	slackness, primal-dual algorithm for the shortest path problem.
11-15	Network Flows: linear programming formulations for network flows and bipartite matching, totally uni-modular matrices integral polyhedral

Assessment Methods

Written tests, assignments, quizzes, presentations as announced by the instructor in the class.

Keywords

optimization problems, linear programming, integer programming, duality, network flow problems

---

Digital Image Processing (BHCS16A) Discipline Specific Elective - (DSE)
Credit: 06

Course Objective

This course introduces students to the fundamentals of digital image processing, and various image transforms, image restoration techniques, image compression and segmentation used in digital image processing.

Course Learning Outcomes

On successful completion of the course, students will be able to:

1. Describe the roles of image processing systems in a variety of applications;

2. Write programs to read/write and manipulate images: enhancement, segmentation, and compression, spatial filtering.

3. Develop Fourier transform for image processing in frequency domain.

4. Evaluate the methodologies for image segmentation, restoration

Detailed Syllabus

Unit 1

Introduction: Digital Image Fundamentals: Brightness, Adaptation and Discrimination, Light and Electromagnetic Spectrum, Image Sampling and Quantization, Some Basic Relationships between Pixels Types of images.

Unit 2

Spatial Domain Filtering: Some Basic Intensity Transformation Functions, Histogram Equalization, Spatial Correlation and Convolution, Smoothening Spatial Filters: Low pass filters, Order Statistics filters; Sharpening Spatial Filters: Laplacian filter

Unit 3

Filtering in Frequency Domain: The Discrete Fourier Transformation (DFT), Frequency Domain Filtering: Ideal and Butterworth Low pass and High pass filters, DCT Transform (1D, 2D).

Unit 4

Image Restoration: Image Degradation/Restoration Process, Noise models, Noise Restoration Filters

Image Compression: Fundamentals of Image Compression, Huffman Coding, Run Length Coding, JPEG.

Unit 5

Morphological Image Processing: Erosion, Dilation, Opening, Closing, Hit-or-Miss Transformation, Basic Morphological Algorithms.

Unit 6

Image Segmentation: Point, Line and Edge Detection, Thresholding, Region Based Segmentation.

Practical

1. Write program to read and display digital image using MATLAB or SCILAB

    a. Become familiar with SCILAB/MATLAB Basic commands

    b. Read and display image in SCILAB/MATLAB

    c. Resize given image

    d. Convert given color image into gray-scale image

    e. Convert given color/gray-scale image into black & white image

    f. Draw image profile

    g. Separate color image in three R G & B planes

    h. Create color image using R, G and B three separate planes

i. Flow control and LOOP in SCILAB

j. Write given 2-D data in image file

2. To write and execute image processing programs using point processing method

    a. Obtain Negative image

    b. Obtain Flip image

    c. Thresholding

    d. Contrast stretching

3. To write and execute programs for image arithmetic operations

    a. Addition of two images

    b. Subtract one image from other image

    c. Calculate mean value of image

    d. Different Brightness by changing mean value

4. To write and execute programs for image logical operations

    a. AND operation between two images

    b. OR operation between two images

    c. Calculate intersection of two images

    d. Water Marking using EX-OR operation

    e. NOT operation (Negative image)

5. To write a program for histogram calculation and equalization using

    a. Standard MATLAB function

    b. Program without using standard MATLAB functions

    c. C Program

6. To write and execute program for geometric transformation of image

    a. Translation

    b. Scaling

    c. Rotation

    d. Shrinking

    e. Zooming

7. To understand various image noise models and to write programs for

    a. image restoration

    b. Remove Salt and Pepper Noise

    c. Minimize Gaussian noise

    d. Median filter and Weiner filter

8. Write and execute programs to remove noise using spatial filters

      a. Understand 1-D and 2-D convolution process

      b. Use 3x3 Mask for low pass filter and high pass filter

9. Write and execute programs for image frequency domain filtering

      a. Apply FFT on given image

      b. Perform low pass and high pass filtering in frequency domain

      c. Apply IFFT to reconstruct image

10. Write a program in C and MATLAB/SCILAB for edge detection using different edge detection mask

11. Write and execute program for image morphological operations erosion and dilation.

12. To write and execute program for wavelet transform on given image and perform inverse wavelet transform to reconstruct image.

References

1. Gonzalez, R. C., & Woods, R. E. (2017). *Digital Image Processing*. 4th edition. Pearson Education.

2. Jain, A. K. (1988). *Fundamentals of Digital Image Processing*. 1st edition Prentice Hall of India.

Additional Resources

1. Castleman, K. R. (1995.). *Digital Image Processing*. 1st edition. Pearson Education

2. Gonzalez, R. C., Woods, R. E., & Eddins, S. (2004). *Digital Image Processing using MATLAB*. Pearson Education Inc.

3. Schalkoff, D. (1989). *Image Processing and Computer Vision*. 1st edition. John Wiley and Sons.

Course Teaching Learning Process

- Use of ICT tools in conjunction with traditional class room teaching methods
- Interactive sessions
- Class discussions

Tentative weekly teaching plan is as follows:

Week	Content
1	Brightness, Adaptation and Discrimination, Light and Electromagnetic Spectrum, Image Sampling and Quantization.
2-5	Some Basic Relationships Between Pixels ,Spatial Domain Filtering, Intensity Transformation Functions, Histogram Equalization, Spatial Correlation and Convolution , Low pass filters, Order Statistics filters, Sharpening Spatial Filters: Laplacian filterFiltering in Frequency Domain The Discrete Fourier Transformation(DFT)
6-7	Frequency Domain Filtering:Ideal and Butterworth Low pass and High pass filters, Image Degradation/Restoration Process
8-10	Noise models, Noise Restoration Filters, Image Compression, Huffman Coding,Run Length Coding, Bit Plane Coding
11-12	Morphological Image Processing, Erosion, Dilation, Opening, Closing , Hit-or-Miss Transformation, Basic Morphological Algorithms
13-15	Image Segmentation: Point, Line and Edge Detection ,Thresholding, Region Based Segmentation

Assessment Methods

Written tests, assignments, quizzes, presentations as announced by the instructor in the class.

Keywords

image transform, image restoration, image processing, image segmentation.

Microprocessors (BHCS16B) Discipline Specific Elective - (DSE)

Credit: 06

Course Objective

This course introduces internal architecture, programming model of Intel Microprocessors (8086 -Pentium) and assembly language programming using an assembler. Students will also learn interfacing of memory and I/O devices with microprocessor.