4105Computer Vision

Lecture 1

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What is the difference between Computer Vision and Image Processing?

- Computer Vision:
  - Is the use of seen as a major input that governs actions.
  - Includes Image processing
  - In other words, make it more useful, extract data, and/or learn something from image.

- Image Processing
  - Image processing means to perform objective operations on the images.
  - Includes: acquisition and digitization, enhancement, restoration, segmentation, detection, representation, description, recognition, encoding, steganography, watermarking, ……..

What is the objective of Digital image processing/ Computer vision?

- The ultimate goal of digital Image processing/computer vision is building up
  - “Digital image processing-based system”
  - ” Computer vision system”

- Systems that uses digital Image as a major input with possible other inputs.
- Such systems enabled due to
  - Advances in acquisition systems as well as,
  - Processing platforms
  - Researchers' efforts in computer visions: open-source libraries (such as openCV, matlab)

Sample systems: Computer vision/Image processing

- Smart bombs: Those store the target picture and have the maneuver ability to hit the target precisely.
- Smart missiles: The missiles that use in its terminal phase guidance based on pre-stored images to correct any minor deviations from the destination target.
- Security systems (face recognition, fingerprints)
- Material analysis (using Image processing ease the identification of deformation or cracks in metal alloy)
- Machine Control or quality control (visual inspection)

Sample Systems: Computer Vison/Image Processing cont

- Medical (X-ray, Sonar)
- Auto-Drive
- Robotics
- Motion Detection
- Smart Cities
- Remote sensing
- Law enforcement
- Data Encoding (send a coded information within a photo)

Digital Image processing based /Computer vision systems

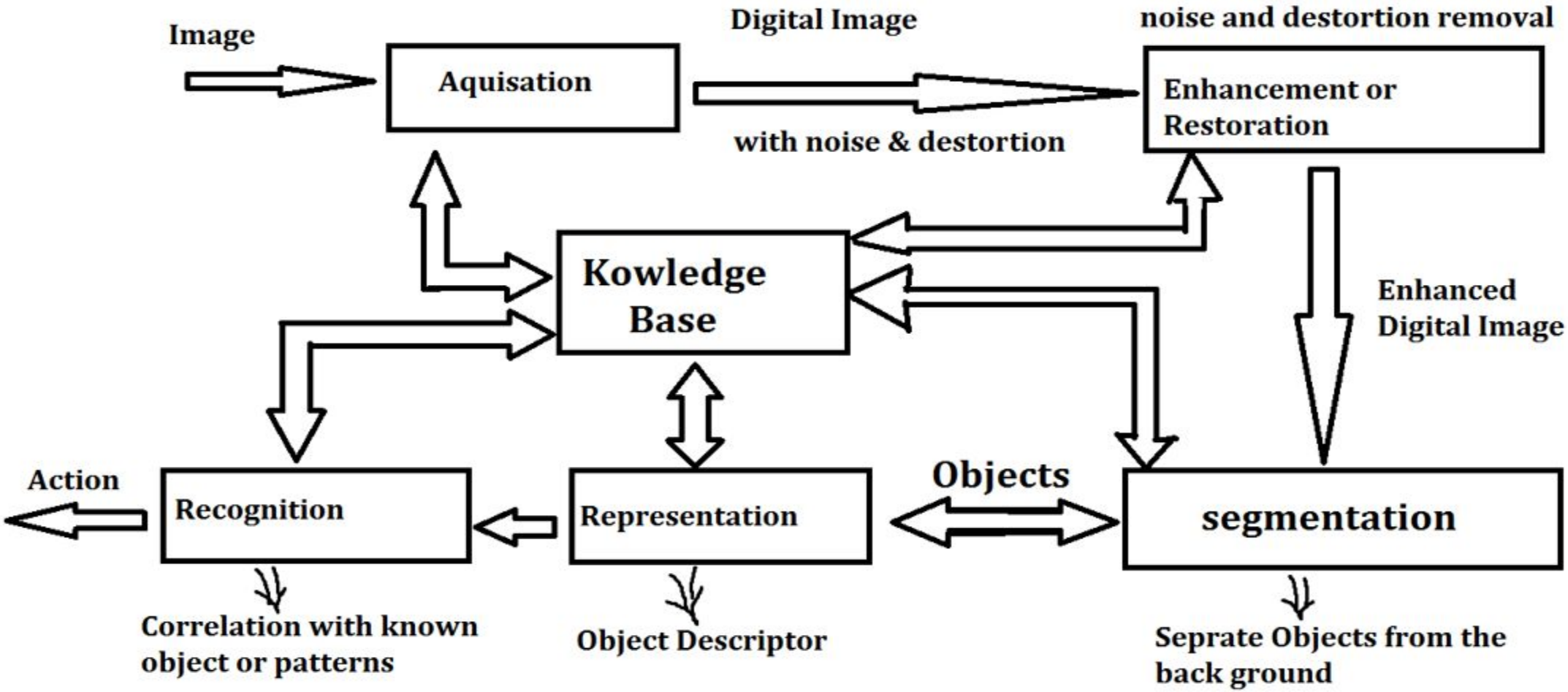
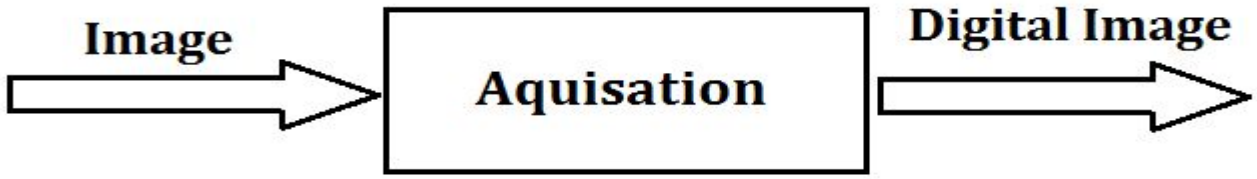


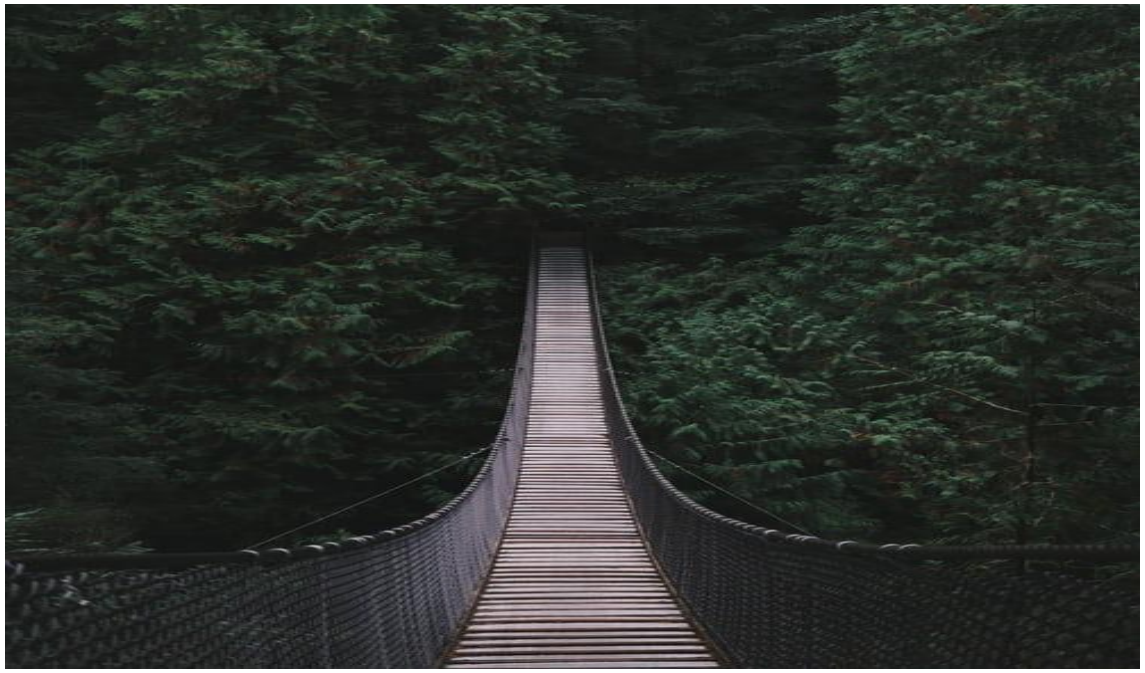
Fig 1: Image processing based systems

Basic Elements of the system

- Acquisition
- Enhancement
- Restoration
- Segmentation
- Description
- Feature extraction
- Detection
- Recognition
- Encoding/Decoding

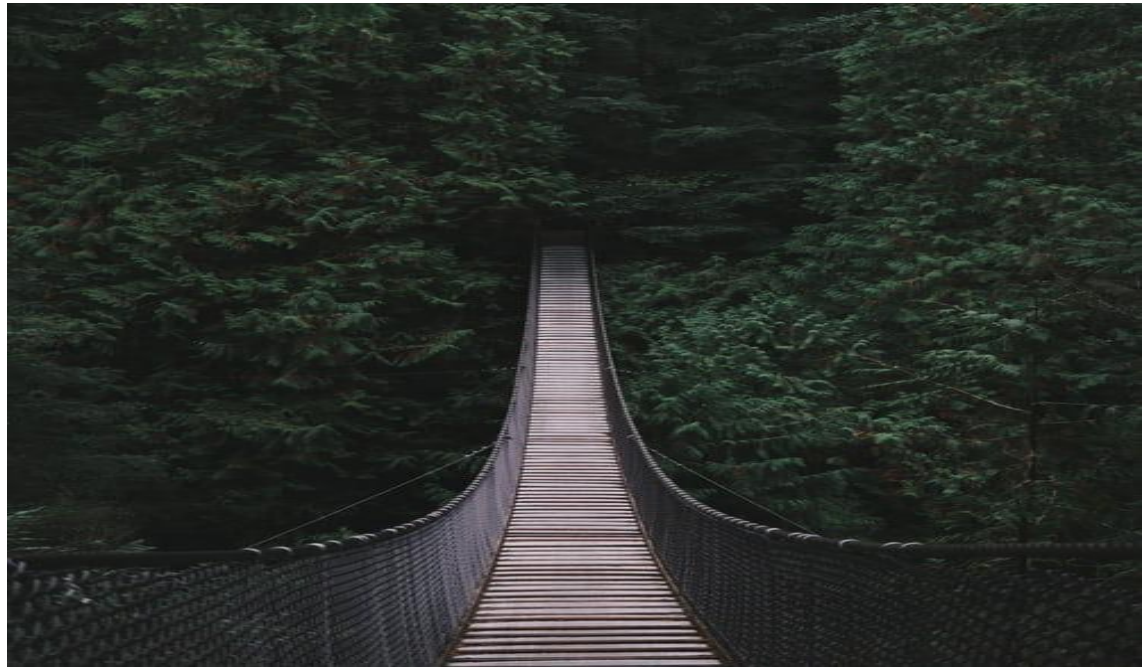
1) Image Acquisition/Image Digitation





- Computers stores and process Numbers
- Computer memory is of finite size
- Processing Power has ceiling

Images



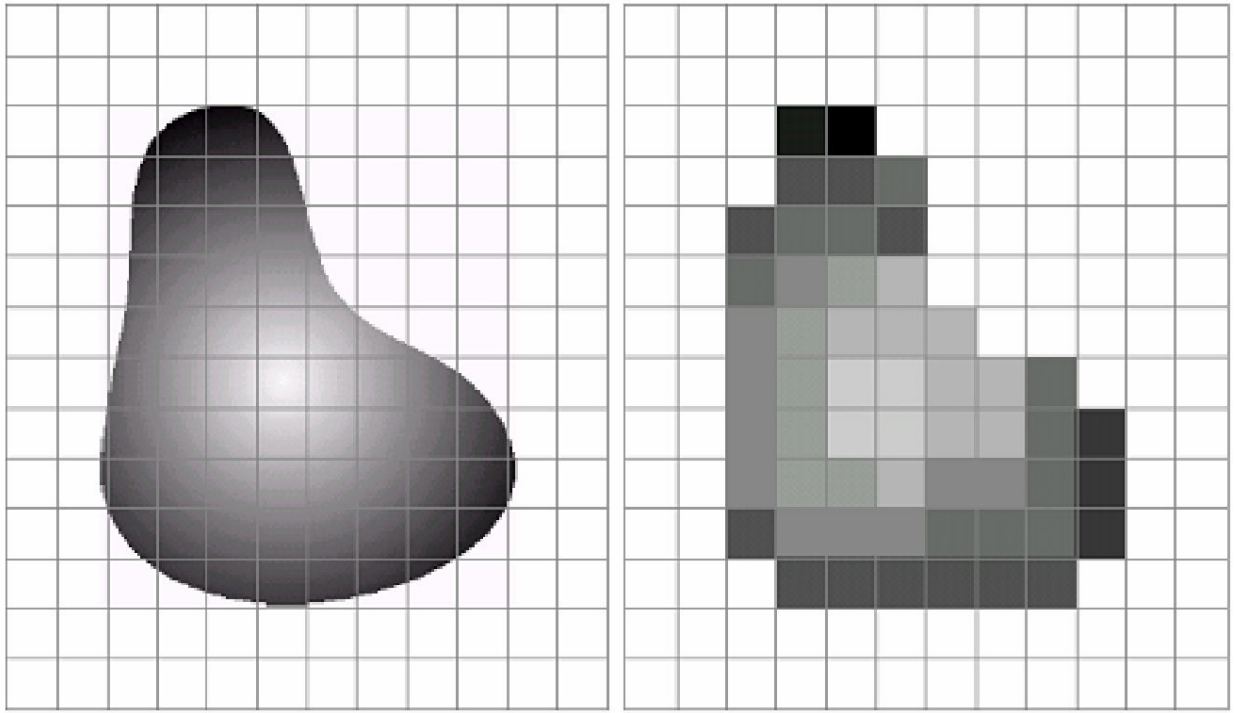
- Images in General
  - Infinite positions in x
  - Infinite positions in Y
  - Infinite Possible Colors

So, images has to be turned to numbers of finite sizes to be able to store and process:
SAMPLING AND QUANTIZATION

Sampling and Quantization

- Image process step done during acquisition to digitize an image
- **Sampling:**
  - Divide the image into samples: "N" in "x" and "M" in "y" as result we will have "M x N" picture elements (image elements or pels) which is called pixels.
  - The pixels are the intersection of x-axis samples with y-axis samples.
  - The outcome is an image grid over the Image.
- **Quantization**
  - group interval of greys/colors into single value to form finite number of colors/grays
  - Quantization done on the output of the sensors set per pixel
  - The outcome is color/gray index within the range.
  - Sensors could be gray that produce a reading per pixel or 3 readings (RED, GREEN,BLUE)
  - Quantization levels counts or quantization bits q is directly linked to colors/gray resolutions
  - Number of possible colors/grays are 2^q
- Image resolution is :MxNxq

Samples and Quantization cont



Fine sampling
- Good image
- Precise description
- High memory requirements
- Processing power needed is very big
- Transmit require high bandwidth channels

Coarse Sampling
- poor image
- false contouring
- low memory requirements
- low processing power
- low bandwidth sufficient

Image Resolution

- Directly points to the quality, memory requirements, processing powers, and transmit time.
- Quantization Levels does any level counts make a sense?
  - L =1,2,3,4,5,6,7,8,….?

- In General, Digital Image Processing perspective
  - Is an Image matrix which is finite matrix of integer values or
  - 3 image matrices for color images
- Color Images quantizes to 24 bit are called true color images
- Color images resolutions nowadays are over eye resolutions