

1. Image: A visual representation of something.

2. Digital Image: A picture in a digital format, made up of small elements called pixels.

3. Intensity/Gray Level: The brightness of a pixel in a grayscale image, from black to white.

4. Pixel: The smallest unit of a digital image, containing color or brightness information.

A white text with black text

Description automatically generated

a. Fundamental processes in digital image processing with outputs as images:

1. Image Enhancement:

- Improve contrast and brightness.

- Sharpen or blur the image.

- Correct colors and color distribution.

2. Image Restoration:

- Remove noise and artifacts.

- Reduce blurriness and restore sharpness.

- Fill in missing or damaged regions.

3. Image Compression:

- Reduce file size without losing quality (lossless).

- Achieve higher compression with some loss of detail (lossy).

- Use wavelet transforms for efficient representation.

b. Fundamental processes in digital image processing with outputs as image attributes:

1. Image Segmentation:

- Detect edges and boundaries.

- Group pixels into distinct regions.

- Separate foreground and background.

2. Feature Extraction:

- Identify important keypoints.

- Analyze textures and patterns.

- Extract scale-invariant features.

3. Object Recognition:

- Match templates for detection.

- Compare attribute histograms.

- Utilize deep learning for recognition.

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To store a 256x256 image with 32 gray levels, you need 5 bits for each pixel.

Total bits required = 256 \* 256 \* 5 = 327,680 bits.

A close up of text

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a. Array Product:

Array Product = [a11\*b11 a12\*b12]

[a21\*b21 a22\*b22]

b. Matrix Product:

Matrix Product = [a11\*b11 + a12\*b21 a11\*b12 + a12\*b22]

[a21\*b11 + a22\*b21 a21\*b12 + a22\*b22]

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a. 3x3 Median Filter at (2,3): Replace the center value (7) with the median value (20.5):

5 6 6 12

14 6 20.5 11

21 22 22 23

21 20 21 20

b. 3x3 Max Filter at (2,3): Replace the center value (7) with the maximum value (23):

5 6 6 12

14 6 23 11

21 22 22 23

21 20 21 20

c. 3x3 Min Filter at (2,3): Replace the center value (7) with the minimum value (6):

5 6 6 12

14 6 6 11

21 22 22 23

21 20 21 20

The results of the operations are as follows:

1. 3x3 Median Filter: 20.5 b. 3x3 Max Filter: 23 c. 3x3 Min Filter: 6

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Description automatically generated

7. Three types of frequency domain filters and their purposes:

a. Low-pass Filter: Smooths or blurs an image, removing noise and preserving main structures.

b. High-pass Filter: Sharpens an image by enhancing edges and details.

c. Band-pass Filter: Extracts specific frequency ranges for tasks like edge detection or noise reduction.

8. Four hardware-oriented color models:

a. RGB (Red, Green, Blue): Used in digital displays and cameras.

b. CMYK (Cyan, Magenta, Yellow, Key/Black): Used in the printing industry.

c. YUV/YCbCr: Used in video compression and transmission.

d. HSV (Hue, Saturation, Value): Used for color representation and manipulation in image editing.