
technology
digital
computer
internet
image processing


PROCESSING


Nikon

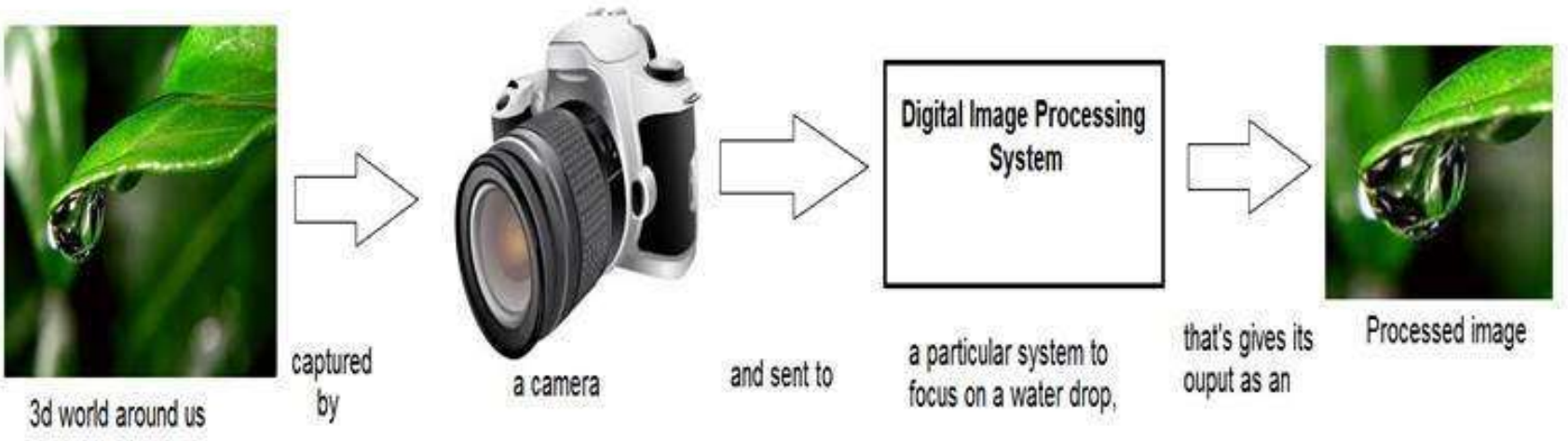
Contents

- What is image processing ?
- Why image processing is needed?
- What is digital image processing ?
- Steps in Image processing
- Applications

- Image processing is manipulating an image to achieve a preferred reality.

- However, image processing is more accurately defined as a means of translation between the human visual system and digital imaging devices.

DIGITAL IMAGE PROCESSING



- The human visual system does not perceive the world in the same manner as digital detectors, with display devices imposing additional noise and bandwidth restrictions.

- Image processing must be approached in a manner consistent with the scientific method so that others may reproduce, and validate, one's results.

- A digital image is composed of picture elements, of ones and zeros. *f* Converting an image into digital format can be done with a digital camera,

- Digital Image Definition
- Fundamental steps in Digital Image

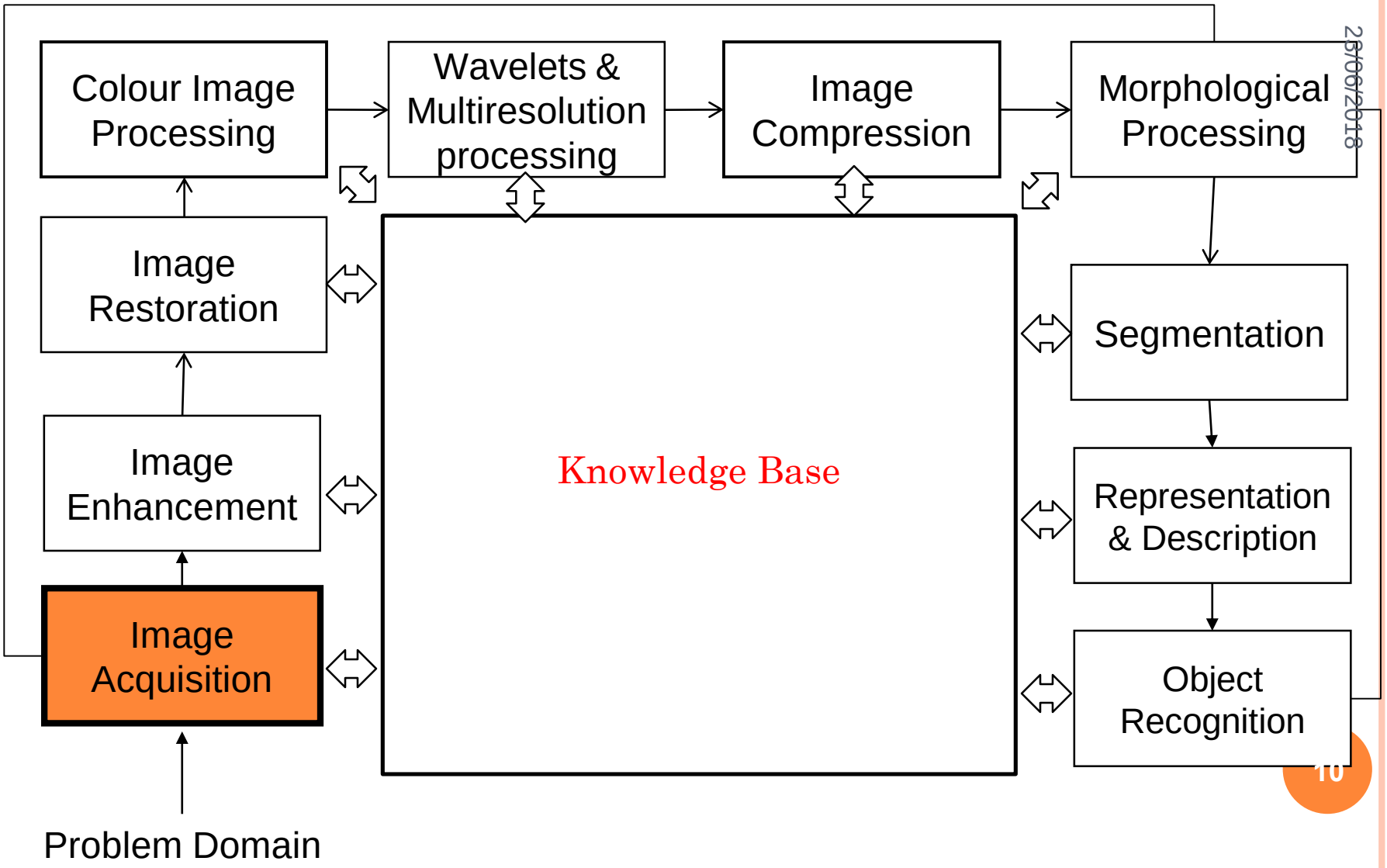
Digital Image Definition

- An image can be defined as a two-dimensional function f(x,y)
- x,y: Spatial coordinate
- f: the amplitude of any pair of coordinate x,y, which is called the intensity or gray level of the image at that point.
- x,y and f, are all finite and discrete quantities.


ANALOG
DIGITAL

Fundamental Steps in Digital Image Processing:

Outputs of these processes generally are images

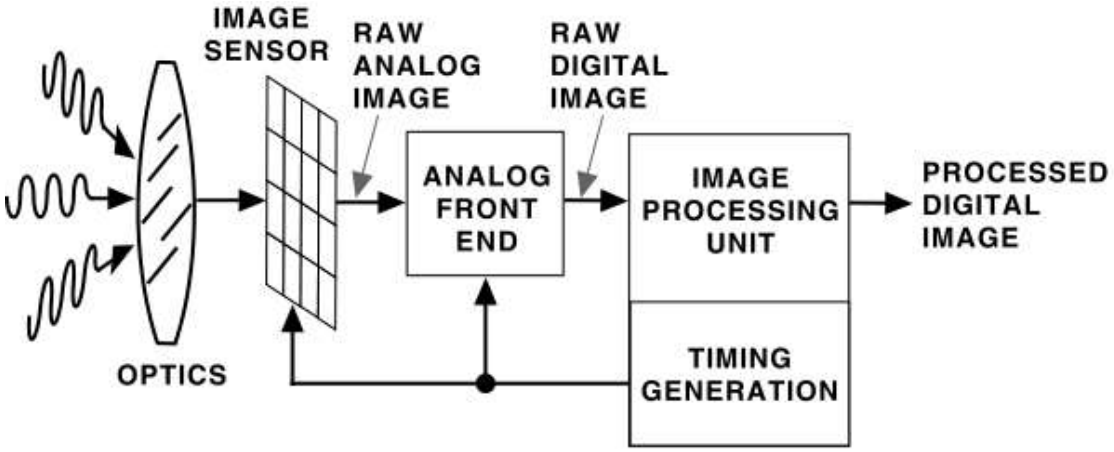


Outputs of these processes generally are image attributes

Fundamental Steps in DIP

- **Step 1: Image Acquisition**

The image is captured by a sensor (eg. Camera), and digitized if the output of the camera or sensor is not already in digital form, using analogue-to-digital convertor



Step 2: Image Enhancement

The process of manipulating an image so that the result is more suitable than the original for specific applications.

The idea behind enhancement techniques is to bring out details that are hidden, or simple to highlight certain features of interest in an image.

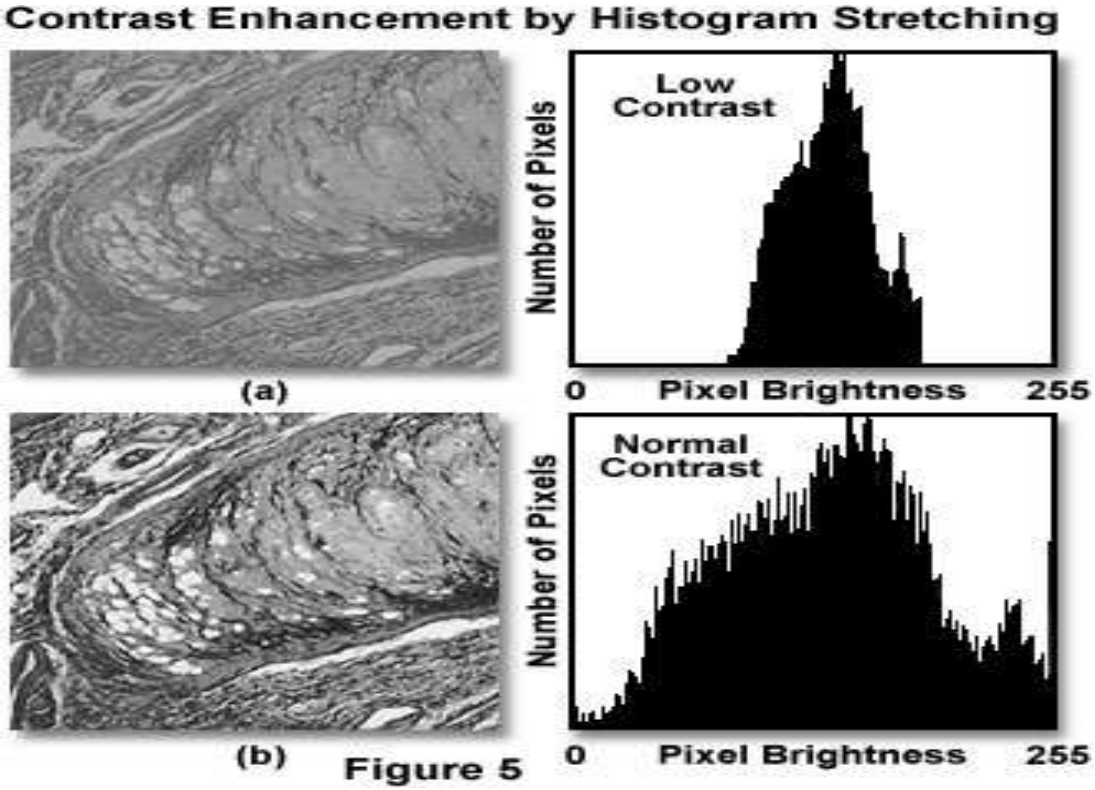


Figure 5

Step 3: Image Restoration

- Improving the appearance of an image

- Tend to be mathematical or probabilistic models. Enhancement, on the other hand, is based on human subjective preferences regarding what constitutes a “good” enhancement result.

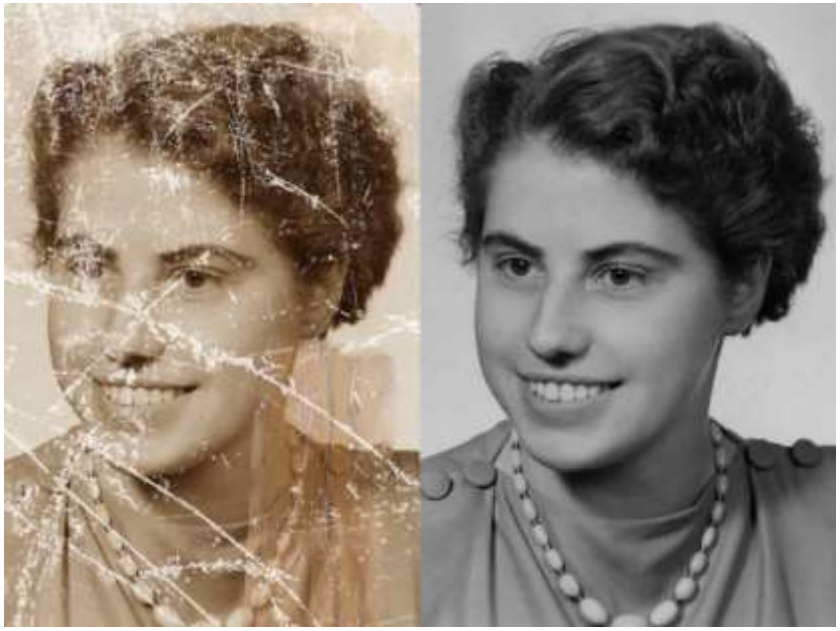
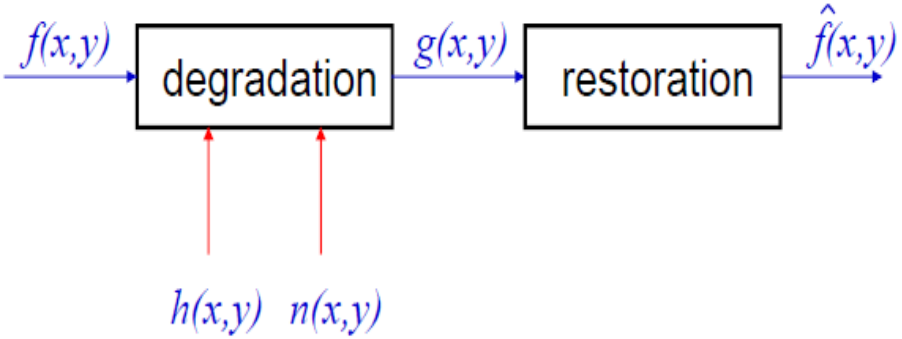


IMAGE DEGRADATIONS

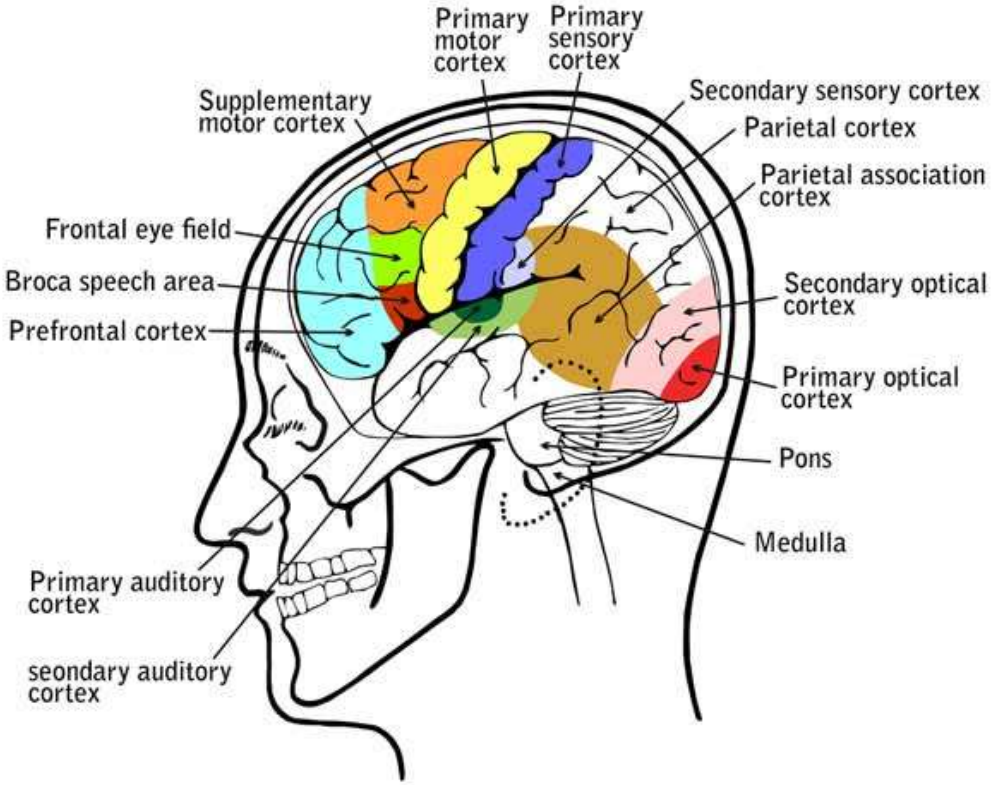
- motion blur, focus blur, resolution
- The inverse filter
  - $f(x,y)$ – image before degradation, 'true image'
  - $g(x,y)$ – image after degradation, 'observed image'
  - $h(x,y)$ – degradation filter
  - $\hat{f}(x,y)$ – estimate of $f(x,y)$ computed from $g(x,y)$
  - $n(x,y)$ – additive noise



$$g(x,y) = h(x,y) * f(x,y) + n(x,y) \Leftrightarrow G(u,v) = H(u,v)\,F(u,v) + N(u,v)$$

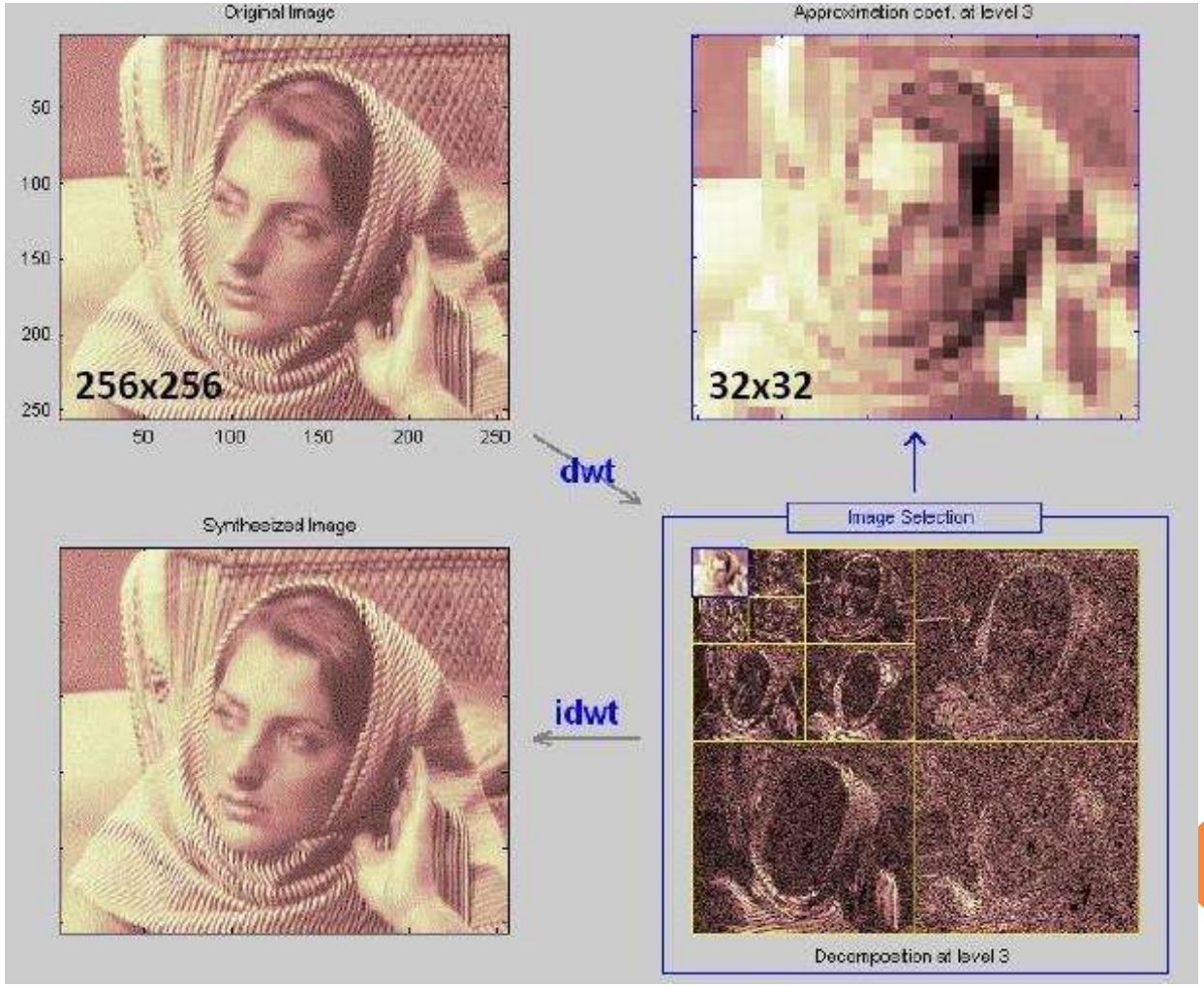
Step 4: Colour Image Processing

Use the colour of the image to extract features of interest in an image



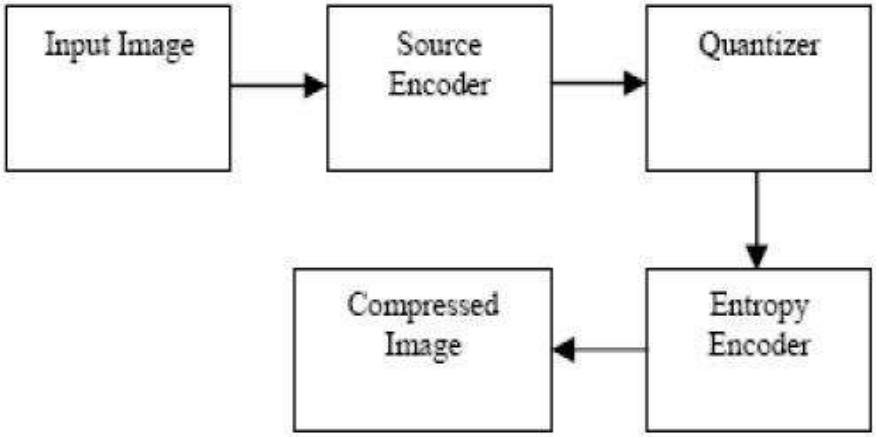
Step 5: Wavelets

Are the foundation of representing images in various degrees of resolution. It is used for image data compression.



Step 6: Compression

Techniques for reducing the storage required to save an image or the bandwidth required to transmit it.



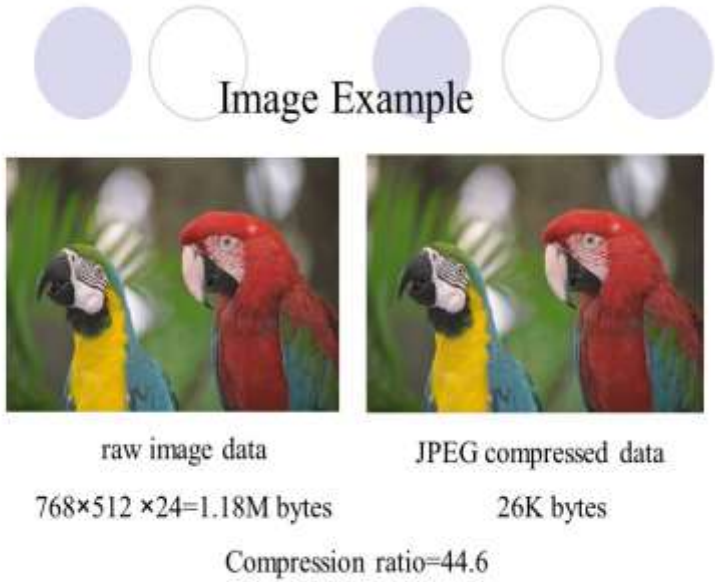
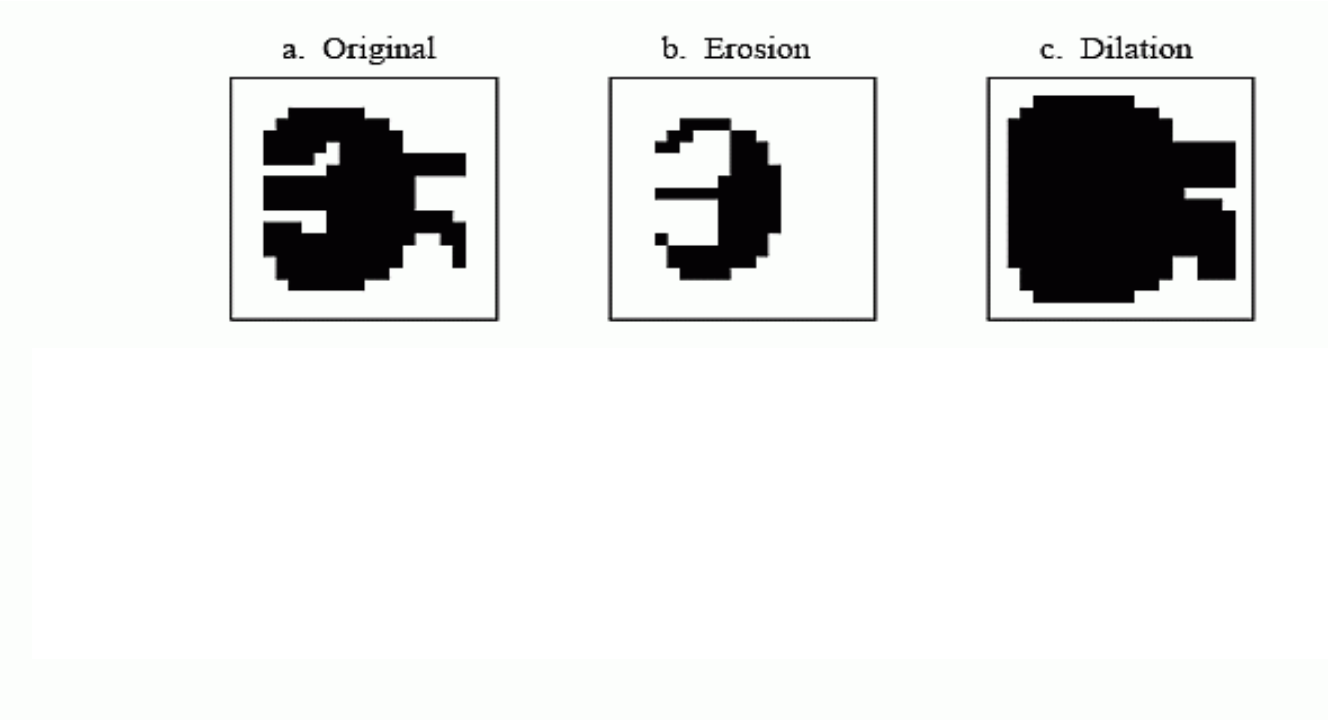


Image entropy is a quantity which is used to describe the `business' of an image, i.e. the amount of information which must be coded for by a compression algorithm. Low entropy images, such as those containing a lot of black sky, have very little contrast and large runs of pixels with the same or similar DN values.

Step 7: Morphological Processing

Tools for extracting image components that are useful in the representation and description of shape.

In this step, there would be a transition from processes that output images, to processes that output image attributes.



Step 8: Image Segmentation

Segmentation procedures partition an image into its constituent parts or objects.

The more accurate the segmentation, the more likely recognition is to succeed.

Step 9: Representation and Description

- **Representation:** Make a decision whether the data should be represented as a boundary or as a complete region. It is almost always follows the output of a segmentation stage.

- **Boundary Representation:** Focus on external shape characteristics, such as corners and inflections

- **Region Representation:** Focus on internal properties, such as texture or skeleton shape

- Choosing a representation is only part of the solution for transforming raw data into a form suitable for subsequent computer processing.

- **Description:** also called, ***feature selection***, deals with extracting attributes that result in some information of interest.

Step 10: Recognition and Interpretation

Recognition: the process that assigns label to an object based on the information provided by its description.

Step 10: Knowledge Base

Knowledge about a problem domain is coded into an image processing system in the form of a knowledge database.

Applications

- Detecting License Plate
- Detecting Text in Still Images
- Enhancing X-Ray Images
- Extracting Urban Areas in Google Maps Aerial Images
- Extracting Forest Areas in Google Maps Aerial Images
- Extracting Agricultural Fields in Google Maps Aerial Images