IMAGE PROCESSING OPERATIONS

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ABSTRACT

"The manipulation and analysis of information contained in images"

- Simple examples: glasses, TV settings, photo developing, etc.
- Advanced examples: CAM checking, OCR

Image Processing is any form of information processing for which the input is an image, such as photographs or frames of video; it is not necessary that output will be an image, it can be a set of features of the image. Most image processing techniques involve treating the image as a two dimensional signal and applying standard signal-processing techniques to it.

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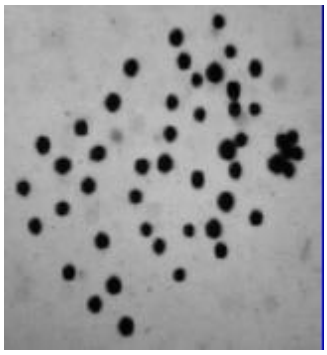
1. Introduction

Image analysis involves analyzing the image for useful content



- Some examples of image analysis are:

  – counting number of blood cells in an image

  – finding and tracking "missiles"

  – finding the zip code in the address on an envelope

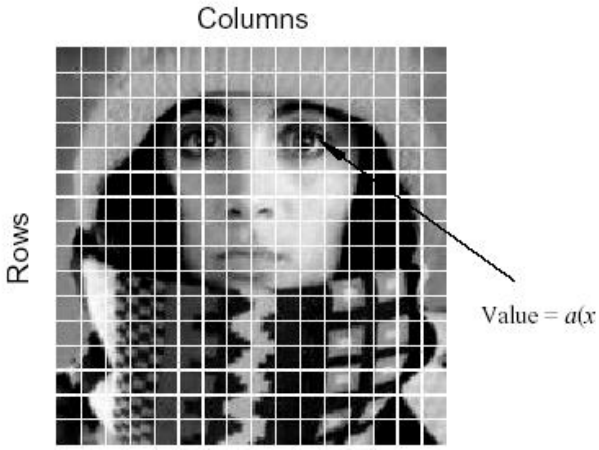
Purpose of image processing

- Image enhancement
- Pattern recognition
- Data reduction
- Image combination
- Data compression
- Image synthesis

A digital image $a[m, n]$ described in 2D discrete space is derived from an analog images $a(x, y)$ in a 2D continuous space through a *sampling* process that is frequently referred to as digitization.

The 2D continuous image $a(x, y)$ is divided into *N rows* and *M columns*. The

intersection of a row and a column is termed a ***pixel***. The value assigned to the integer coordinates [*m*,*n*] with {*m*=0,1,2,…,*M*–1} and {*n*=0,1,2,…,*N*–1} is *a*[*m*,*n*]. In fact, in most cases *a*(*x*,*y*)—which we might consider to be the physical signal is a function of many variables including depth (*z*), color (λ), and time (*t*).



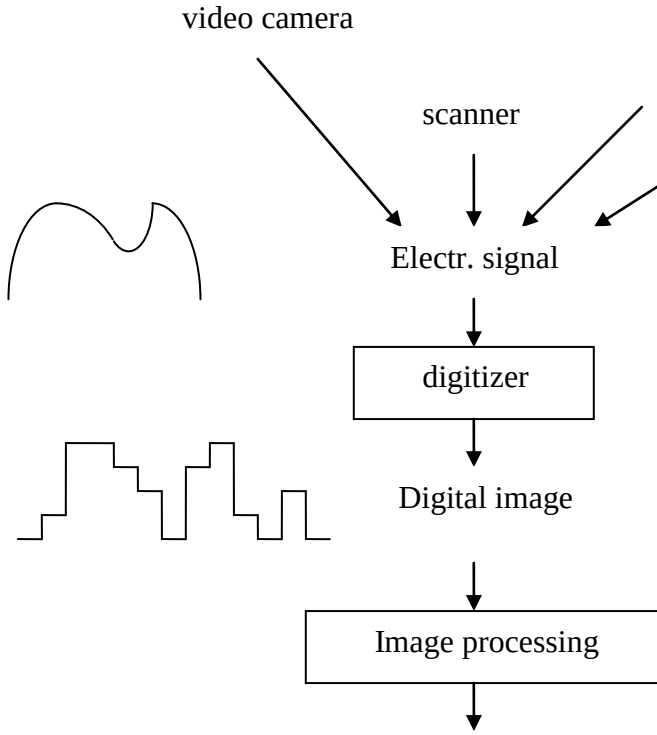
The image can now be represented as a matrix of integer value

Digital Image Processing

Digital image processing is a challenging domain of programming for several reasons. First the issue of digital image processing appeared relatively late in computer history, it had to wait for the arrival of the first graphical operating systems to become a true matter. Secondly, digital image processing requires the most careful optimisations and especially for real time applications.

Digital image processing focuses on two major tasks

- Improvement of pictorial information for human interpretation
- processing of image data for storage, transmission and representation (feature extraction) for autonomous machine perception



Digital image processing algorithms are used to perform image processing on digital images. Digital image processing is a subfield of Digital signal processing, so it has many advantages over analog image processing. Digital image processing allows using algorithms applied on input data, and can offer both more

sophisticated performance at simple tasks, and the implementation of methods which would be impossible by analog means, and can avoiding problems such as the build-up of noise and signaling distortion during processing.

Digital image processing is the only practical technology for:

- Classification
- Feature extraction
- Pattern recognition
- Projection
- Multi-scale signal analysis

Some techniques which are used in digital image processing include:

- Principal components analysis
- Independent component analysis
- Self-organizing maps
- Hidden Markov models
- Neural networks

Three levels of Digital Image Processing:

- Low – level Image Processing
  - Image preprocessing to reduce noise, contrast
  - Enhancement, image sharpening
  - Both inputs and outputs are images
- Mid – level Image Processing
  - Segmentation and description
  - The inputs are generally images, but outputs are attributes extracted from those images (e.g., edges, contours…)
- High – level Image Processing
  - Making sense of an ensemble of recognized objects

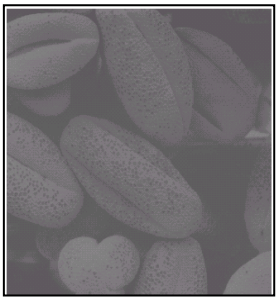
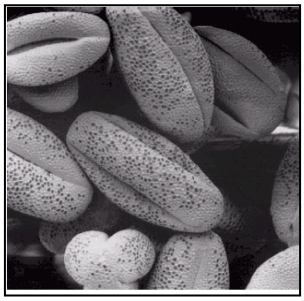
Low Level Process	Mid Level Process
Input: Image **Output:** Image **Examples:** Noise removal, image sharpening	**Input:** Image **Output:** Attributes **Examples:** Object recognition, segmentation

Fundamental Steps in Digital Image Processing

Digital image processing algorithms are used to perform image processing on digital images. There are many steps to perform image processing on digital images. All the steps interact with Knowledge base. Digital image processing is used to improve pictorial information for human interpretation and processing of image data for autonomous machine perception.

1. Image acquisition: - to acquire a digital image

2. Image enhancement: - To highlight some features of image in which we are interested.

3. Image Restoration: The purpose of image restoration is to "compensate for" or "undo" defects which degrade an image. Motion blur, noise, and camera misfocus are reasons of degradation.

4. Color image processing: Color images are indexed images or RGB (red, green, blue) images. RGB color images is an MXNX3 array of color pixels, where each color pixel is a triplet corresponding to the red, green, blue components of an RGB image at a specific spatial location. An indexed image has two components: a data matrix of integers, X, and a color map matrix, map. An indexed image uses" direct mapping" of pixels intensity values to color map values.

5. Wavelets and multiresolution processing: When digital images are to be viewed or processed at multiple resolutions, the discrete wavelet transform is used. A discrete wavelet transform (DWT) is any wavelet transform for which the wavelets (wavelet is that it is a mathematical function used to divide a given function or continuous-time signal into different scale components) are discretely sampled.

6. Image compression: Image compression is the application of Data compression on digital images. Image compression can be lossy or lossless.

7. Morphological processing: To extract image components that is useful in the representation and description of region shape, such as boundaries, skeletons, and the convex hull.

8. Image segmentation: to partitions an input image into its constituent parts or objects. Image segmentation is used to simplify the representation of an image into something which is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.)

9. Image representation: to convert the input data to a form suitable for computer processing.

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