



University of Kurdistan

Digital Image Processing (DIP)

Lecture1: An Introduction to DIP

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Introduction

*“One picture is worth more than
ten thousand words”*

Anonymous



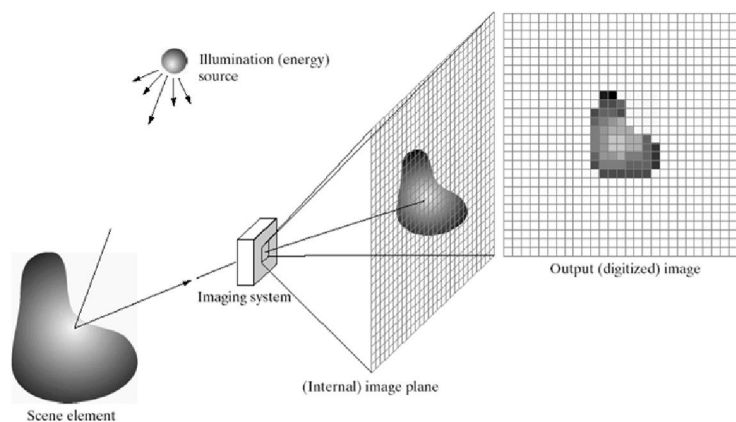
Contents

- This lecture will cover:
 - What is a digital image?
 - What is digital image processing (DIP)?
 - History of digital image processing
 - Key stages in digital image processing
 - State of the art examples of digital image processing



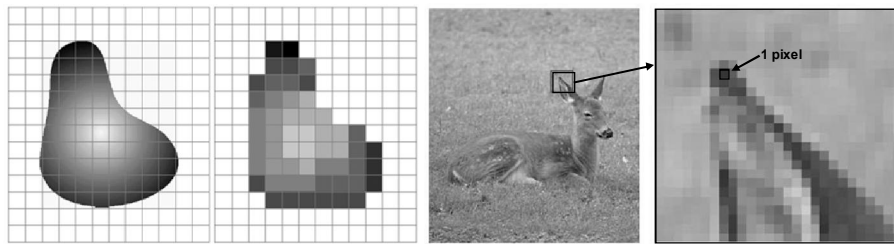
What is a digital image?

- A **digital image** is a representation of a two-dimensional image as a finite set of digital values, called picture elements or pixels.



What is a digital image? (cont...)

- Pixel values typically represent gray levels, colors, heights, opacities, etc.
- Remember digitization implies that a digital image is an approximation of a real scene.



What is a digital image? (cont...)

- Common image formats include:
 - 1 sample per point (B&W or Grayscale)
 - 3 samples per point (Red, Green, and Blue)
 - 4 samples per point (Red, Green, Blue, and “Alpha”, a.k.a. Opacity)



- For most of this course we will focus on grey-scale images.



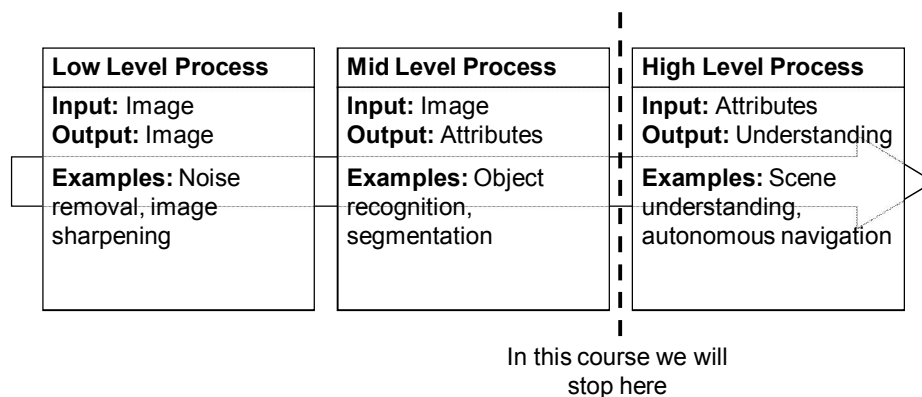
What is digital image processing (DIP)?

- Digital image processing focuses on two major tasks:
 - Improvement of pictorial information for human interpretation.
 - Processing of image data for storage, transmission, and representation for autonomous machine perception.
- Some argument about where image processing ends and fields such as image analysis and computer vision start.

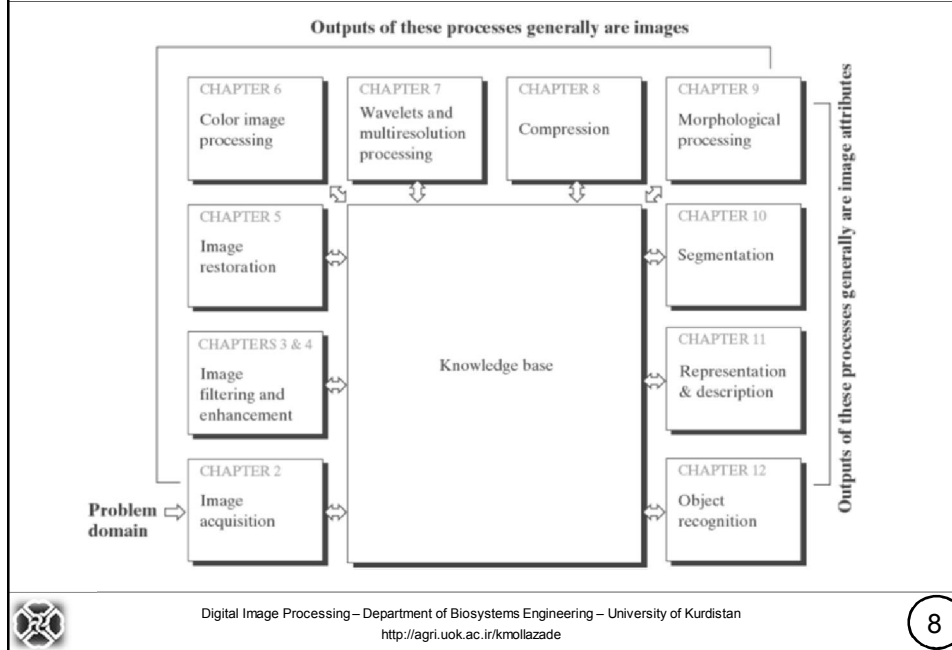


What is digital image processing (DIP)? (cont...)

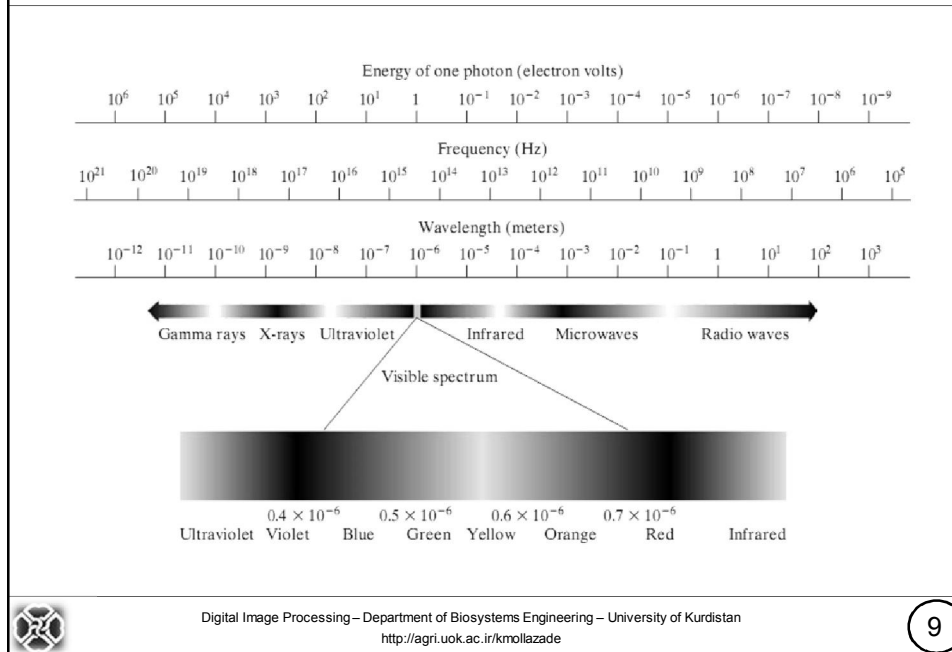
The continuum from image processing to computer vision can be broken up into low-, mid- and high-level processes.



Fundamental Steps in DIP



Radiation from electromagnetic (EM) spectrum



History of DIP

Early 1920s: One of the first applications of digital imaging was in the newspaper industry.



Early digital image

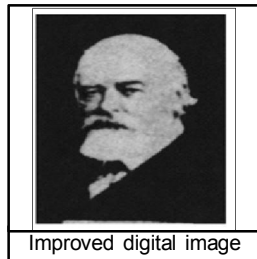
- The Bartlane cable picture transmission service.
- Images were transferred by submarine cable between London and New York.
- Pictures were coded for cable transfer and reconstructed at the receiving end on a telegraph printer.



History of DIP (cont...)

Mid to late 1920s: Improvements to the Bartlane system resulted in higher quality images.

- New reproduction processes based on photographic techniques.
- Increased number of tones in reproduced images.



Improved digital image



Early 15 tone digital image



History of DIP (cont...)

1960s: Improvements in computing technology and the onset of the space race led to a surge of work in digital image processing.

- **1964:** Computers used to improve the quality of images of the moon taken by the *Ranger 7* probe.
- Such techniques were used in other space missions including the Apollo landings.



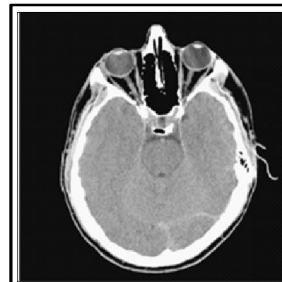
A picture of the moon taken by the Ranger 7 probe minutes before landing



History of DIP (cont...)

1970s: Digital image processing begins to be used in medical applications.

- **1979:** Sir Godfrey N. Hounsfield & Prof. Allan M. Cormack share the Nobel Prize in medicine for the invention of tomography, the technology behind Computerised Axial Tomography (CAT) scans.



Typical head slice CAT image



History of DIP (cont...)

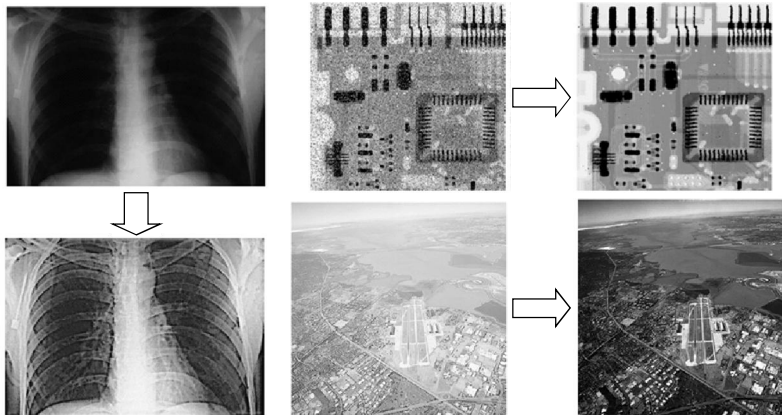
1980s - Today: The use of digital image processing techniques has exploded and they are now used for all kinds of tasks in all kinds of areas.

- Image enhancement/restoration
- Medical visualisation
- Industrial inspection
- Law enforcement
- Human computer interfaces (HCI)



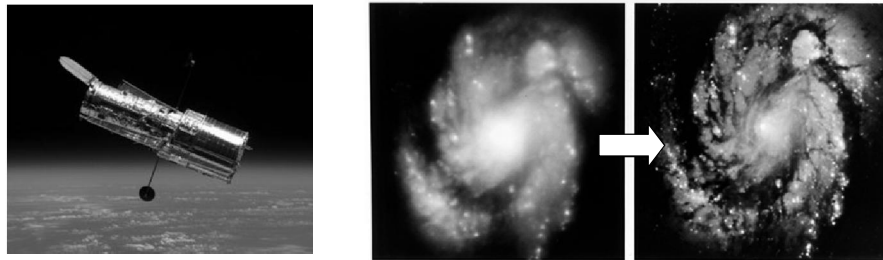
Examples: Image Enhancement

One of the most common uses of DIP techniques: improve quality, remove noise, etc.



Examples: The Hubble Telescope

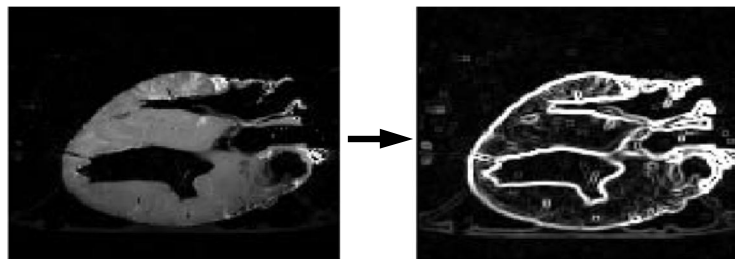
Launched in 1990 the Hubble telescope can take images of very distant objects. However, an incorrect mirror made many of Hubble's images useless. Image processing techniques were used to fix this.



Examples: Medicine

Take slice from MRI scan of canine heart, and find boundaries between types of tissue.

- Image with gray levels representing tissue density.
- Use a suitable filter to highlight edges.



Original MRI Image of a Dog Heart

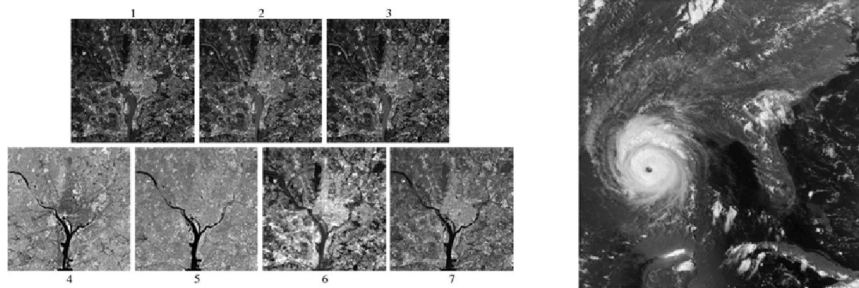
Edge Detection Image



Examples: GIS

Geographic Information Systems (GIS)

- Digital image processing techniques are used extensively to manipulate satellite imagery.
- Terrain classification
- Meteorology



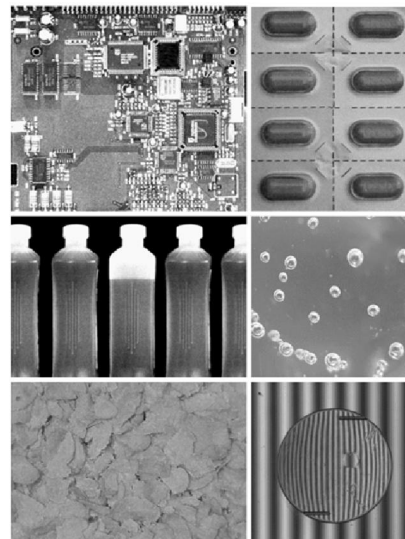
Examples: Industrial Inspection

Human operators are expensive, slow, and unreliable.

Make machines do the job instead.

Industrial vision systems are used in all kinds of industries.

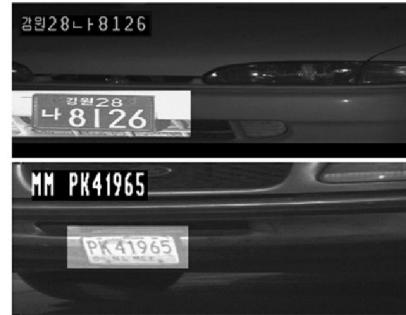
Can we trust them?



Examples: Law Enforcement

Image processing techniques are used extensively by law enforcers.

- Number plate recognition for speed cameras/automated toll systems
- Finger print recognition
- Enhancement of CCTV images



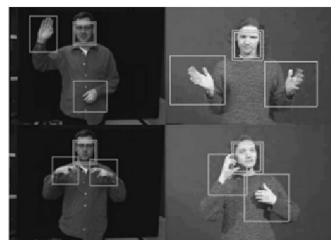
Examples: HCI

Try to make human computer interfaces more natural.

- Face recognition
- Gesture recognition

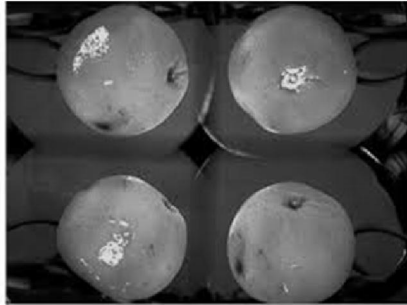
Does anyone remember the user interface from “Minority Report”?

These tasks can be extremely difficult.



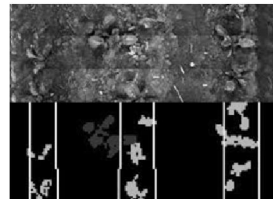
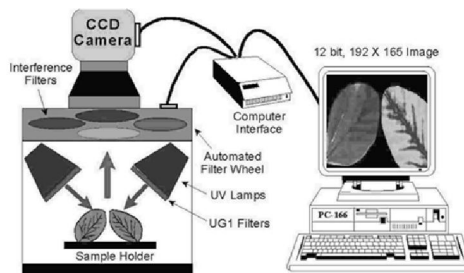
Applications: Biosystems Engineering (BE)

Sorting and grading of fruits and vegetables



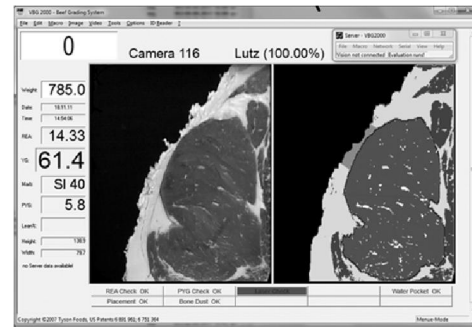
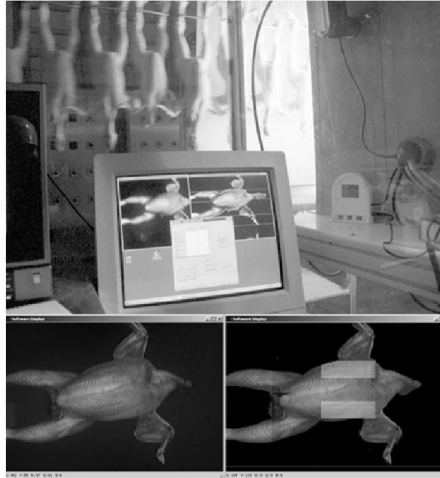
Applications: Biosystems Engineering (BE)

Plant diseases detection / Weed detection



Applications: Biosystems Engineering (BE)

Poultry / meat quality inspection



Applications: Biosystems Engineering (BE)

Food quality evaluation



- Other examples

What do you think?



Summary

- We have looked at:
 - What is a digital image?
 - What is digital image processing?
 - Key stages in digital image processing
 - History of digital image processing
 - State of the art examples of digital image processing
- Next time we will start to see how it all works...

