



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Electronics & Communication (Communication System Engineering)

Course / Subject Code: ME01005021

Course / Subject Name : Image Processing

w. e. f. Academic Year:	2024-25
Semester:	1 st Semester
Category of the Course:	PEC

Prerequisite:	Signals and Systems, Digital Signal Processing
Rationale:	PG Students of EC Engineering need to possess good understanding of the fundamentals and applications of Image Processing specially in image feature extraction, including basic image processing operations, Low-level feature extraction (including edge detection), Feature extraction by shape matching, Flexible shape extraction (snakes and other techniques), Object description, Introduction to texture description, segmentation and classification and 3-D image processing. They are expected to be able to design algorithms for image processing.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Understand the concept of digital image processing to enhance image and reduce noise from image.	U
02	Analyze and implement different image processing algorithms for 2-D and 3-D images.	N
03	Develop image processing programs in MATLAB.	A

*Revised Bloom's Taxonomy (RBT)

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	



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3	0	2	4	70	30	20	30	150
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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Basic image processing operations: Overview, Histograms, Point Operators, Group operators, Other statistical Operators, Mathematical morphology.	3	5
2.	Low- level feature extraction (including edge detection): Overview, First-order edge detection operators, Second- order edge detection operators, Other edge detection operators, Comparison of edge detection operators, Phase Congruency, Localized feature extraction, Detecting image curvature, Describing image motion.	6	15
3.	Feature extraction by shape matching: Overview, Thresholding and subtraction, Template matching, Hough transform (HT), Generalized Hough transform (GHT), Other extensions to the HT.	3	5
4.	Flexible shape extraction (snakes and other techniques): Overview, Deformable templates, Active contours (snakes), Shape skeletonization, Flexible shape models: active shape and active appearance	6	15
5.	Object description: Overview, Boundary descriptions(Boundary and region, Chain codes, Fourier descriptors), Region descriptors(Basic region descriptors, Moments)	6	15
6.	Introduction to texture description, segmentation and classification: Overview, What is texture, Texture description(Performance requirements, Structural approaches, Statistical approaches, Combination approaches), Classification(The k-nearest neighbor rule, Other classification approaches), Segmentation	9	20
7	3D Image Acquisition: Volume imaging vs. sections, Basics of reconstruction, Algebraic reconstruction methods, Maximum entropy, Defects in reconstructed images, Imaging geometries, Three-dimensional tomography, High resolution tomography	6	10



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8	3D Image Visualization: Sources of 3D data, Serial sections, Optical sectioning, Sequential removal Stereo, 3D data sets, Slicing the data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Special display hardware, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D, Measurements on 3D images.	6	15
Total		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	20	30	10	10

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Feature Extraction and Image Processing, Mark S. Nixon and Alberto S. Aguado, Elsevier Publication, Second Edition, 2008
2. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, Third Edition, Pearson Education
3. Fundamentals of Digital Image Processing: Practical Approach with examples in MATLAB, Chris Solomon and Toby Breckon, Wiley-Blackwell.
4. Digital Image Processing Using MATLAB, Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, Second Edition, Tata McGraw Hill Publication
5. Digital Image Processing, S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill Publication
6. Digital Image Processing, S Sridhar, Oxford University Press
7. The Image Processing Handbook, Third Edition by John C. Russ CRC Press, CRC Press 1998

(b) Open source software and website:

- OpenCV
- <https://nptel.ac.in>



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- Rahul Dubey, “An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications”, Cengage India Publication
- Raj Kamal, “Internet of Things: Architecture and Design Principles, Mc Graw Hill Education
- Hanes et al “IoT Fundamentals”, Cisco Press Vijay Madiseti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, Paperback, 2015.
- McEwen, H. Cassimally, “Designing the Internet of Things”, Wiley, 2013.
- Yashwant Kanetkar, “21 Internet of Things Experiments”, Kindle edition Adeel Javed, “Building Arduino projects for Internet of Things”, Apress publication
- Donald Noris, “The Internet of Things: Do it yourself Projects with Arduino, Raspberry PI and Beagle Bone Black” Mc Graw Hill Publication Adrian McEwen & Hakim Cassimally, “Designing the Internet of things”, Willey publication
- Rahul Dubey, “An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications”, Cengage India Publication
- Raj Kamal, “Internet of Things: Architecture and Design Principles, Mc Graw Hill Education Hanes et al “IoT Fundamentals”, Cisco Press
- Vijay Madiseti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, Paperback, 2015. A. McEwen, H. Cassimally, “Designing the Internet of Things”, Wiley, 2013. Yashwant Kanetkar, “21 Internet of Things Experiments”, Kindle edition
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- Adrian McEwen & Hakim Cassimally, “Designing the Internet of things”, Willey publication
- Rahul Dubey, “An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications”, Cengage India Publication

Suggested Course Practical List:(30 Hours)

1. Image Enhancement: Point Processing Techniques
2. Image Enhancement: Histogram Equalization
3. Image Enhancement: Low pass Filtering
4. Image Enhancement: Sharpening Filter
5. Image Enhancement: Erosion & Dilation of image
6. Image Segmentation: First order Edge Detection operators: Roberts, Prewitts, sobel operators, canny operator
7. Image Segmentation: Second order Edge Detection operators: laplacian, Marr–Hildreth operator



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8. Morphological Processing: Boundary Extraction

9. Morphological Processing: Object Identification

10. Feature Extraction: Texture filters

11. Segmentation: Split and Merge Algorithms

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