Digital Image Processing (750474) Lecture 2

Outline of the Lecture

- ➢ **Fundamental Steps in Digital Image Processing.**
- ➢ **Components of a Digital Image Processing System.**

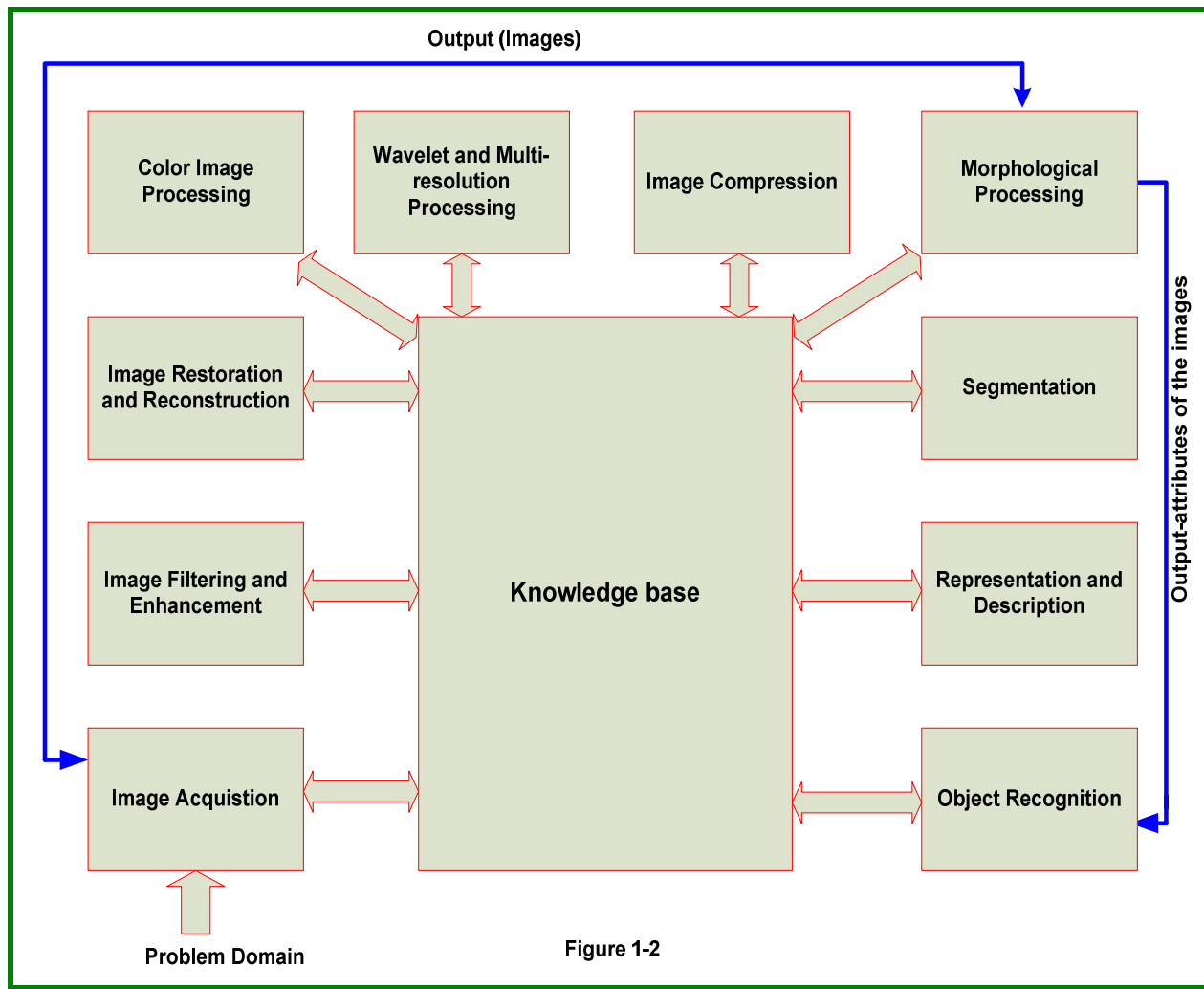## Fundamental Steps in Digital Image Processing

Figure 1-2

Step 1. Image Acquisition:

- • In this step, the image is captured by a **sensor** (such as a monochrome or color TV camera) and **digitized**, if the output of the camera or sensor is not already in digital form- an **analog-to-digital** converter (**ADC**) digitizes it.
  - o **Camera:**

Camera consists of 2 parts:
- ➢ A **lens** that collects the appropriate type of radiation emitted from the object of interest and that forms an image of the real object.
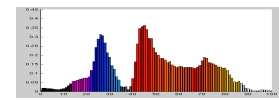
> ➢ `Semiconductor device` – so called charged coupled device or `CCD` which converts the **irradiance** at the image plan into an **electrical signal**.
> - o `Frame Grabber`
> ➢ Frame Grabber only needs circuits to **digitize the electrical signal** (standard video signal) from imaging sensor to store the image in the memory (RAM) of the computer.

Step 2. Image Enhancement:
- `Image Enhancement` is the process of manipulating an image so that the result is more suitable than the original for specific applications. Enhancement techniques are so varied, and use so many different image processing approaches.

Step 3. Image Restoration:
- `Improving` the appearance of the image.
- Tend to be `mathematical or probabilities models` of image degradation.

Step 4. Color Image Processing:
- Use the `color` of the image to extract features of interest in an image.

Step 5. Wavelets:
- Used in image data `compression` and `pyramidal representation`.

Step 6. Compression:
- Techniques Compression for
  - o Reducing the storage required to `save` an image.
  - o Reducing the size of the image to `transmit` it ("**JPEG Standard**"), with suitable bandwidth required for transmission.

Step 7. Morphological Processing:
- Morphological Processing are the `tools` for extracting image' components that are useful in the representation and description of shape.

Step 8. Image Segmentation:
- Computer tries to separate `objects` from the image background.
- It is one of the most `difficult tasks` in DIP.
- `Segmentation kinds`:
  - o `Autonomous Segmentation.`
  - o `Rugged Segmentation` (long process to get successful solution).
  - o `Erratic Segmentation`.

Step 9. Representation and Description:
- Representation makes a decision whether the data should be represented as a `boundary` or as a `complete region`:
  - o `Boundary Representation` focuses on `external` shape characteristics, such as corners and inflections.
  - o `Region Representation` focuses on `internal` properties, such as texture or skeleton shape.

Step 10. Recognition and Interpretation:
- Recognition is the process that assigns `label` to an object based on the information provided by its `descriptors`.
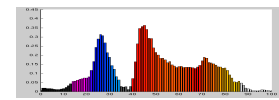
Step 11.   Knowledge base:
- The Knowledge base also controls the **interaction between modules**. The knowledge about a problem is coded into an image processing system in the form of a Knowledge base.

Components of a Digital Image Processing System

1. Image Sensors
   ➢ Physical device that is sensitive to the **energy** radiated by the object.
   ➢ Digitizer that converts the output of the physical sensing device into digital form.

Figure 1-3: Digital Video Camera
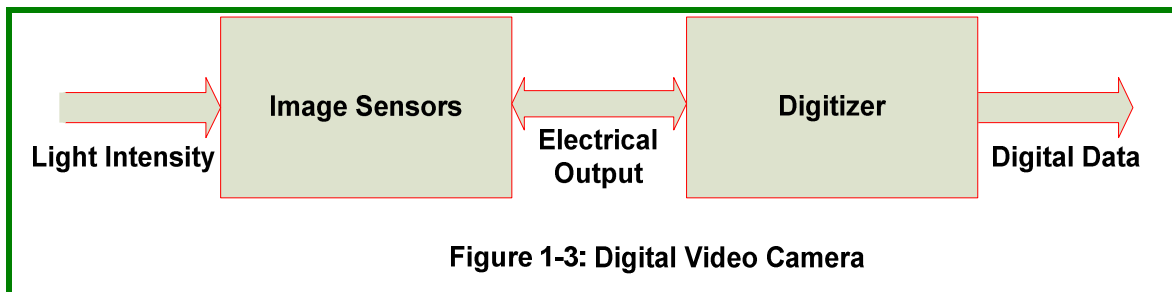
2. Specialized Image Processing Hardware
   ➢ Specialized Image Processing Hardware usually consists of the digitizers and hardware that performs other primitive operations, such as arithmetic logic unit (ALU). Speed is the most important parameter (30 frames /sec).

3. Specialized Image Processing Software
   ➢ Specialized Image Processing Software is specialized modules that perform specific tasks.

4. Computer: Image processing system: from computer to a supercomputer.

5. Mass Storage Capability:
   ➢ It is a must in image processing applications (image size of 1024x1024 pixels, with intensity level for each pixel : 8 bits, requires one Megabyte for saving)
   ➢ **Mass Storage categories**:
     o **Short-term storage** for use during processing.
     o **On-line storage** for relatively fast operations.
     o **Archival storage** for infrequent access.

6. Image Displays: Flat screen TV monitors.

7. Hardcopy: devices for recording images: laser printers, film cameras, CD-ROM disk, others.

8. Networking: the key parameter is the bandwidth.