



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3162009
Semester – VI
Subject Name: Machine Vision

Type of course: Professional Elective Course

Prerequisite: Zeal to learn the subject

Rationale: This subject is designed to understand the various image processing techniques to enhance the digital image for different applications. Enormous applications of digital image processing are covered in this syllabus to make it a multidisciplinary course. Importance of digital image processing is revealed in the content such as image enhancement, restoration, filtering, etc.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction: Comparison with human visual system and perception level, digital image presentation, Definitions of digital image, Examples of the fields that use digital image processing, fundamental steps in image processing, components / elements of digital image processing systems, image acquisition, storage, processing, communication and display.	4
2	Digital Image Fundamentals: Elements of visual perception – brightness adaption and discrimination, light and electromagnetic spectrum, image sensing and acquisition, sampling and quantization, some basic relationships between pixels, connectivity, adjacency, distance measures, different types of image sensors, different types of file formats.	5
3	Image Enhancement in Spatial Domain: point processing and mask processing, Basic gray level transformations, histogram processing, histogram equalization, histogram matching, local enhancement, histogram statistics, image subtraction, image averaging, basics of spatial filtering – smoothing, sharpening filters and order statistics filters.	8
4	Image Enhancement in Frequency domain: introduction to Fourier Transform and frequency domain, The discrete Fourier Transforms – properties of 2-D Fourier Transform, smoothing frequency domain filters – ideal, butter worth, Gaussian low pass filters with additional examples of low pass filters, sharpening frequency domain filters – ideal, butter worth, Gaussian and Laplacian filters, unsharp masking, high boost filtering, homomorphic filtering, convolution and correlation, sampling, additional properties of 2-D Fourier transfer, Periodicity and need for padding.	8



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5	Image Restoration: model for image degradation/restoration, noise models – probability density functions of noise, periodic noise and estimation of noise parameters; periodic noise reduction by frequency domain filtering, Arithmetic mean filters, geometric mean filters, adaptive filters, Band pass and band reject filters.	5
6	Image compression: fundamentals of image compression and types of redundancy, error free and lossy compression, variable length coding – Huffman coding, arithmetic coding, LZW coding, run length coding.	5
7	Morphological Image Processing: Basic concept, Dilation and Erosion process for binary and gray image with applications, Opening & Closing for binary and gray image with applications, Hit-or-Miss Transformation, Basic Morphological Algorithms, textural segmentation.	5

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

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
35	20	15	15	15	-

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. Refael C. Gonzalez and Richard E. Woods, Digital Image Processing, Addison-Wesley
2. Refael C. Gonzalez and Richard E. Woods Digital Image Processing Using MATLAB Addison-Wesley
3. Scott E Umbaugh, Computer Vision and Image Processing, Prentice-Hall International, Inc.
4. A.K. Jain, Fundamentals of Digital Image Processing, Prentice-Hall of India
5. Milan Sonka, Machine Vision and Image Processing
6. Castleman K.R. Digital Image Processing Prentice-Hall India

Course Outcomes:

After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Enhance digital image using various algorithms with the help of computer programming.	35



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CO-2	Understand the role of image processing in different fields such as medical, engineering, space, biotechnology, ocean, agriculture, food industry, etc.	20
CO-3	Realize the significance of digital image processing in automation.	20
CO-4	Know the mathematical calculations of basic filters used in digital image enhancement.	25

List of Experiments:

1. Learning and implementing basic MATLAB commands.
2. Forming script file and function file in MATLAB.
3. Understanding different image classes.
4. Use of arithmetic and logical operators on images.
5. Image segmentation.
6. Blurring the given image by spatial convolution method.
7. Blurring and sharpening of image with built in command and performing scaling of the image.
8. Performing negative, log, power-law and contrast stretching transformations on given image.
9. Matching of the histogram of image with the specified one.
10. Implementing 1-D and 2-D Discrete Fourier Transformation of given image.

Major Equipment:

Digital camera (gray scale) can be utilized to acquire digital images for further processing. MATLAB or C language programming can be utilized for programming.

List of Open Source Software/learning website:

The website of NPTL may be utilized for additional learning.