Short Syllabus

BCSE417L Machine Vision (3-0-0-3)

Image Digitization – Sampling and Quantization - Image Properties ; Image enhancement: Contrast , Linear Filters , non- Linear Filters - Bilinear Interpolation ; Edge detection - Segmentation – Region Based ,Graph Based - Image Analysis: invariant feature, Image transforms; Morphological Segmentation – Statistical Texture Description – Local Binary Patterns – Syntactic Texture Description Methods - Visual inspection tasks regarding textures ; Frequency domain transformations - FFT's – Haar Wavelet ; Motion Analysis : Detection and Correspondence of Interest Points - Detection of Motion Patterns – Video Tracking – Motion Models to aid tracking ; Detection of known objects by linear filters - Detection of unknown objects - Hough transform - Corner detection - image tagging.

Course code	Course Title	L	T	P	C
BCSE417L	Machine Vision	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To enhance and restore the images acquired from cameras
2. To educate in taking the individual steps that leads to final inspection result based on the acquired image data.
3. To analyze the real-world problems and provide solutions to automated visual inspection

Course Outcomes

At the end of this course, student will be able to:

1. Understand the basics of how an image is processed
2. Enhance, Analyze and segment the image using algorithms
3. To interpret the image and transform it using the mathematical knowledge
4. Extract the features from the image and represent using morphological operations
5. Apply the concept in understanding the scene and process the background part of the image

Module:1	Basics of Image Processing	4 hours

Image Formation Physics, Image Digitization – Sampling and Quantization, Digital Image Properties, Color Image, Color spaces/ conversions, Cameras

Module:2	Preprocessing and Image Enhancement	8 hours

Image enhancement methods: Contrast Adjustment-Histogram Manipulation-Image Smoothening-Image Sharpening; Image Enhancement using Linear Filters – Ideal Low Pass Filter - Gaussian Filter – Ideal Noise Reduction using non linear filters-Geometric Rectification using Bilinear Interpolation-Suppression of in homogeities using Homomorphic Filtering

Module:3	Image Analysis and Segmentation	8 hours

Thresholding - Edge detection- Edge Based Segmentation – Region Based Segmentation-Active Contour Models – Graph Based segmentation - Image Analysis- invariant feature - Image transforms

Module:4	Mathematical Morphology and Texture Description Image Invariant feature	8 hours

Skeletons and object marking – Morphological Segmentation – Statistical Texture Description – Co-occurrence matrices – Local Binary Patterns – Syntactic Texture Description Methods - Object Measurement - Counting -Visual inspection tasks regarding textures

Module:5	Wavelet Transform and Multi-resolution Analysis/ image transforms	5 hours

Image transforms - Frequency domain transformations - FFT's – Haar Wavelet - Multiresolution analysis - Scale-invariant features

Module:6	Motion Analysis	6 hours

Optical Flow – Detection and Correspondence of Interest Points - Detection of Motion Patterns – Video Tracking – Motion Models to aid tracking: Kalman Filters - stereo mapping-image fusion

Module:7	Scene Analysis	4 hours

Detection of known objects by linear filters - Detection of unknown objects - The Hough transform for the detection of lines - Corner detection - image tagging

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)	
1.	Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 4th Edition, Cengage Learning, USA
2.	Jurgen Beyerer, Fernando Puente Leon, Christian Frese,”Machine Vision Automated Visual Inspection: Theory, Practice and Applications”, 2016, Springer
3.	Al Bovik, “The Essential Guide to Image Processing”, 2009, Academic Press
Reference Books	
1.	Oge Marques, Practical Image and Video Processing using MATLAB, IEEE Press, Wiley Publications

Mode of Evaluation: CAT / Written Assignment / Quiz / FAT			
Recommended by Board of Studies	09-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022