Subject Code	Subject Name	Credits
26CS504	COMPUTER VISION	4

Course Objectives

1. To introduce the fundamental concepts and techniques of Computer Vision and digital image analysis.
2. To understand image processing foundations such as filtering, thresholding, edge detection, and feature extraction.
3. To study methods for shape analysis, region analysis, and object recognition in images.
4. To explore real-world computer vision applications including face recognition, surveillance, and intelligent transportation systems

Learning Outcomes

After the completion of the course, the graduate will be able to

1. Apply fundamental image processing techniques such as filtering, thresholding, and edge detection for image analysis.
2. Analyze shapes and regions in images using methods such as connected component labeling, boundary descriptors, and moment-based features.
3. Implement detection methods using the Hough Transform and RANSAC for identifying geometric structures in images.
4. Understand principles of 3D Computer Vision including 3D reconstruction, motion estimation, and optical flow.

Unit 1 - Image processing foundations (12 Hrs.)

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection, techniques – corner and interest point detection – mathematical morphology – texture.

Unit 2 - Shapes and regions (12 Hrs.)

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions –skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary

Unit 3 - Hough transform (12 Hrs.)

Line detection – Hough Transform for line detection – foot-of-normal method – line localization – line fitting– RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.

Unit 4 - 3d vision and motion (12 Hrs.)

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture –shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

Unit 5 – Applications (12 Hrs.)

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

References:

1. Dusty Phillips, Python 3 Object-Oriented Programming, Packet Publishing.
2. Steven F. Lott, Mastering Object-Oriented Python, Packet Publishing.
3. Luciano Ramalho, Fluent Python, O'Reilly Media.
4. Mark Lutz, Learning Python, O'Reilly Media.
5. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, O'Reilly Media.