge, theories and methods in image processing and computer vision.
2: Implement basic and some advanced image processing techniques in OpenCV.
3: Apply 2D a feature-based based image alignment, segmentation and motion estimations.
4: Apply 3D image reconstruction techniques.
5: Design and develop innovative image processing and computer vision applications.

Syllabus

Unit I: Introduction to Image Formation and Processing

Computer Vision, Geometric primitives and transformations, Photometric image formation, digital camera, Point operators, Linear filtering, More neighborhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations, Global optimization.

Unit II: Feature Detection, Matching and Segmentation

Points and patches, Edges, Lines, Segmentation, Active contours, Split and merge, Mean shift and mode finding, Normalized cuts, Graph cuts and energy-based methods.

UnitIII:**Feature-based Alignment & Motion Estimation**

2D and 3D feature-based alignment, Pose estimation, Geometric intrinsic calibration, Triangulation, Two-frame structure from motion, Factorization, Bundle adjustment, Constrained structure and motion, Translational alignment, Parametric motion, Spline-based motion, Optical flow, Layered motion.

Unit IV: **3D Reconstruction**

Shape from X, Active range finding, Surface representations, Point-based representations Volumetric representations, Model-based reconstruction, Recovering texture maps and albedos.

UnitV:**Image-based Rendering and Recognition**

View interpolation Layered depth images, Light fields and Lumigraphs, Environment mattes, Video-based rendering, Object detection, Face recognition, Instance recognition, Category recognition, Context and scene understanding, Recognition databases and test sets.

TEXT BOOKS:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, Second Edition, 2015.

REFERENCE BOOKS:

1. Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006
3. E. R. Davies, "Computer and Machine Vision", Fourth Edition, Academic Press, 2012.

LABORATORY EXPERIMENTS:

1. OpenCV Installation and working with Python
2. Basic Image Processing , loading images, Cropping, Resizing, Thresholding, Contour analysis, Bolb detection
3. Image Annotation – Drawing lines, text circle, rectangle, ellipse on images
4. Image Enhancement, Understanding Color spaces, color space conversion, Histogram equialization, Convolution, Image smoothing, Gradients, Edge Detection
5. Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB Image features, Feature matching and cloning
6. Feature matching based image alignment
7. Image segmentation using Graphcut / Grabcut
8. Camera Calibration with circular grid
9. Pose Estimation
10. 3D Reconstruction – Creating Depth map from stereo images