Image Processing
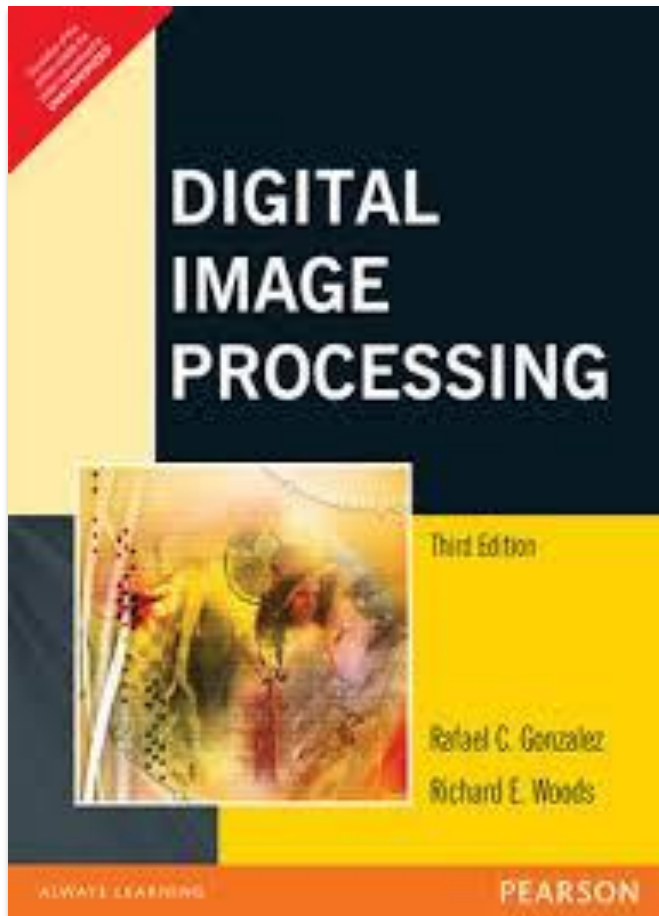
Semester VII

Department of Computer Engineering

Dharmsinh Desai University

Text Book

DIGITAL IMAGE PROCESSING

Third Edition

Rafael C. Gonzalez

Richard E. Woods

ALWAYS LEARNING

PEARSON

Title: Digital Image Processing
Author : Rafael C. Gonzalez
Richard E. Woods

Meaning of image processing

In today 's world, each day countless number of images (such as medical, surveillance and remote sensing) are collected using various image acquisition devices.

The course of actions taken to enhance the acquired image quality, to extract meaningful information from the acquired image, and to represent these information in a compact fashion is known as image processing.

Image Processing

Advantage of DIP Techniques

Digital image processing techniques have been significantly improving the accuracy of automatic decision making systems, dramatically reducing human intervention, as a result reducing the manual labor cost significantly.

Image Processing

➢ **Computer vision**

Ultimate goal is to use computers to emulate human vision, including learning and being able to make inferences and take actions based on visual inputs.

This area itself is a branch of artificial intelligence (AI) whose objective emulate human intelligence

There are no clear cut boundaries in the continuum from image processing at one to computer vision at the other.

Image Processing

➤ Computer vision

However, one useful paradigm is to consider three types of computerized processes in this continuum.

Low level processing

Involve primitive operations such as image preprocessing to reduce noise, contrast enhancement and image sharpening.

Input and output are images

Image Processing

➢Computer vision

Mid level processing

Involves tasks such as segmentation (partitioning an image into regions or objects)

Inputs are images and outputs are attributes extracted from those images (e.g. edges, objects)

Higher level processing

"making sense" of an ensemble of recognized objects, as in image analysis and at the far end of the continuum, performing the cognitive functions normally associated with vision.

Image Processing

➢Why do we need digital image processing?

➢Improvement of pictorial information for human perception

➢Noise filtering

➢Contrast enhancement

➢De blurring

➢Remote sensing

➢Brain tumor detection

➢Cancer detection

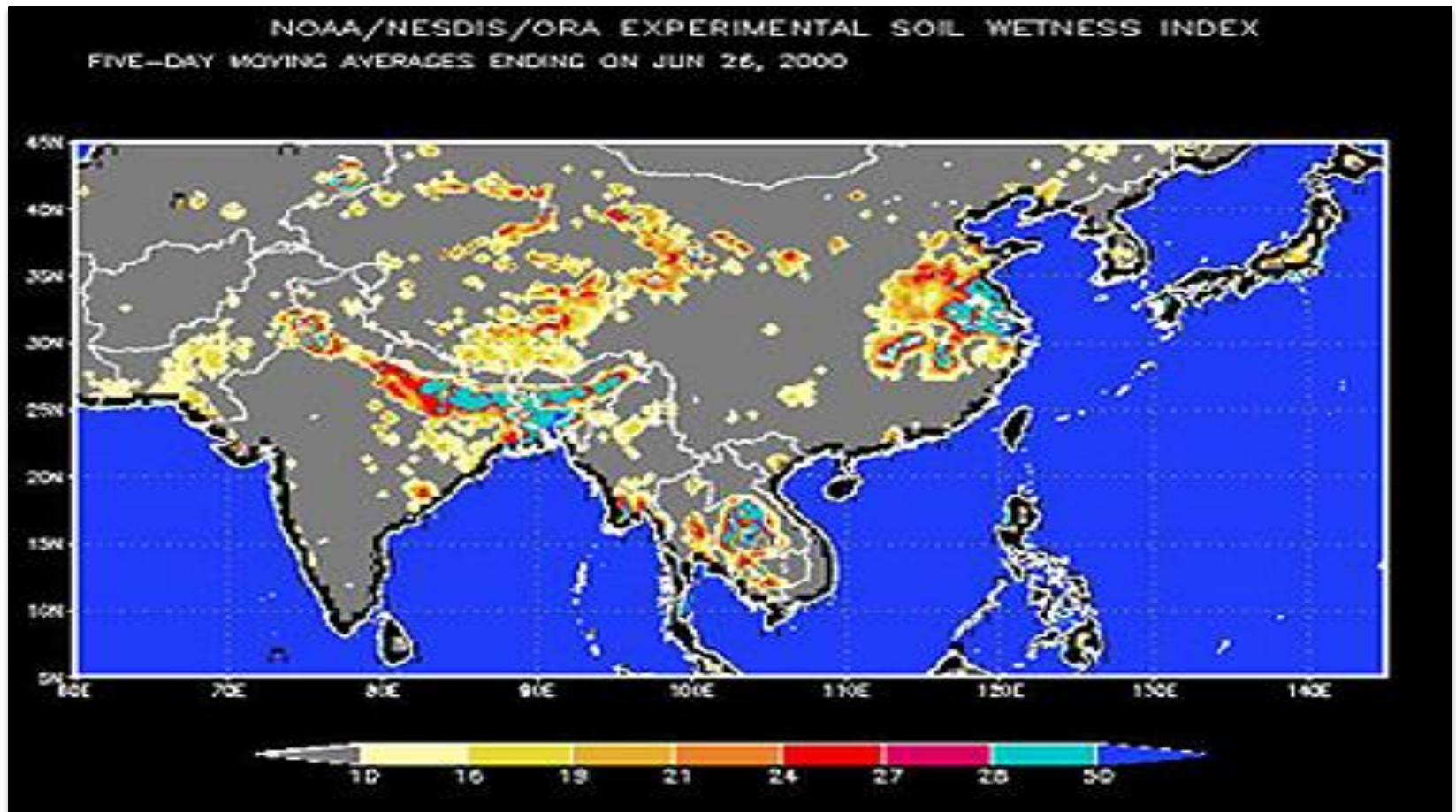➢Ultra sonogram

Image Processing applications

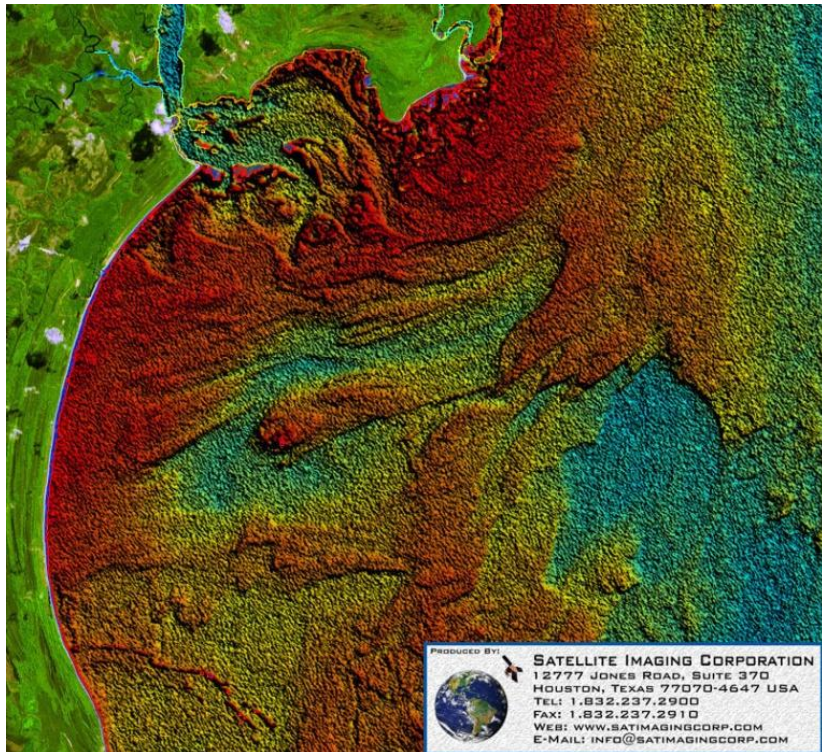Noise filtering

Contrast enhancement

De blurring

Remote Sensing

NOAA/NESDIS/ORA EXPERIMENTAL SOIL WETNESS INDEX
FIVE-DAY MOVING AVERAGES ENDING ON JUN 26, 2000

Geographic Information Systems: Satellite imaging for topographical analysis, urban development, agriculture crop estimation

Geographic Information Systems: Satellite imaging for topographical analysis, urban development, agriculture crop estimation
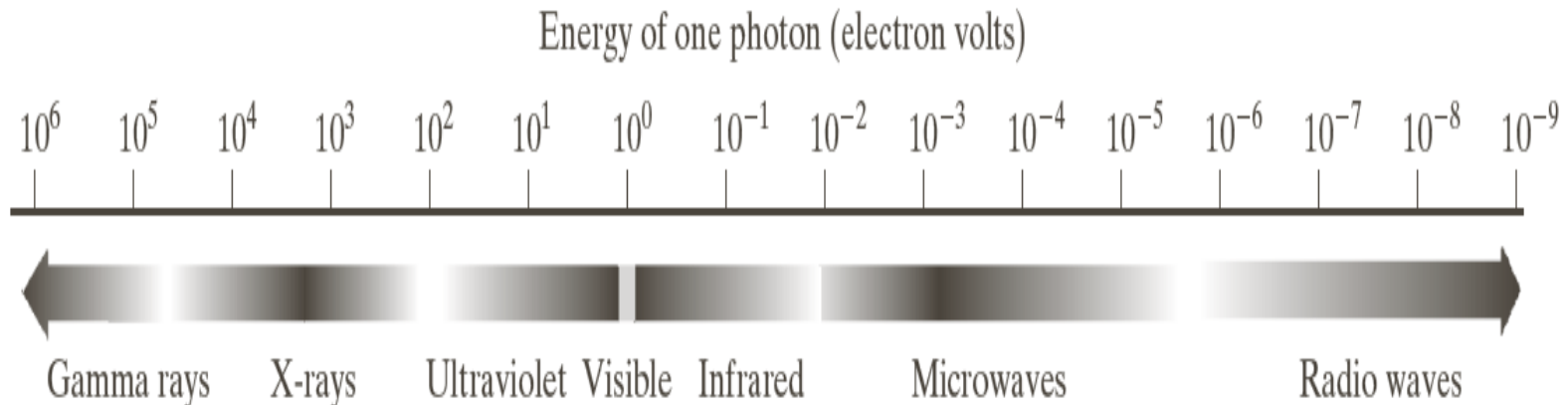

FUN WORLD

AHMEDABAD CITY 15 KM AWAY

Electromagnetic spectrum

Energy of one photon (electron volts)

$10^6 \quad 10^5 \quad 10^4 \quad 10^3 \quad 10^2 \quad 10^1 \quad 10^0 \quad 10^{-1} \quad 10^{-2} \quad 10^{-3} \quad 10^{-4} \quad 10^{-5} \quad 10^{-6} \quad 10^{-7} \quad 10^{-8} \quad 10^{-9}$

Gamma rays   X-rays   Ultraviolet Visible Infrared   Microwaves   Radio waves

FIGURE 1.5 The electromagnetic spectrum arranged according to energy per photon.

Imaging in Medical domain: X-rays, CT scans, MRI scans, Ultrasound
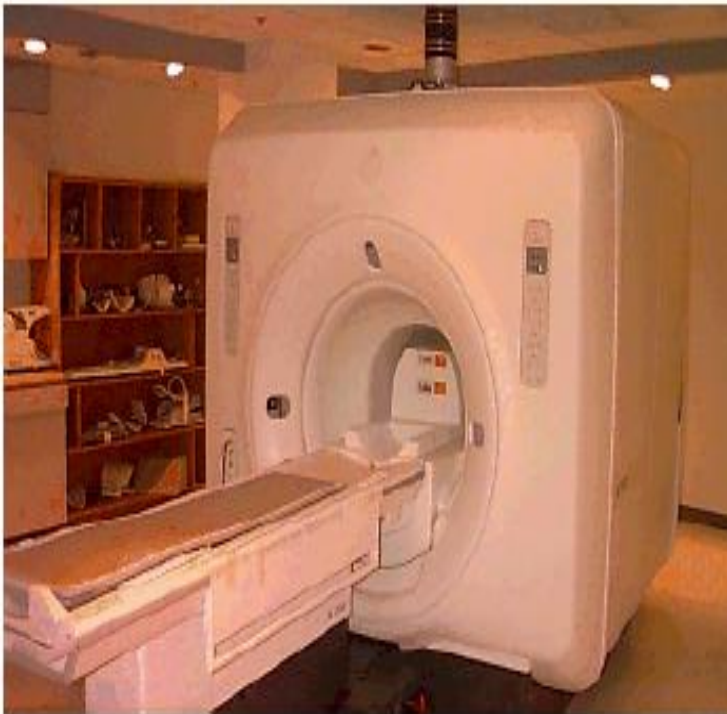
Medical applications

Brain Tumor
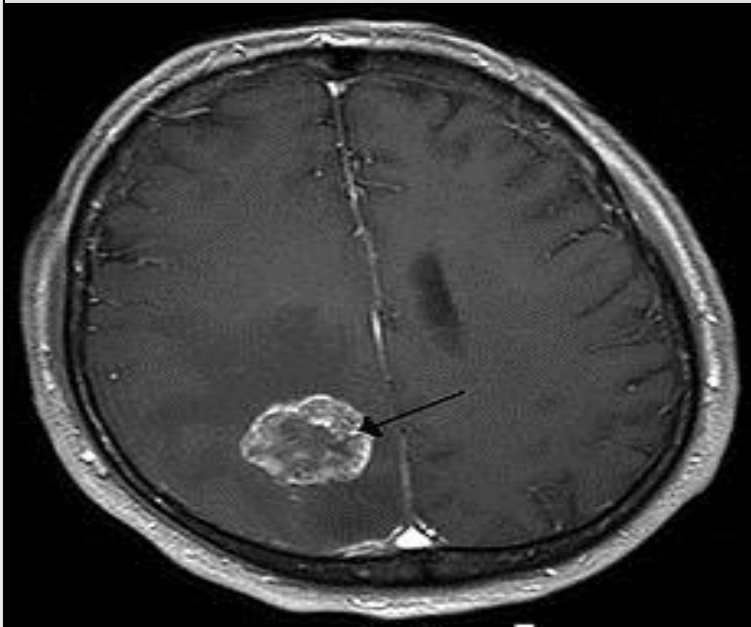
Sonogram

Image Processing applications

➢ one purpose is improve quality of image by using pictorial information.

➢Autonomous machine applications

    ➢Purpose is extract attributes, features from images

    ➢Inspection (ex. Bottling plant automation, Boundary Information)

    ➢Automated inspection (Structure information ,Surface information)

    ➢Fingerprint Recognition

    ➢Machine processing of satellite images for weather prediction and crop assessment etc.

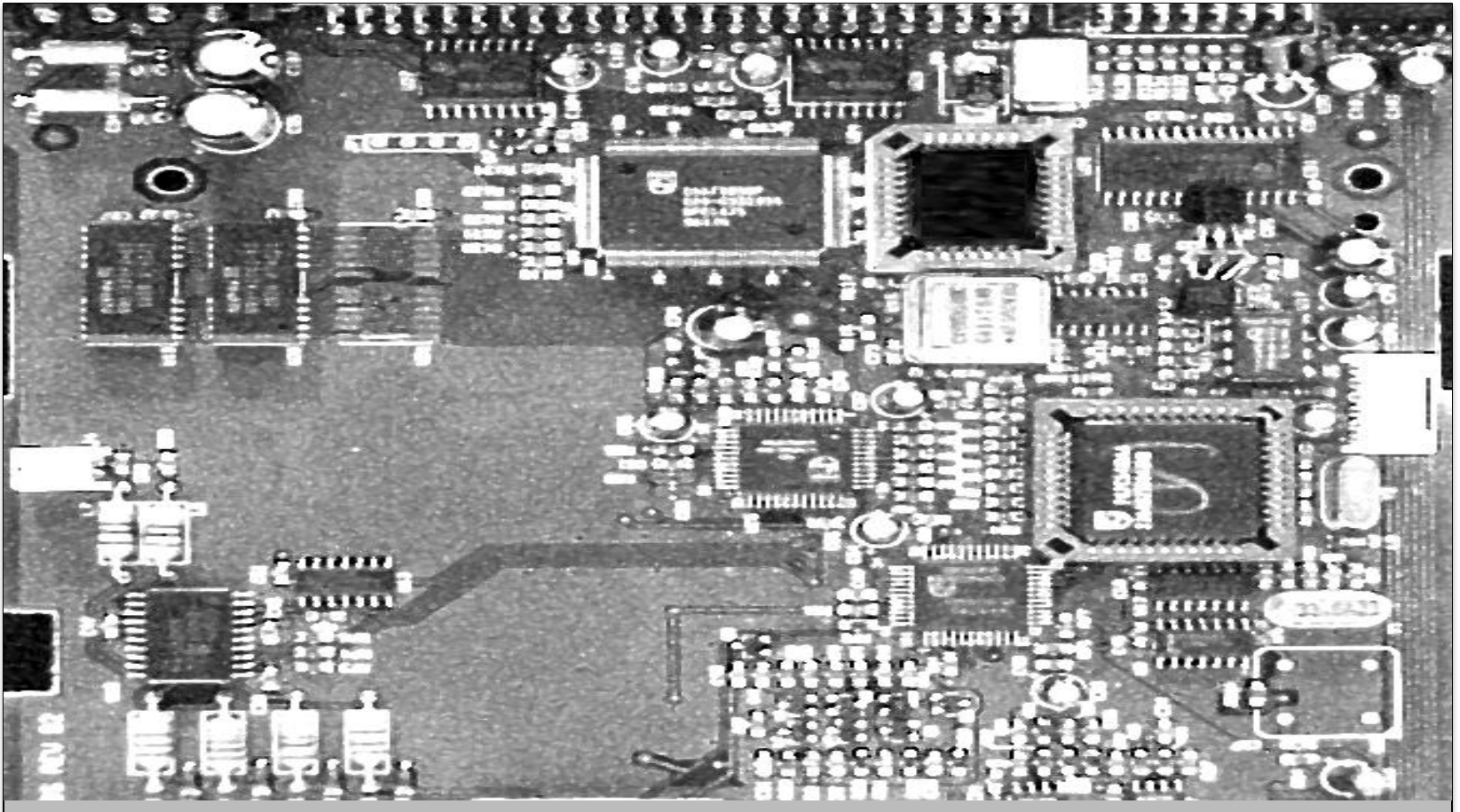# Bottling plant automation
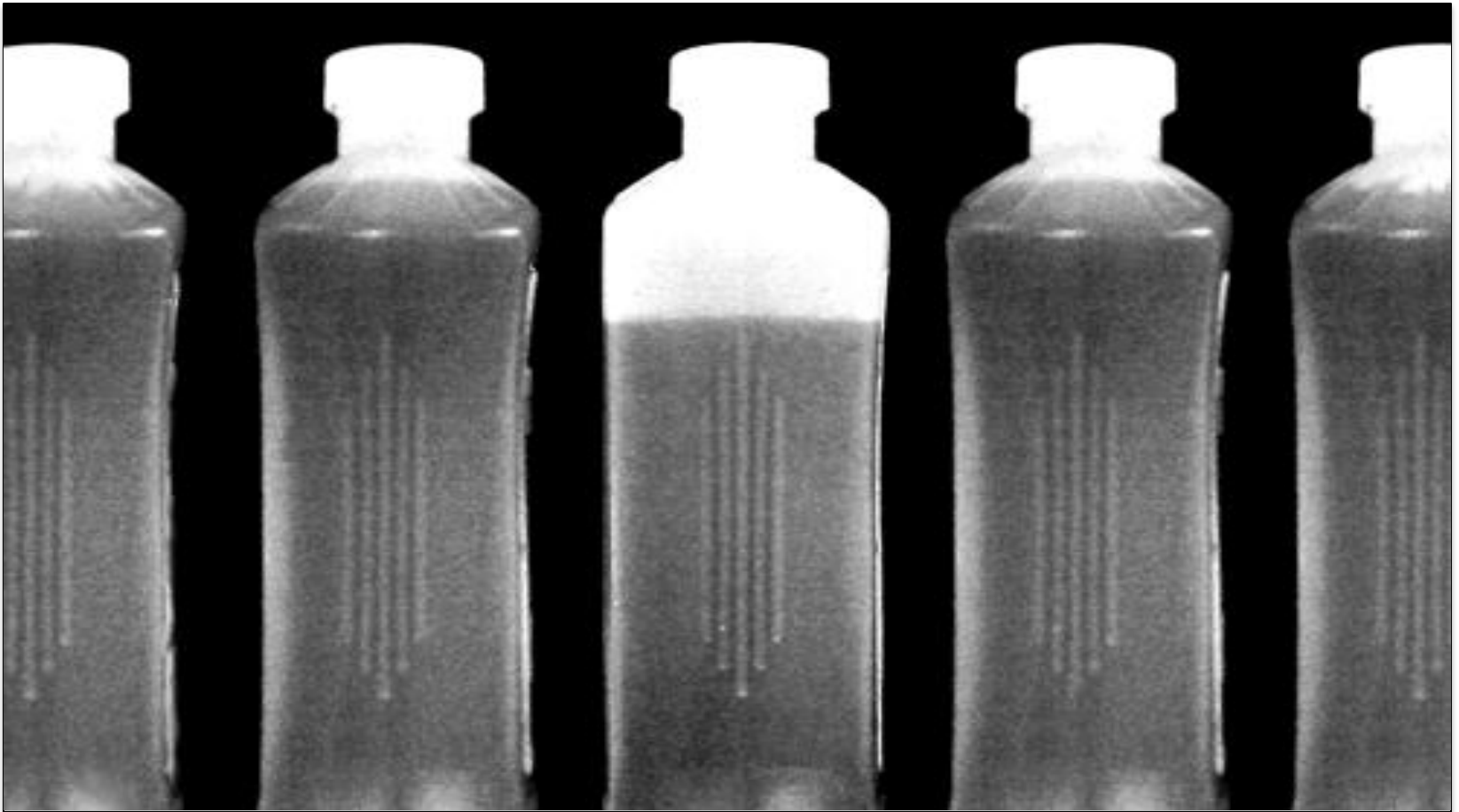
Boundary Information

Block Processing - Borders & Fixed Threshold
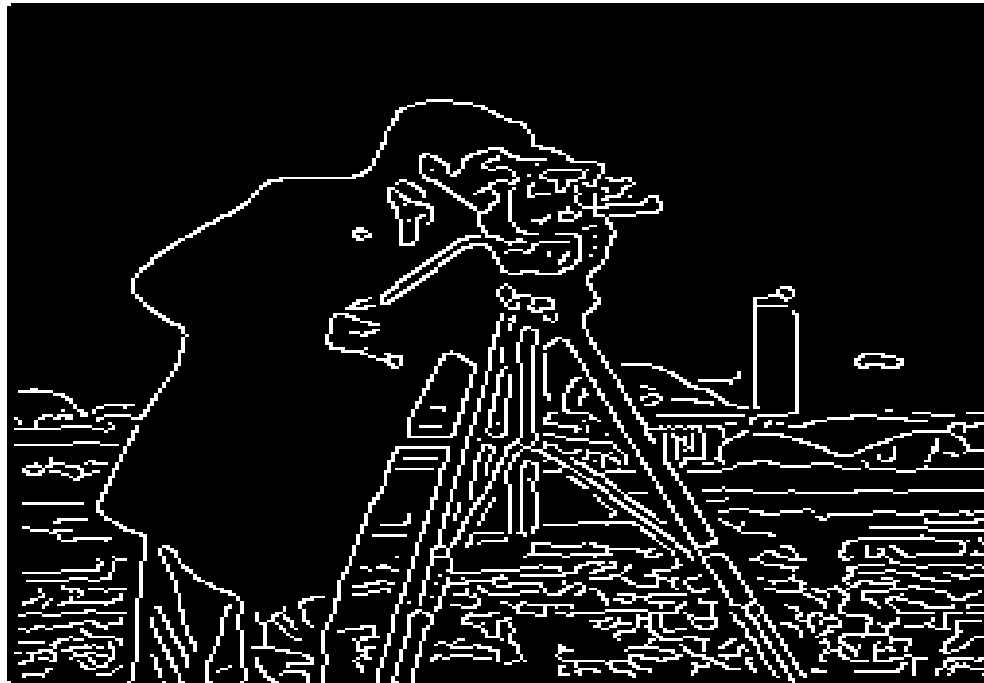
IC Manufacturing

surface inspection

testing for:
color,
soiling,
scratches and
damage
checking for shape
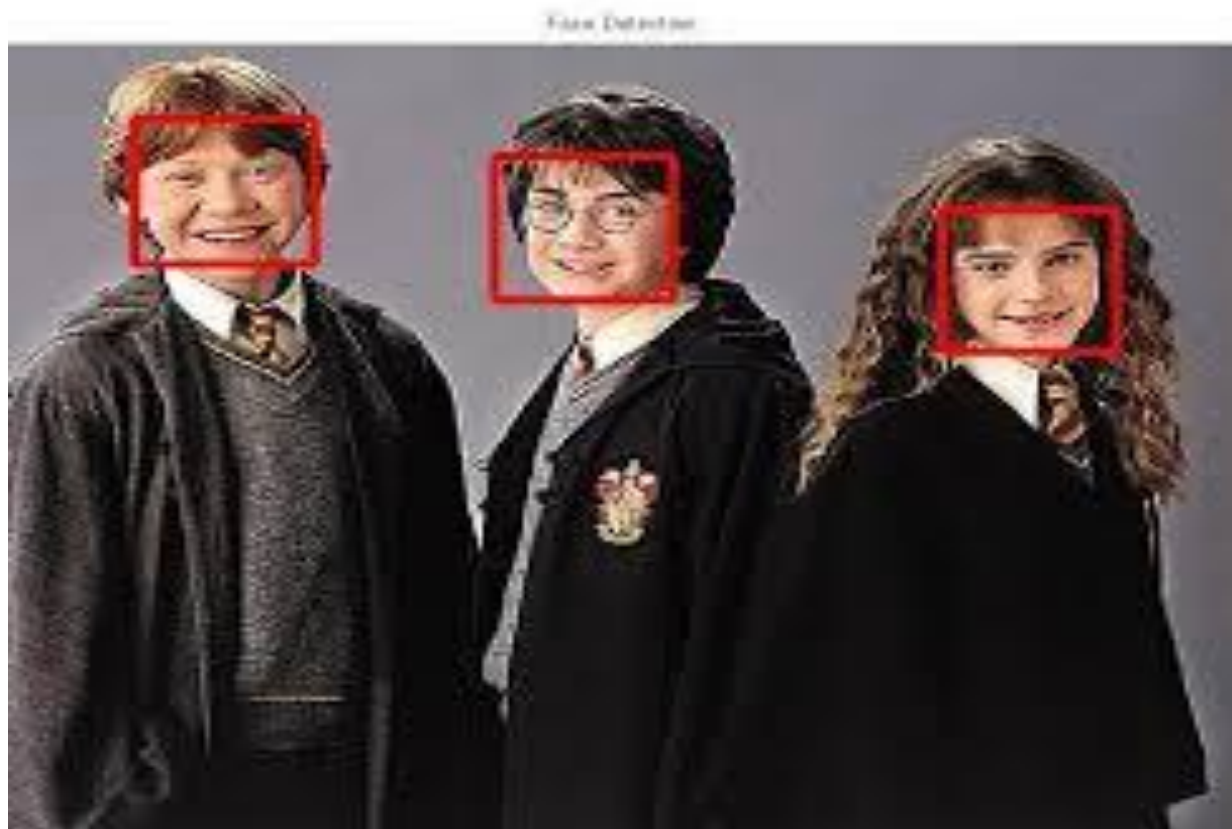
Disposable syringes

completeness
inspection
testing for:
correct assembly,
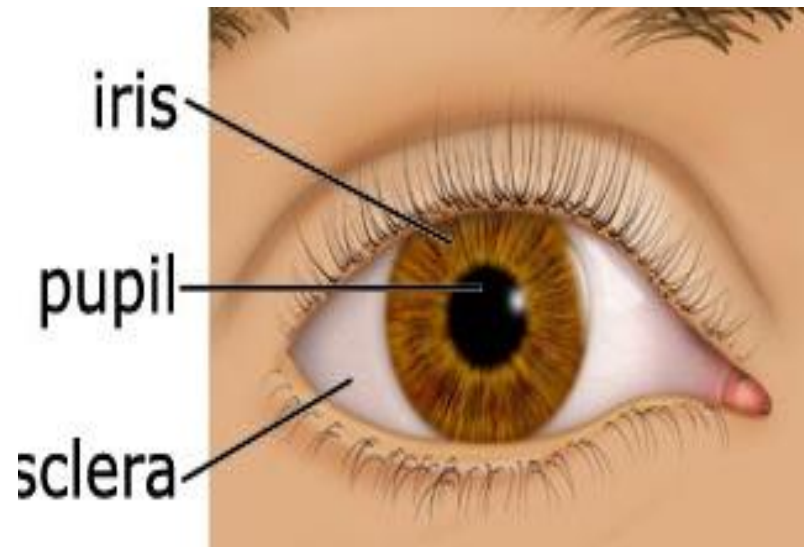completeness,
writing,
damage and color

Cosmetic bottles

printing check testing for:
color,
completeness,
size,
legibility and precision details

Face detection

Iris detection

finger print recognition
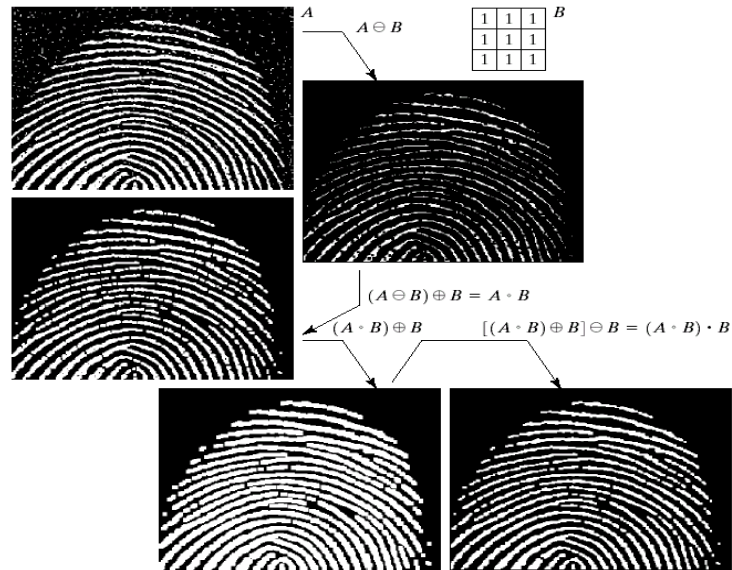
Image inpainting

Character Detection
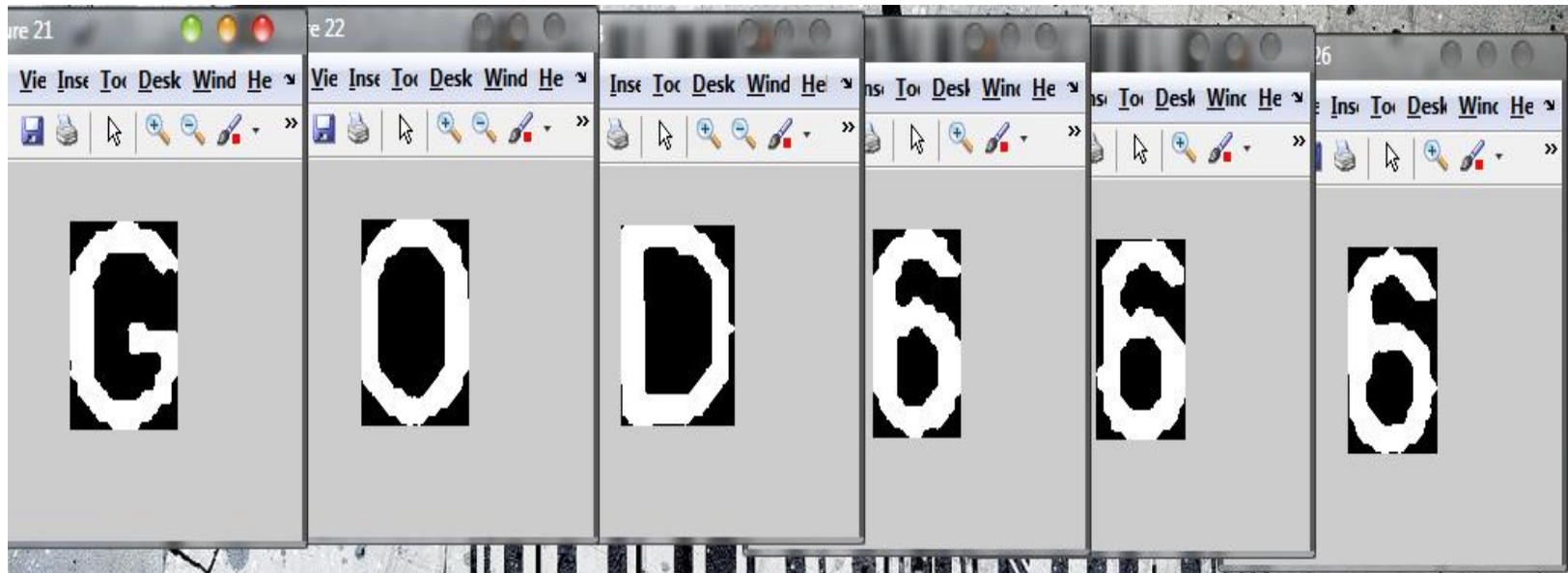
Image stitching

Automated Target Detection

Compute Self-Resemblance

Input

Salient object map

Boundary map

center

center+surround

local analysis window
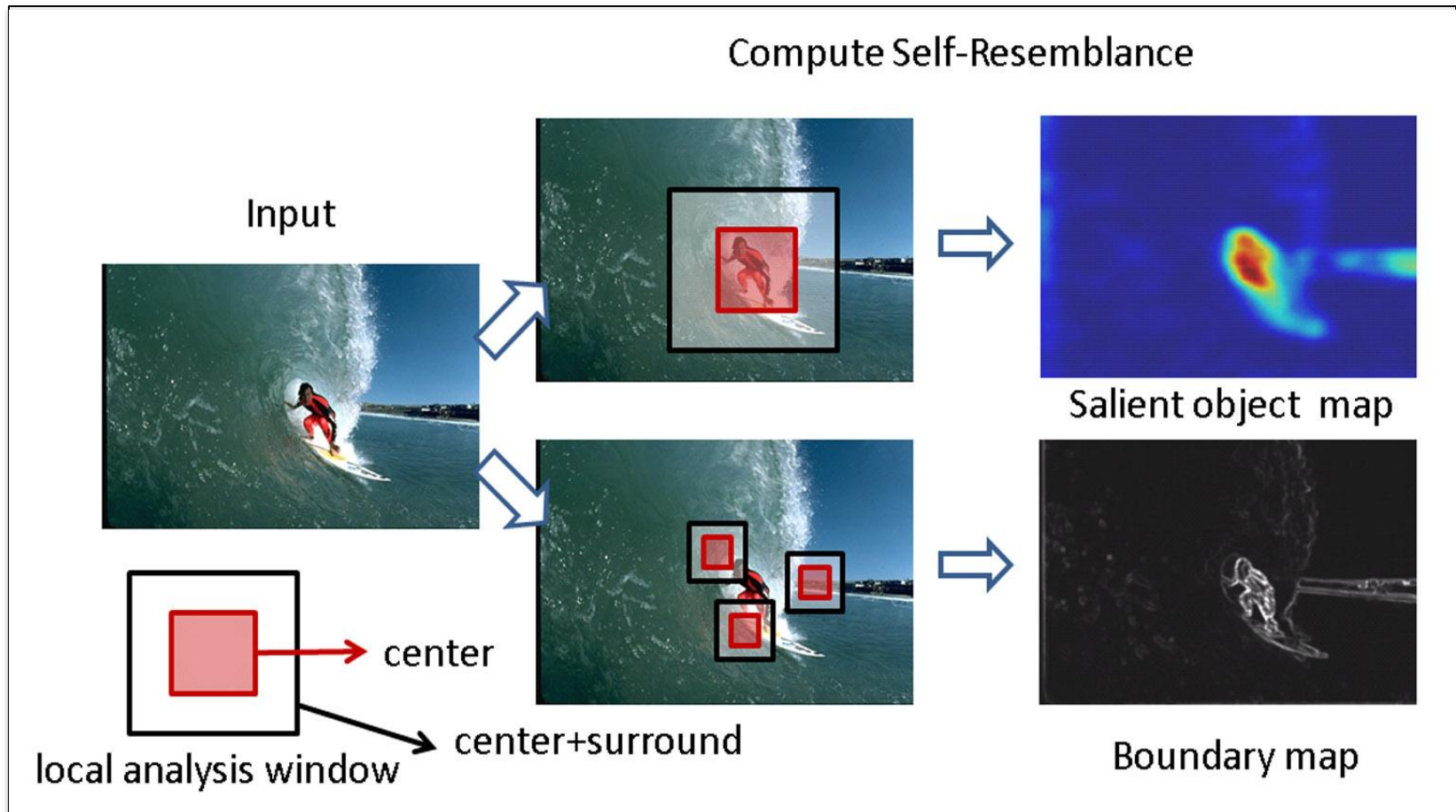
Number plate recognition

Human Computer Interface: Gesture recognition, Face recognition from video
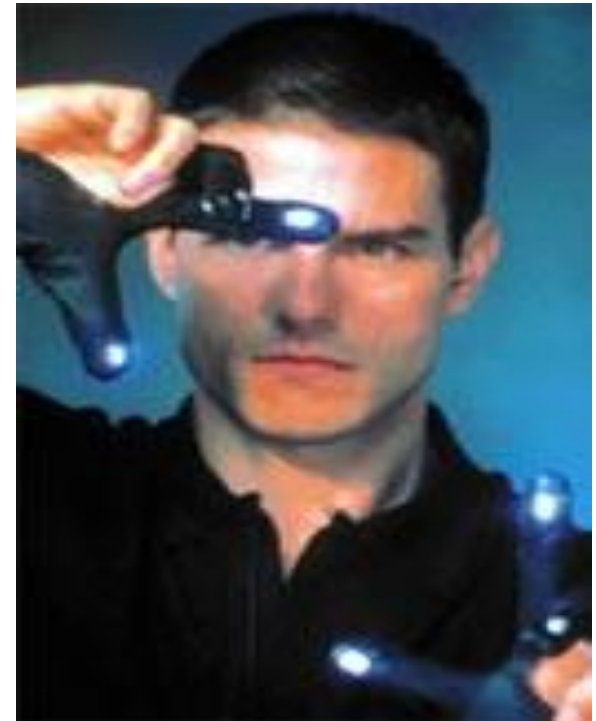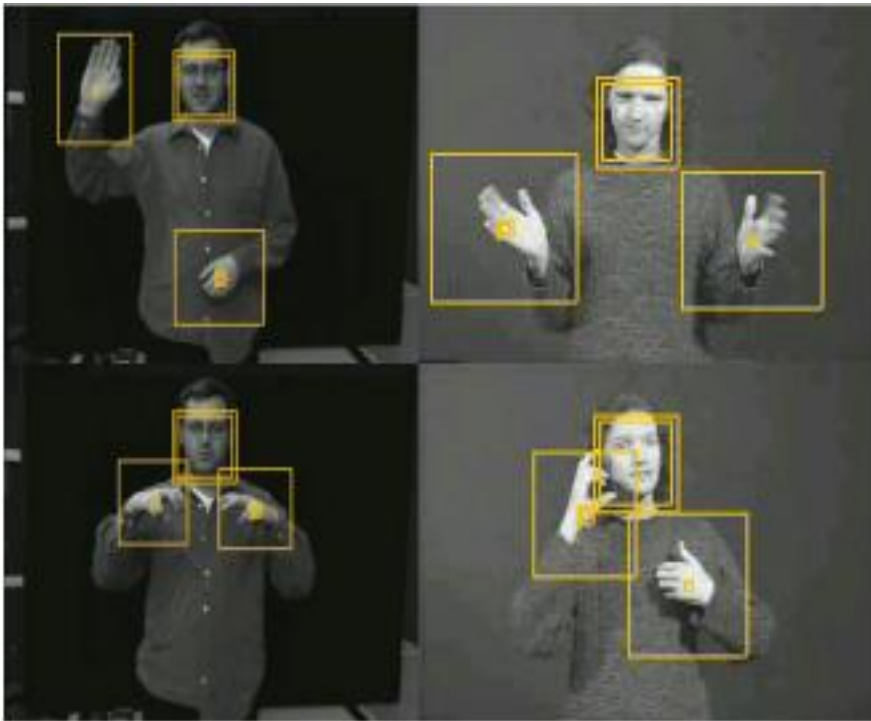
Artistic and Visual Effects: Computer Graphics, Animation, Special Effects

POLKARELLA
IN THE RAIN OF FURY!!
A SHORT FILM BY ZUBUYER KAOLIN

CGSociety.org

Copyright (C) Zubuyer Kaolin, submitted 21 November 2007

Video Doorbell & Video Security

Traffic Monitoring
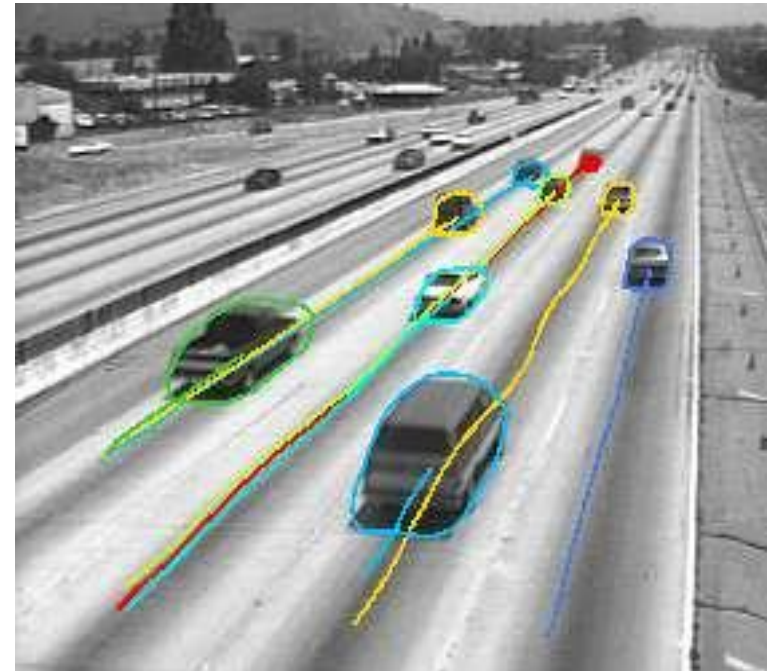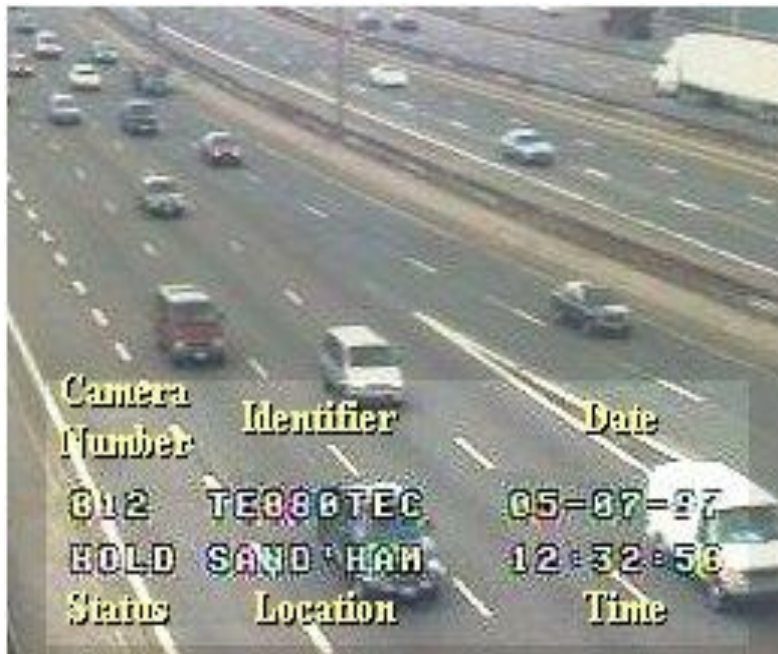
Other applications

➤ Handwriting Recognition Software
➤ Online signature Verification
➤ Robotics

Image Representation

➢How image is represented in digital computer?

➢F (x, y) = r(x , y) * i(x ,y)

Where, r is reflectivity and i is intensity of light that is falling on the object surface.

Image to be represented in the form of a finite 2-D matrix.

➢Can we store analog image in our digital computer?

Fundamental steps in digital image processing

Outputs of these processes generally are images

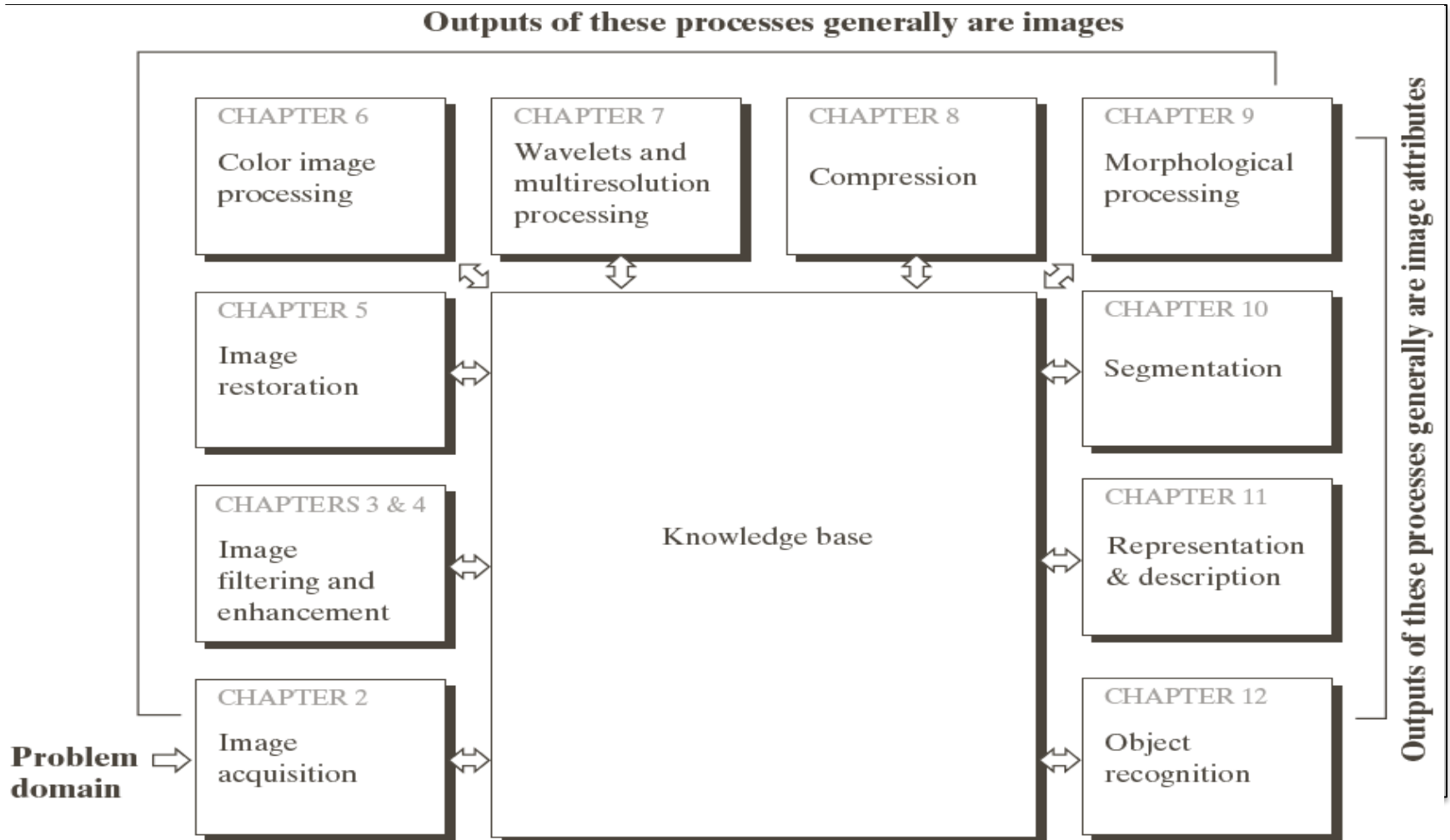| CHAPTER 6	CHAPTER 7	CHAPTER 8	CHAPTER 9
Color image processing	Wavelets and multiresolution processing	Compression	Morphological processing

CHAPTER 5		CHAPTER 10
Image restoration	Knowledge base	Segmentation

CHAPTERS 3 & 4	CHAPTER 11
Image filtering and enhancement	Representation & description

CHAPTER 2	CHAPTER 12
Image acquisition	Object recognition

Problem domain

Outputs of these processes generally are image attributes

Fundamental steps in digital image processing

➢Image acquisition : involves preprocessing

➢Image Enhancement: Process of manipulating an image so that the result is more suitable than the original for a specific application

➢Image Restoration : deals with improving the appearance of an image

Image enhancement is subjective and image restoration is objective

Restoration techniques is based on mathematical or probabilistic models of image degradation while enhancement is based on human subjective preferences

Fundamental steps in digital image processing

➢Color image processing : area that has been gaining in importance because of the significant increase in the use of digital images over the internet.

➢Wavlets : representing images in various degrees of resolution.

➢Compression: deals with techniques for reducing the storage required to save an image or bandwidth required to transmit.

➢Morphological processing : deals with tools for extracting image components that are useful in the representation and description of shape.

Fundamental steps in digital image processing

➢ Segmentation : partition an image into its constituent parts or objects.

➢ Representation and description: it follows output of segmentation stage , which is usually is raw pixel data, constituting either the boundary of region.

➢ Example: Set of pixels separating one image region from another.

➢ Object recognition : process that assigns a label (e.g. Vehicle) to an object based on its descriptors.

Components of a general purpose image processing system
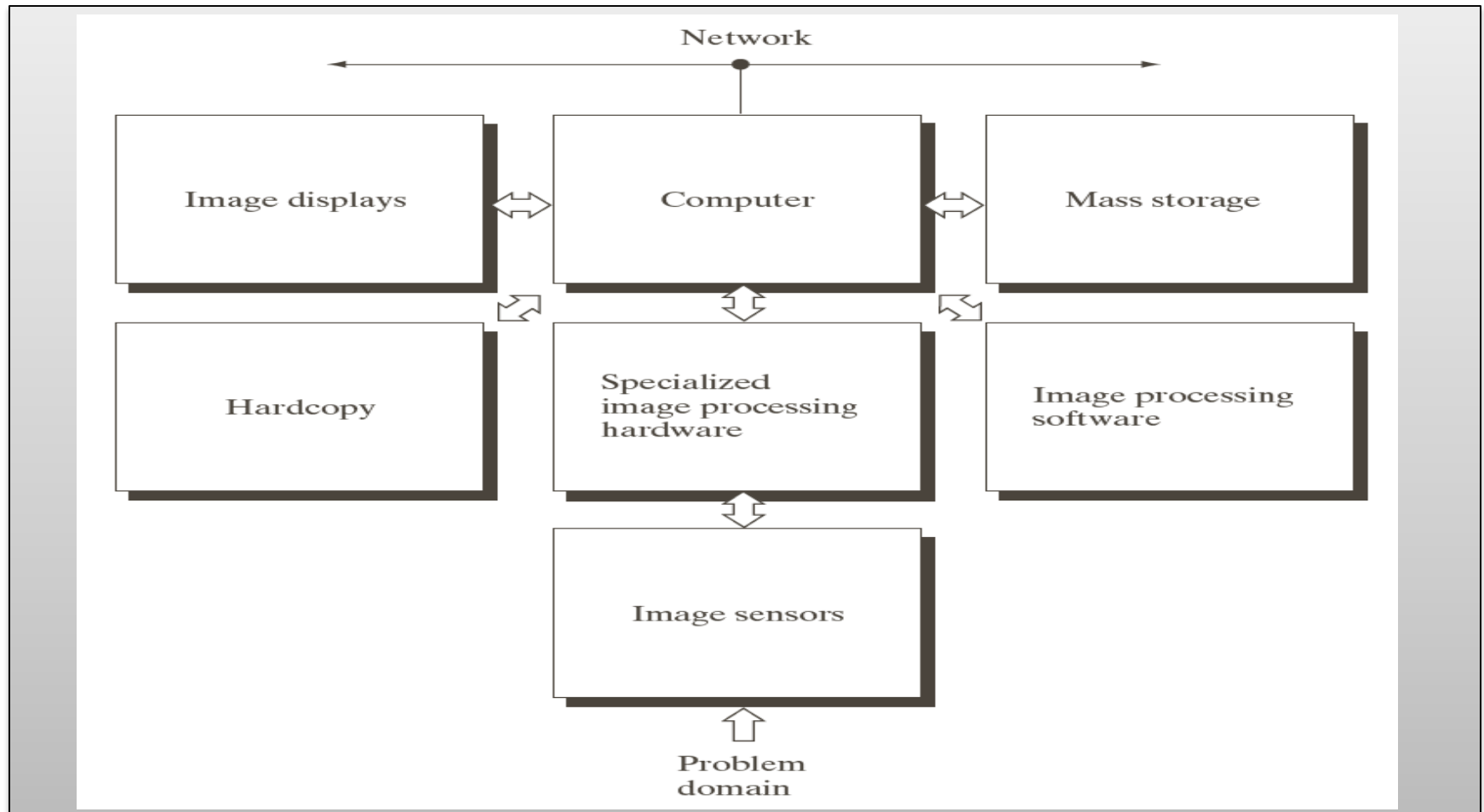
Components of a general purpose image processing system

➢Image sensors: two elements are required to acquire digital images.

➢The first is physical device that is sensitive to the energy radiated by the object we wish to image.

➢The second called a digitizer, is a device for converting the output of the physical sensing device into digital form.

➢Specialized image processing hardware usually consists of the digitizer and hardware that performs arithmetic and logical operations in parallel on entire images .

➢Computer in an image processing system is a general –purpose computer .

Components of a general purpose image processing system

➢ Software for image processing consists of specialized modules that perform specific tasks .

➢ Mass Storage :

> ➢ Short term storage for use during processing
>
> ➢ Online storage
>
> ➢ Archival storage

➢ Image displays in use today mainly color TV monitors(included graphics card)

➢ Hardcopy devices like printer, film cameras, heat sensitive devices .

➢ Networking is a default function in any computer system .

Thank you