Digital Image Processing

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Digital Image Processing

General Information

Evaluation (Tentative):
2 Minors, 1 Major, Quizes (65%)
Assignments >= 3 (35%)

TA
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Course Page
http://www.cse.iitd.ernet.in/~pkalra/col783
Digital Image Processing

Acquisition: Photography
Digital Image Processing

X-ray/CT/MRI

Electron Microscope

Remote Sensing

Other Acquisition Modalities

Thermal Imaging
Digital Image Processing: Applications

Some Applications: Biometric and Recognition
Digital Image Processing: Applications

Object Detection
Digital Image Processing: Applications

Computational Photography
Digital Image Processing

2D Image → Image Processing → 2D Image

3D Scene/Object → Computer Graphics → 2D Image

2D Image → Computer Vision → 3D Object
Digital Image Processing

Computer Graphics
Digital Image Processing

Computer Vision

Output

Image

Synthetic Camera

Real Camera

Real Scene
Digital Image Processing

Course Contents (Tentative)

Fundamentals
Image Enhancement
Image Segmentation
Image Restoration
Image Transforms
Image Compression (+Video)
Image Analysis:
  Representation/Description
  Recognition/Identification
FIGURE 2.15 An example of the digital image acquisition process. (a) Energy (“illumination”) source. (b) An element of a scene. (c) Imaging system. (d) Projection of the scene onto the image plane. (e) Digitized image.
**Fundamentals**

**Sampling and Quantization**

**FIGURE 2.16** Generating a digital image. (a) Continuous image. (b) A scan line from $A$ to $B$ in the continuous image, used to illustrate the concepts of sampling and quantization. (c) Sampling and quantization. (d) Digital scan line.
**Fundamentals**

**Sampling and Quantization**

**FIGURE 2.17** (a) Continuous image projected onto a sensor array. (b) Result of image sampling and quantization.
An image is a spatial representation of an object, a 2D or 3D scene.

Abstractly, an image is a continuous function defining a rectangular region of a plane

- intensity image - proportional to radiant energy received by a sensor/detector

**FIGURE 2.15** An example of the digital image acquisition process. (a) Energy (“illumination”) source. (b) An element of a scene. (c) Imaging system. (d) Projection of the scene onto the image plane. (e) Digitized image.
Fundamentals

- An image can be thought of as a function with resulting values of the light intensity at each point over a planar region.

2D function \( f(x,y) \)
Fundamentals

Image Representation

FIGURE 2.18
Coordinate convention used in this book to represent digital images.
**Fundamentals**

**Image Resolution (Spatial)**

*FIGURE 2.19* A $1024 \times 1024$, 8-bit image subsampled down to size $32 \times 32$ pixels. The number of allowable gray levels was kept at 256.
Fundamentals

Image Resolution (Spatial)
Fundamentals

Image Resolution (Intensity Levels)

FIGURE 2.21
(a) 452 × 374, 256-level image.
(b)–(d) Image displayed in 128, 64, and 32 gray levels, while keeping the spatial resolution constant.
Fundamentals

Intensity/Luminance and Brightness

Mach Band Effect

Simultaneous Contrast

Perceived brightness

Actual illumination
Fundamentals

Other Operations

**Neighborhood**

$N_4, N_D, N_8$

**Adjacency/Connectivity**

4-connected
8-connected

**Distance**

Euclidian
$D_4$
$D_8$