

02204412

Digital Image Processing

Duangpen Jetpipattanapong

Course Topic

- Introduction
- Image formation and representation
- Color
- Image transformation
- Discrete Wavelet Transform
- Image Enhancement and Restoration
- Image Segmentation
- Recognition of Image Patterns
- Texture and Shape Analysis

Score (Approximate)

- Project
 - 20%
- Midterm
 - 40%
- Final
 - 40%

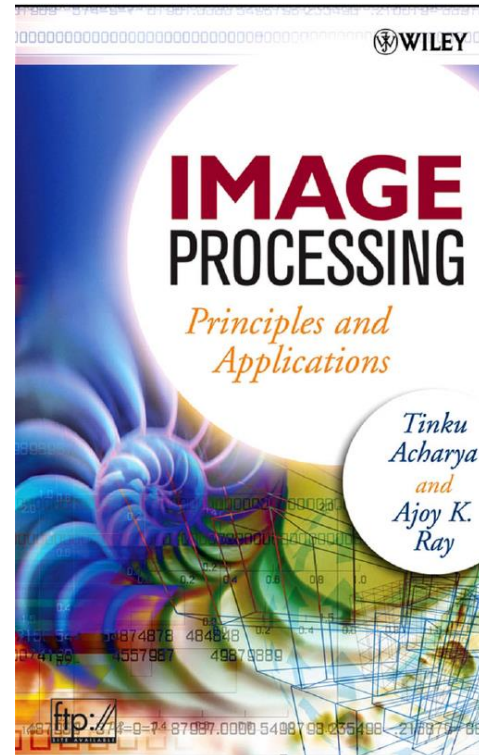
Group Grading

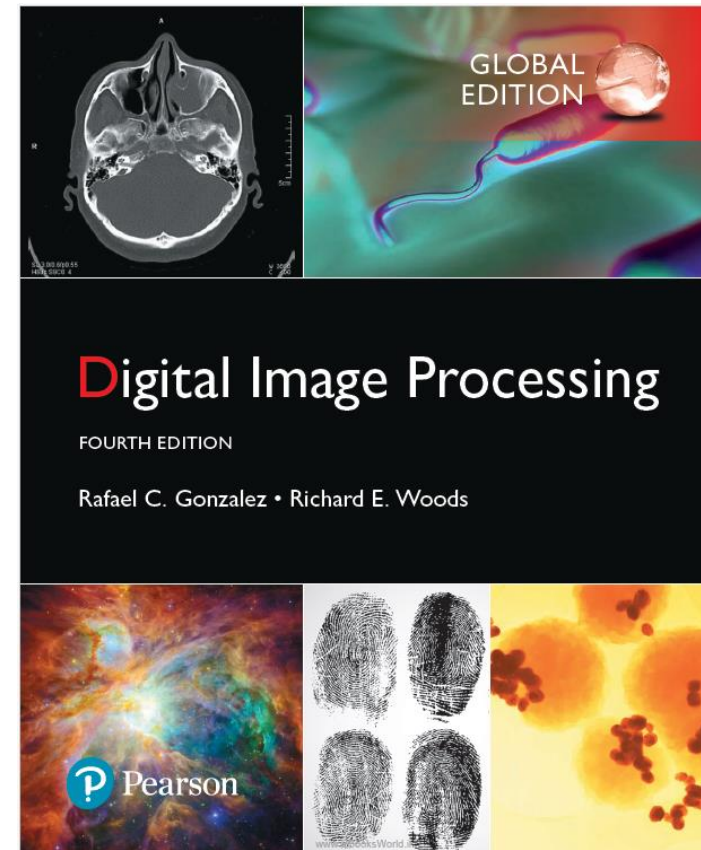
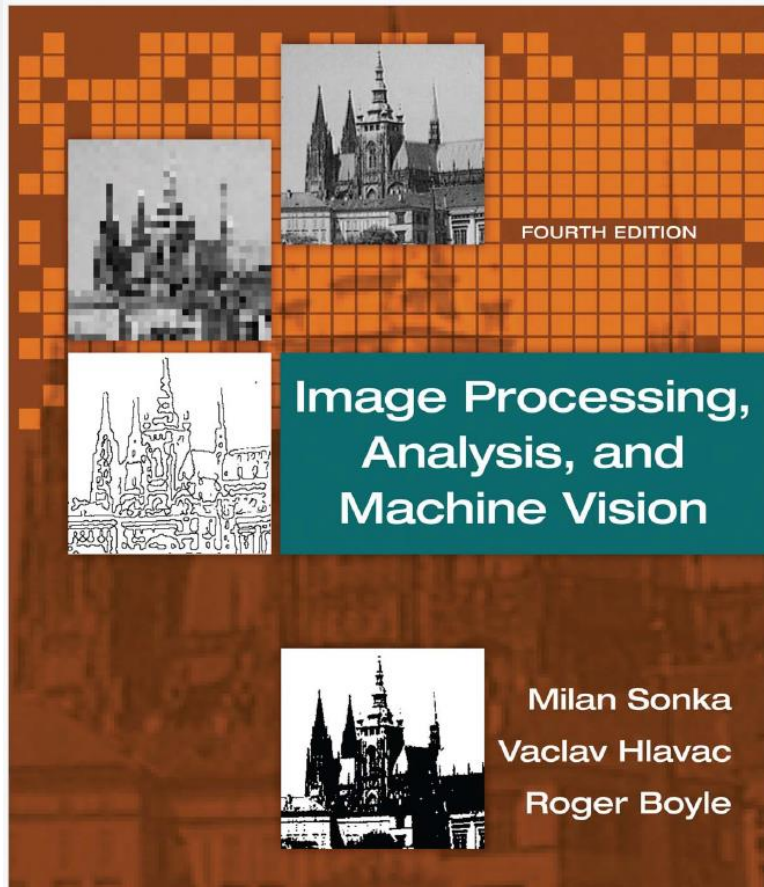
Material

- Slide

<https://www.dropbox.com/scl/fo/o46e6wcequtqq4jkopusk/h?rlkey=p32dypgl0y7hrfvlp5tr7unwi&dl=0>

- IMAGE PROCESSING
Principles and Application



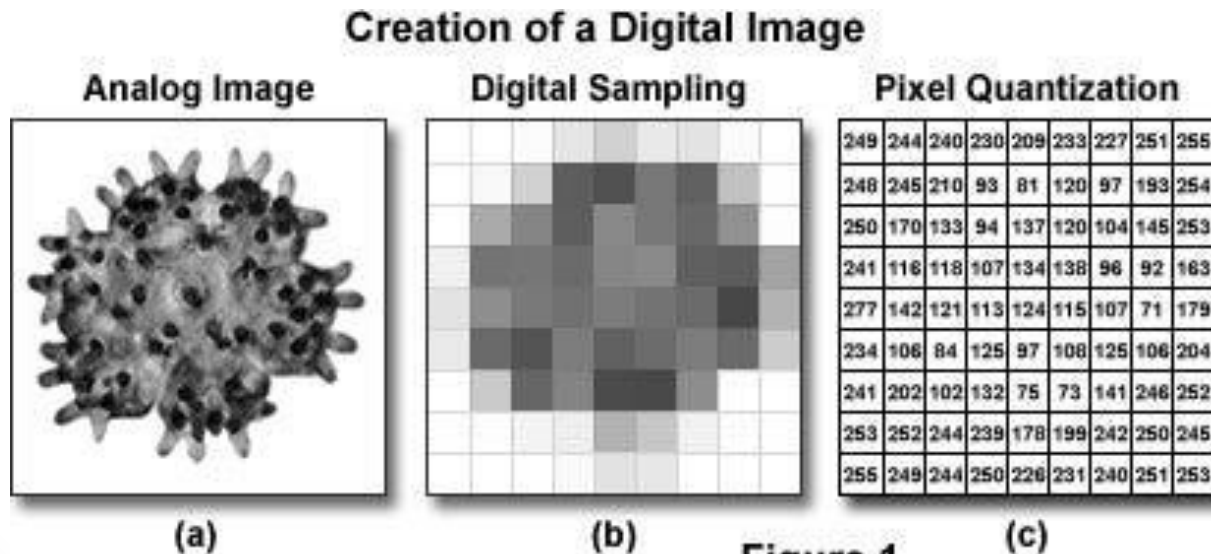


Introduction to Image Processing

Duangpen Jetpipattanapong

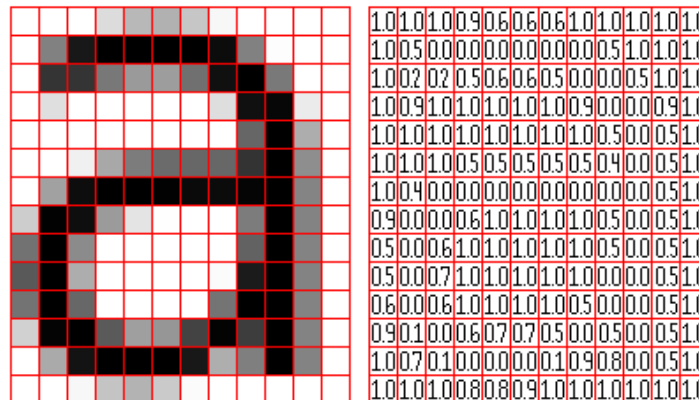
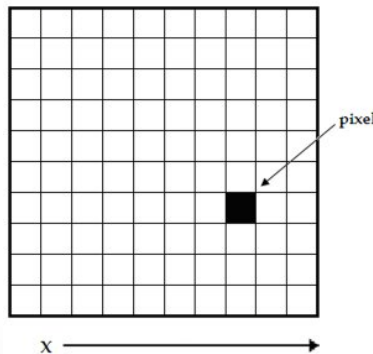
What is an image?

- The signal representation as a **2D function $F(x,y)$** where x and y are spatial coordinates.
- The amplitude of F at a particular value of x,y is known as the **intensity** of an image at that point.
- If x,y , and the amplitude value is finite then we call it a **digital image**.



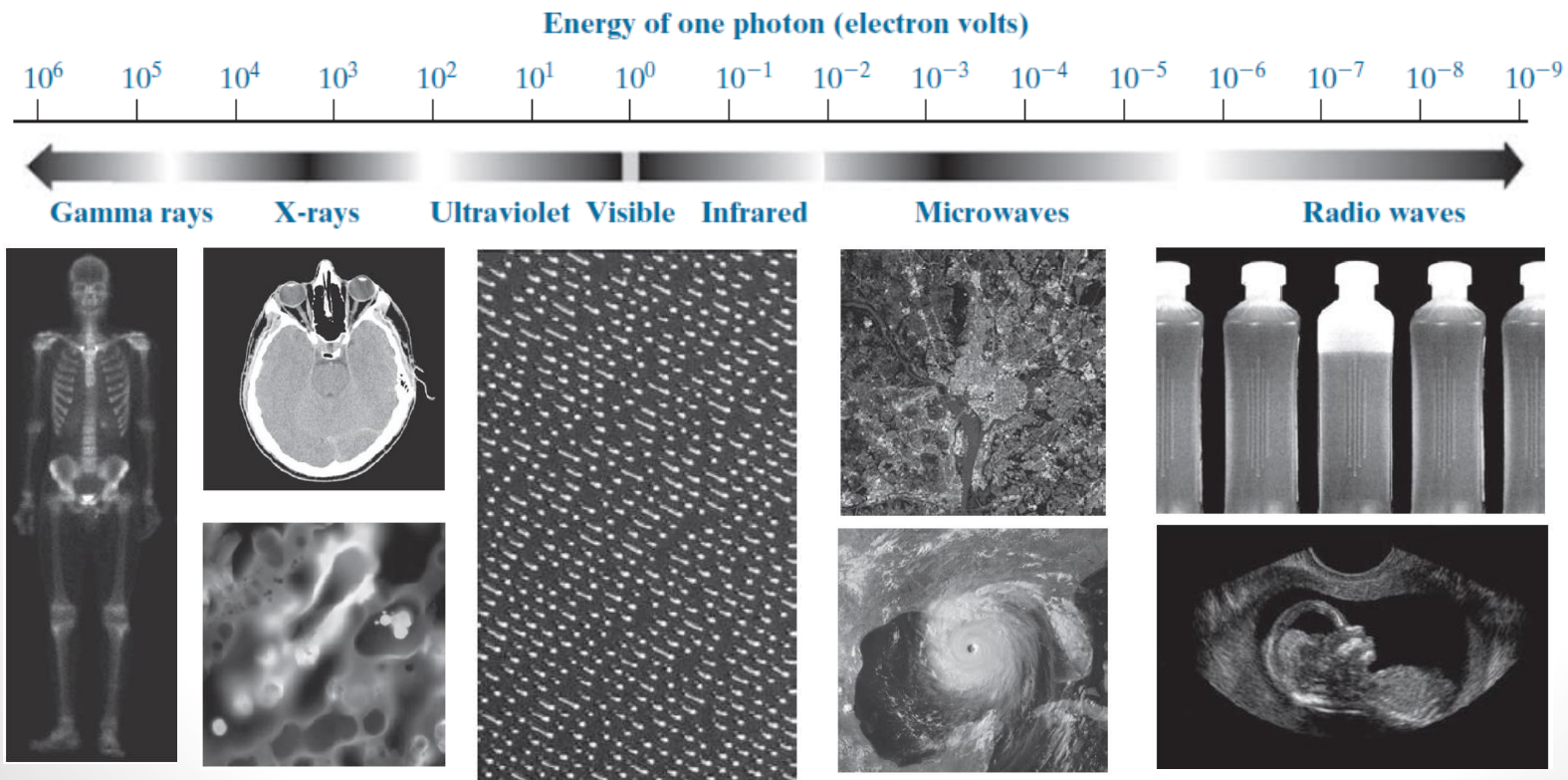
What is an image?

- Digital image can be represented as an **array of pixels** arranged in columns and rows.
- Pixels are the elements of an image that contain information about **intensity and color**.
- The dimensions (height and width) of digital images based on the number of pixels.
 - For example, if the dimensions of an image are 500 x 400 (width x height), the total number of pixels in the image is 200000.



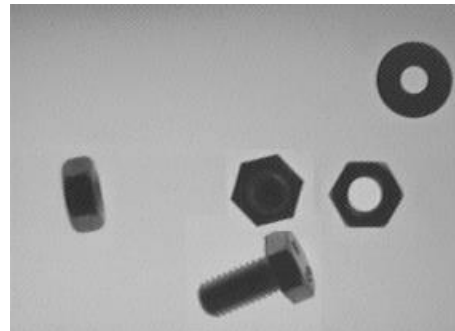
What is an image?

- Images based on radiation from the electromagnetic (EM) spectrum are the most familiar, especially
- images in the **X-ray** and **visual bands** of the spectrum.



What Is Image Processing?

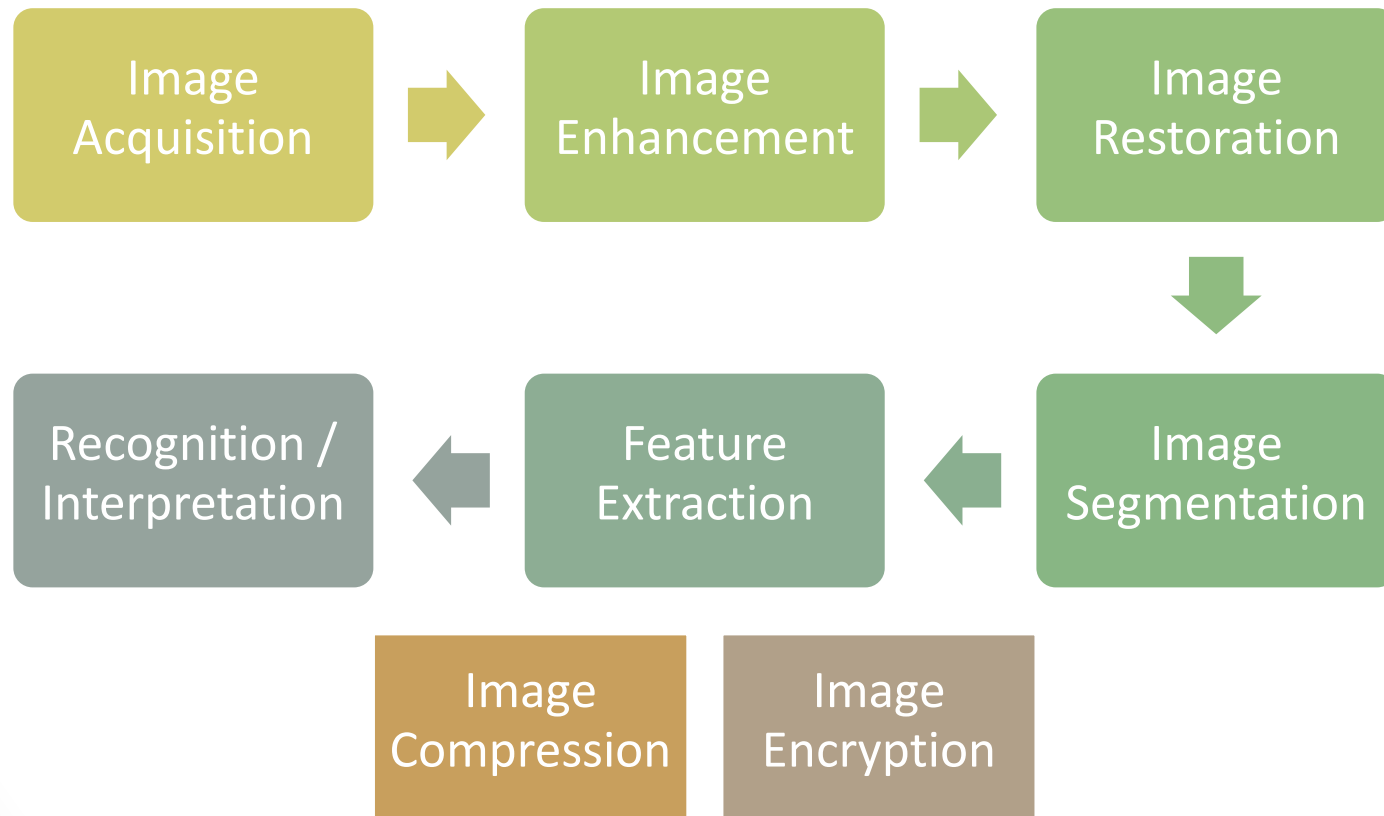
- Image processing **transforms an image into a digital form** and **performs certain operations** to get useful information.
- Image processing involves performing operations on an image to **make it better** or to **get important information** from it.
- The input is an image, and the output can be **a better image** or some **important details** from the image. This can be used for further analysis and decision-making.



three types of
objects, *nuts, rings,*
and *screws*

- The area of an object
- The aspect ratio
- The number of holes
- The number of contour sides

Fundamental Steps of Image Processing



Purpose of Image Processing

- There are five main purpose of the DIP :

Sharpening and restoration

- Create an enhanced image from the original image

Visualization

- Find objects that are not visible in the image

Recognition

- Distinguish or detect objects in the image

Measurement of pattern

- Measure the various patterns around the objects in the image

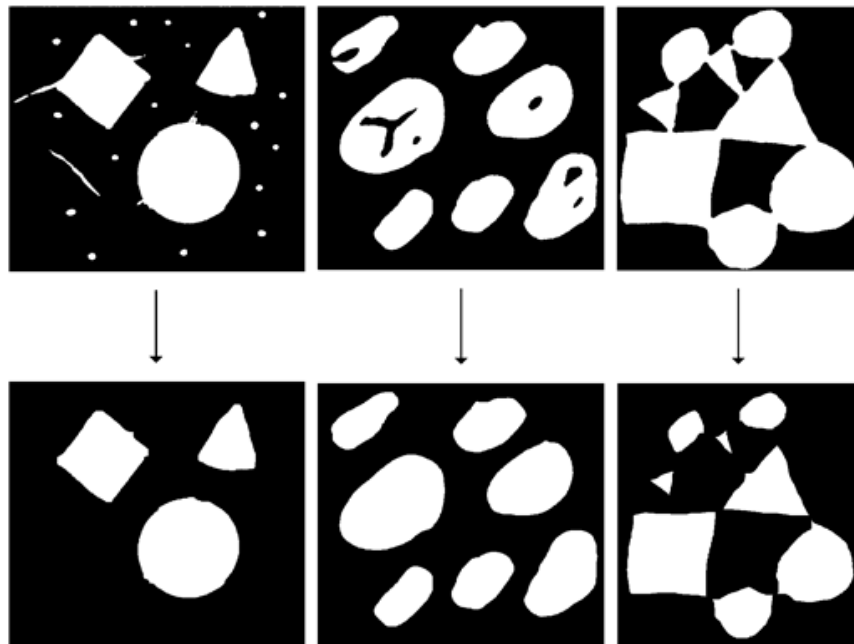
Image Retrieval

- Browse and search images from a large database of digital images that are similar to the original image

Classic image processing algorithms

Morphological Image Processing

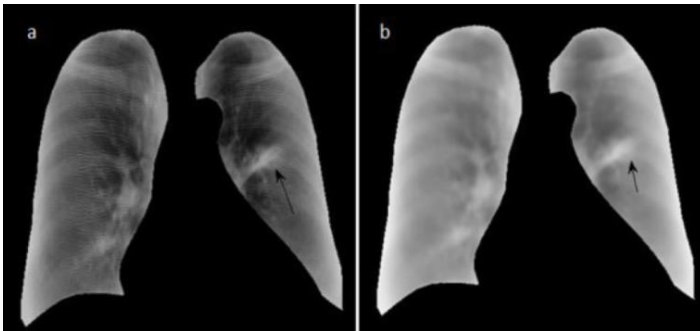
- **remove the imperfections from the binary images** because binary regions produced by simple thresholding can be distorted by noise. It also helps in smoothing the image using opening and closing operations.



Classic image processing algorithms

Gaussian Image Processing

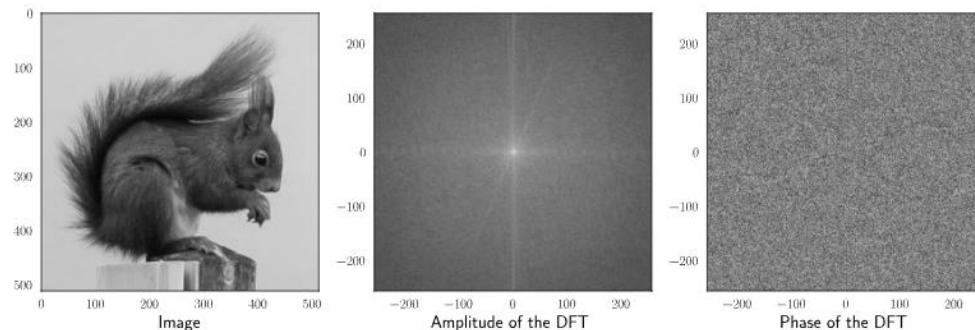
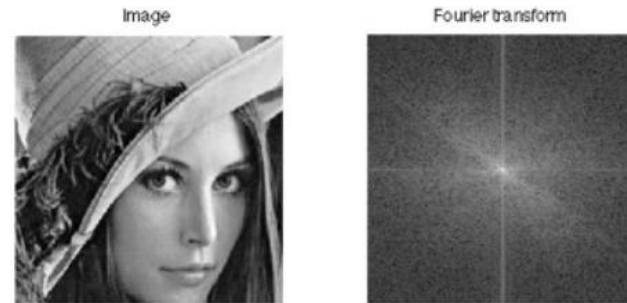
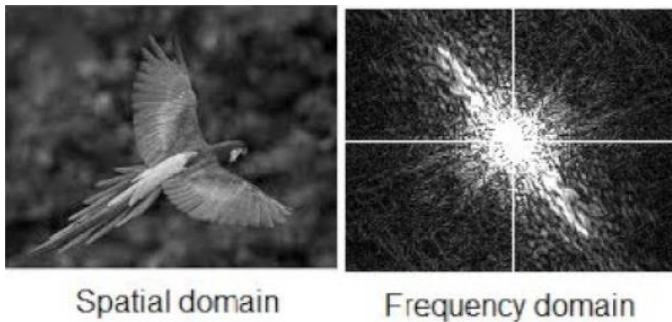
- Gaussian blur, also known as Gaussian smoothing, results from blurring an **image** by a **Gaussian** function.
- It is used to **reduce image noise and reduce details**.



Classic image processing algorithms

Fourier Transform in image processing

- Fourier transform breaks down an image into sine and cosine components.
- It has multiple applications like image reconstruction, compression, and filtering.



Classic image processing algorithms

Edge Detection in image processing

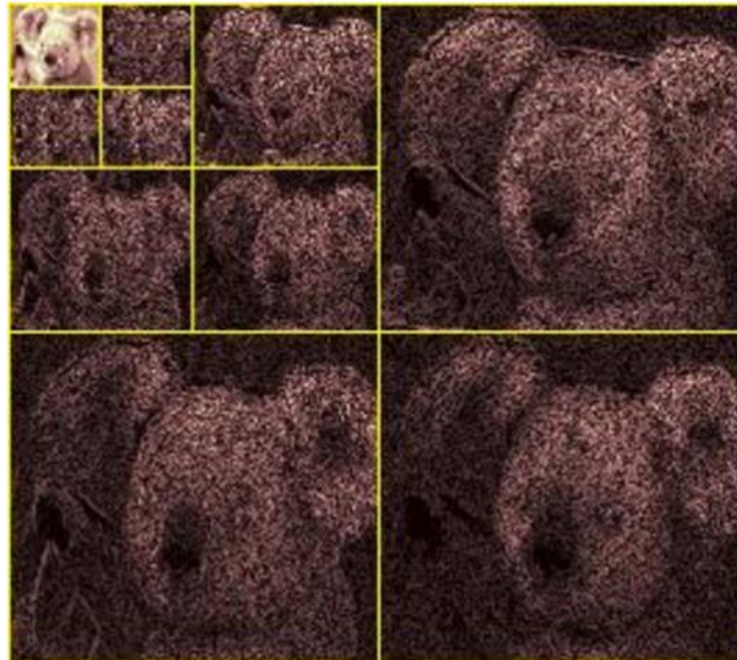
- Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness.
- This could be very beneficial in extracting useful information from the image because most of the shape information is enclosed in the edges.



Classic image processing algorithms

Wavelet Image Processing

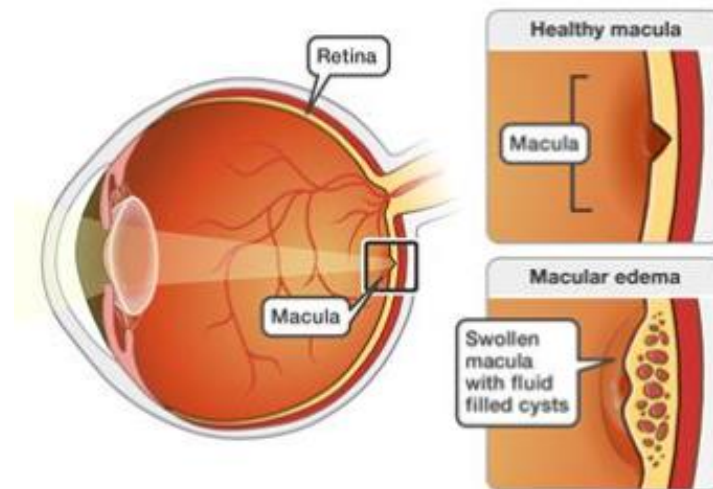
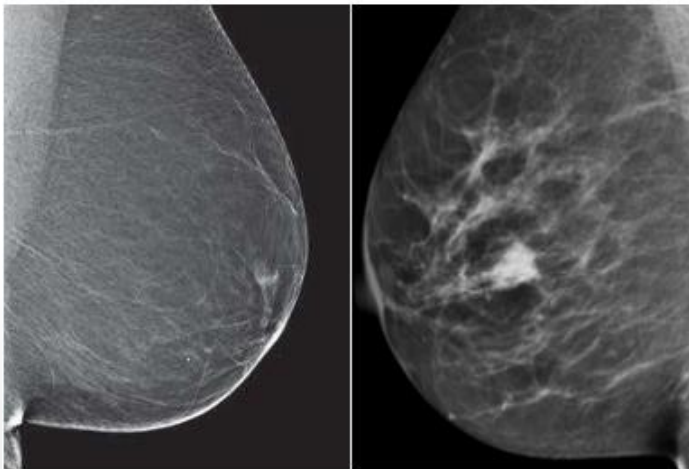
- Wavelets take both **time and frequency** into consideration. This transform is apt for non-stationary signals.



Applications of Image Processing

Medical Image Retrieval

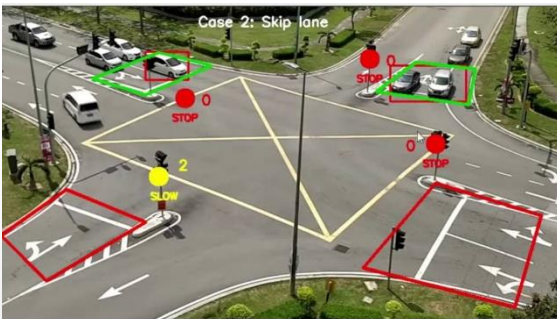
- Image processing has been extensively used in medical research, enabling more efficient and accurate treatment plans.
 - Ex. The early detection of breast cancer in breast scans.
 - Ex. Diabetes can damage the retina's blood vessels, causing eye damage or retinopathy.



Applications of Image Processing

Traffic Sensing Technologies

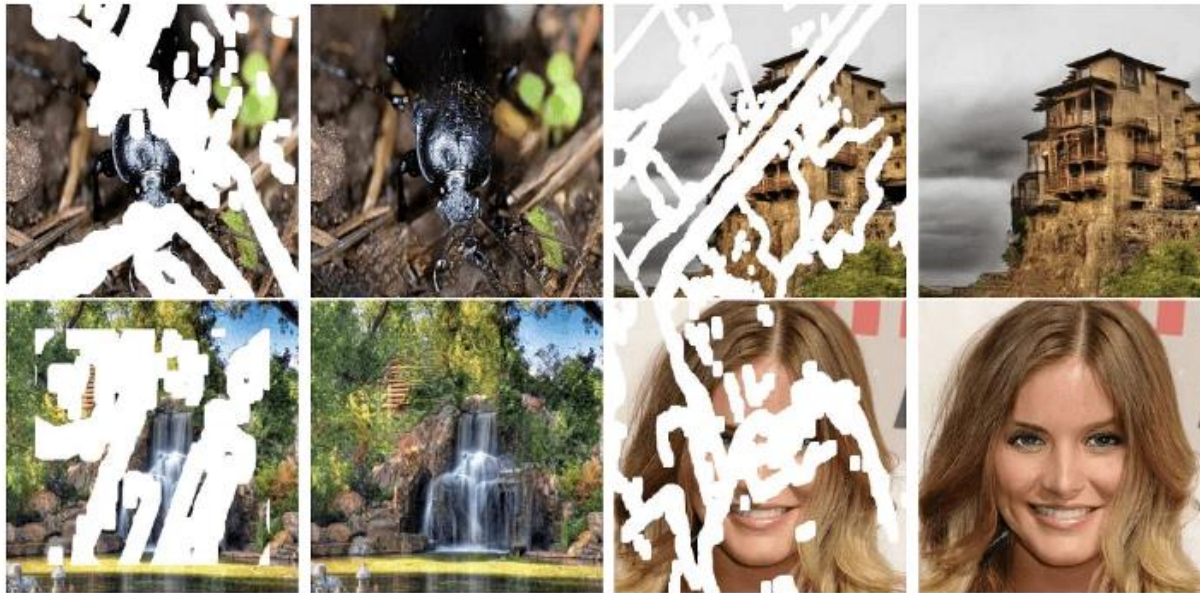
- In the case of traffic sensors, the detection zones can be set up for multiple lanes and used to sense the traffic in a particular station.
- Besides this, it can auto-record the vehicle's license plate, distinguish the type of vehicle, monitor the driver's speed on the highway, and lots more.



Applications of Image Processing

Image Reconstruction

- To recover and fill in an image's missing or corrupt parts.
- This involves the extensively trained process with existing photo datasets to create newer versions of old and damaged photos.



Applications of Image Processing

Face Detection and Recognition

- the machine is first trained with the specific features of human faces, such as the shape of the face, the distance between the eyes, etc. Then, accept all objects in an image resembling a human face.
- Face detection is a vital tool used in security, biometrics, and even filters available on most social media apps.

