



Image Processing

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2009

Referensi

1. Rafael C. Gonzales E. Woods, "Digital Image Processing, 2nd Edition", Prentice Hall, 2001
2. Dadet Pramadihanto, Image Enhancement, Inhouse Training Politeknik Elektronika Negeri Surabaya, 1999.
3. Riyanto Sigit dkk, "Step by Step dkk, Pengolahan Citra Menggunakan Visual C++", Andi Offset
4. Acmad Basuki dkk, Pengolahan Citra Menggunakan Visual Basic, Graha Ilmu



Materi DIP (16 minggu) :

1. Pendahuluan
2. Format Citra
 - Citra Berwarna
 - Citra gray-scale
 - Citra Biner
3. Transformasi Derajat Keabuan
 - Binerisasi
 - Transformasi Spasial
 - Inversi
 - Brightness
 - Kontrass
 - Auto level
4. Histogram
 - Histogram pada citra
 - Perataan histogram
5. Transformasi Fourier
 - Transformasi Fourier
 - DFT
 - DCT
 - FFT
6. Filter Pada Citra
 - Konsep Filter
 - Konvolusi
 - Low Pass Filter
 - High Pass Filter
7. Generate Noise
8. Reduksi Noise Pada Citra
 - Pseudo Noise
 - Filter Rata-rata
 - Filter Gaussian
 - Filter Median
9. Deteksi Tepi
 - Differensiasi Pixel
 - Metode Robert
 - Metode Prewitt
 - Metode Sobel
10. Format Warna
 - RGB
 - Normalized RGB
 - HSV
 - YCrCb
11. Histogram Warna
 - Cubic RGB
 - Histogram Segmen Warna
12. Thresholding
 - Segmentasi Derajat Keabuan
 - Adaptive Thresholding
 - Segmentasi Area
13. Histogram Proyeksi
14. Thinning dan Skeletoning
 - Thinning
 - Skeletoning
15. Aplikasi Pengolahan Citra
 - Image Retrieval
 - Pengenalan Angka
 - Deteksi Kulit
16. Pengantar Computer Vision



Penilaian

- UTS 30%
- UAS 50%
- Tugas 20%



Pengantar

(Sumber : Lecture Notes Wanasanan Thongsongkrit)

- Early days of computing, data was numerical.
- Later, textual data became more common.
- Today, many other forms of data: voice, music, speech, images, computer graphics, etc.
- Each of these types of data are signals.
- Loosely defined, a signal is a function that conveys information



Hubungan DSP dengan Bidang Ilmu yang Lain

(Sumber : Lecture Notes Wanasanan Thongsongkrit)

- As long as people have tried to send or receive through electronic media : telegraphs, telephones, television, radar, etc. there has been the realization that these signals may be affected by the system used to acquire, transmit, or process them.
- Sometimes, these systems are imperfect and introduce noise, distortion, or other artifacts.



Hubungan DSP dengan Bidang Ilmu yang Lain

(Sumber : Lecture Notes Wanasanan Thongsongkrit)

- Understanding the effects these systems have and finding ways to correct them is the fundamental of signal processing.
- Sometimes, these signals are specific messages that we create and send to someone else (e.g., telegraph, telephone, television, digital networking, etc.).
- That is, we specifically introduce the information content into the signal and hope to extract it out later.



Hubungan DSP dengan Bidang Ilmu yang Lain

(Sumber : Lecture Notes Wanasanan Thongsongkrit)

- Sometimes, these man-made signals are encoding of natural phenomena (audio signal, acquired image, etc.), but sometimes we can create them from scratch (speech generation, computer generated music, computer graphics).
- Finally, we can sometimes merge these technologies together by acquiring a natural signal, processing it, and then transmitting it in some fashion.



What is Image Processing ?

- Image processing is a subclass of signal processing concerned specifically with pictures.
- Improve image quality for human perception and/or computer interpretation.



Beberapa Bidang Ilmu yang Berhubungan dengan Image

- Computer Graphics : the creation of images.
- Image Processing : the enhancement or other manipulation of the image – the result of which is usually another images.
- Computer Vision: the analysis of image content.



Pengolahan Data Berdasarkan Input/Output

	OUTPUT	
	IMAGE	DESKRIPSI
INPUT	IMAGE	Image Processing Computer Vision
	DESKRIPSI	Grafika Komputer Data Mining dll.



Dua Macam Aplikasi DIP

- Improvement of pictorial information for human interpretation
- Processing of image data for storage, transmission, and representation for autonomous machine perception



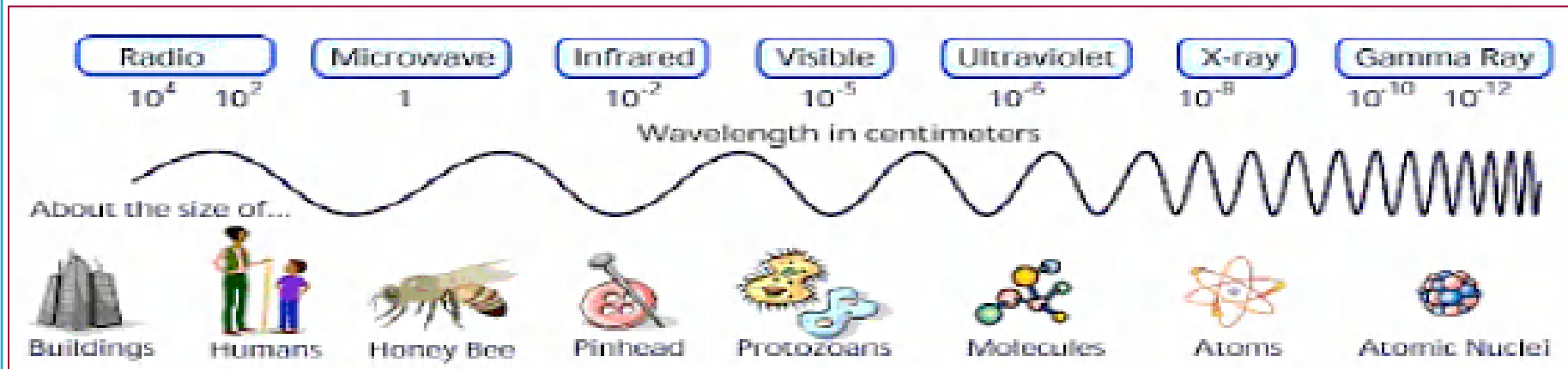
Bidang yang Memanfaatkan DIP

Dikelompokkan berdasarkan sumber dari gambar

- Radiation from the Electromagnetic spectrum
- Acoustic
- Ultrasonic
- Electronic (in the form of electron beams used in electron microscopy)
- Computer (synthetic images used for modeling and visualization)



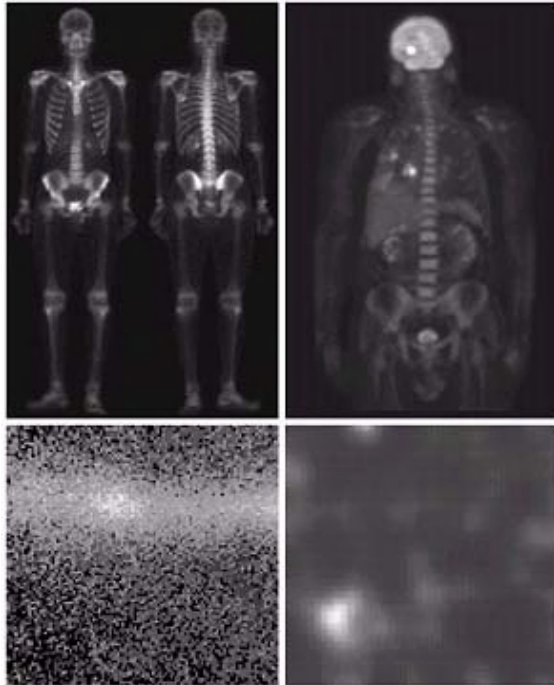
Alat-Alat Capture Sesuai Frekwensinya



Diambil dari modul pelatihan image processing yang disusun oleh bapak Dadet Pramadihanto



Gamma-Ray Imaging



Nuclear Image

(a) Bone scan

(b) PET (Positron emission tomography) image

Astronomical Observations.

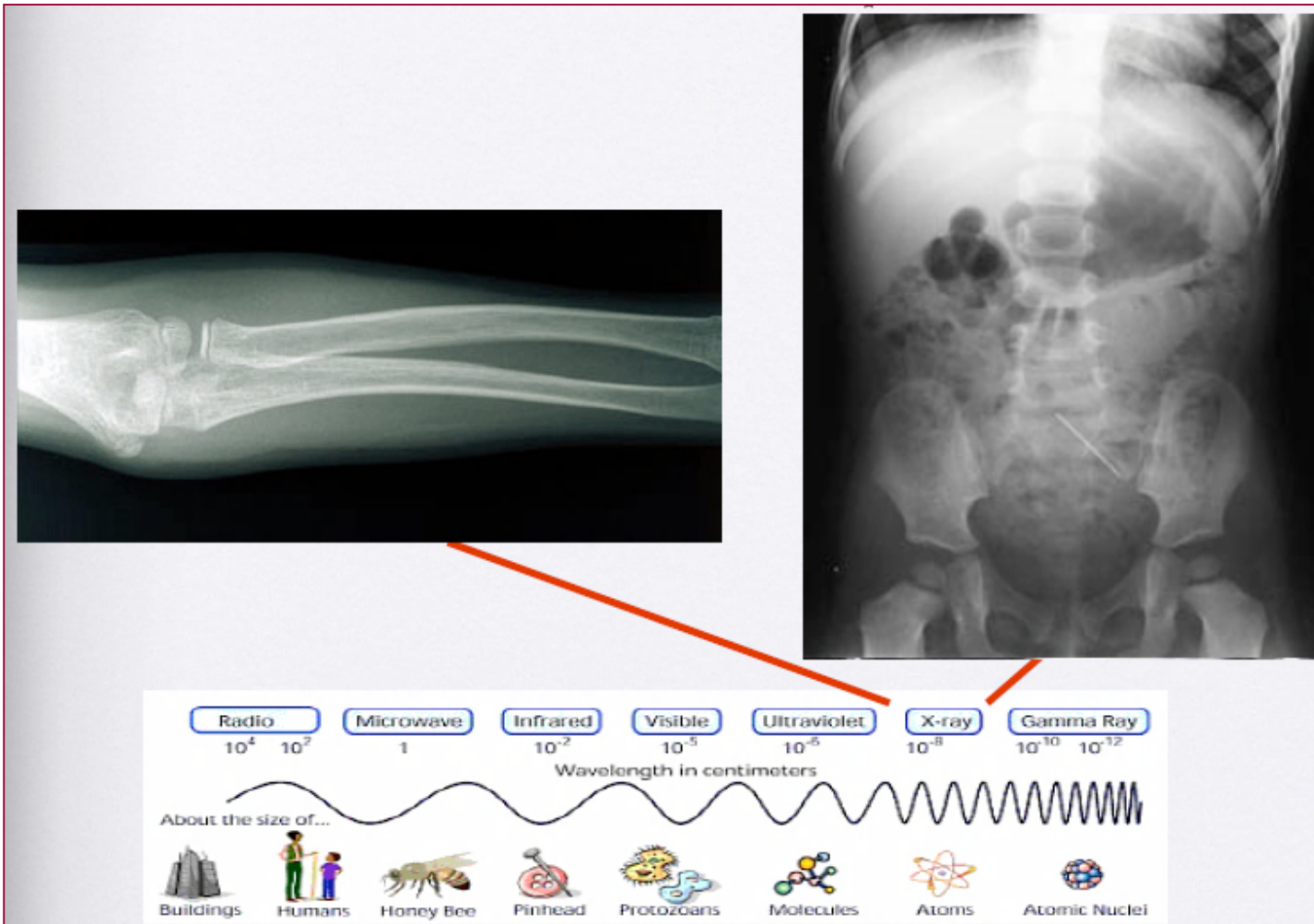
(c) Cygnus Loop

Nuclear Reaction

(d) Gamma radiation from a reactor valve

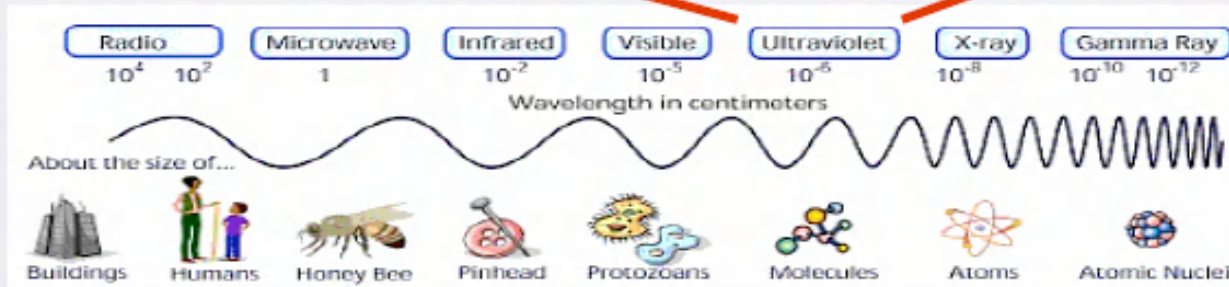


X-Ray Imaging

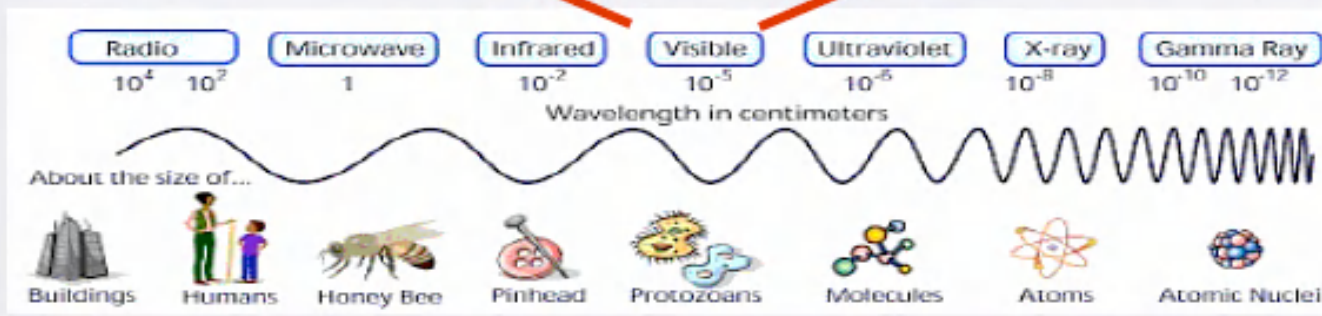


Ultraviolet Imaging

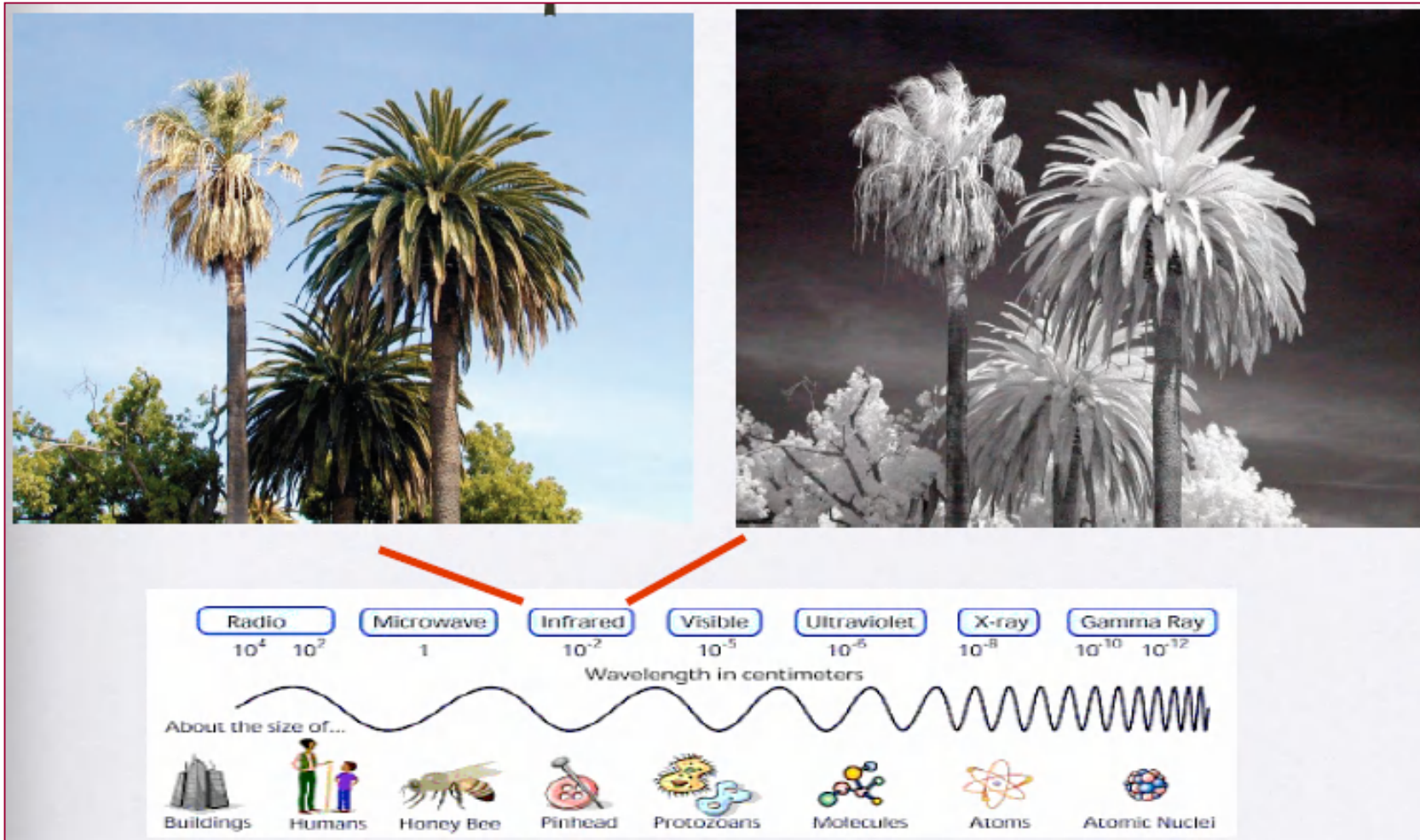
Potentilla



Visible Imaging



Infrared Imaging



Imaging in Microwave Band

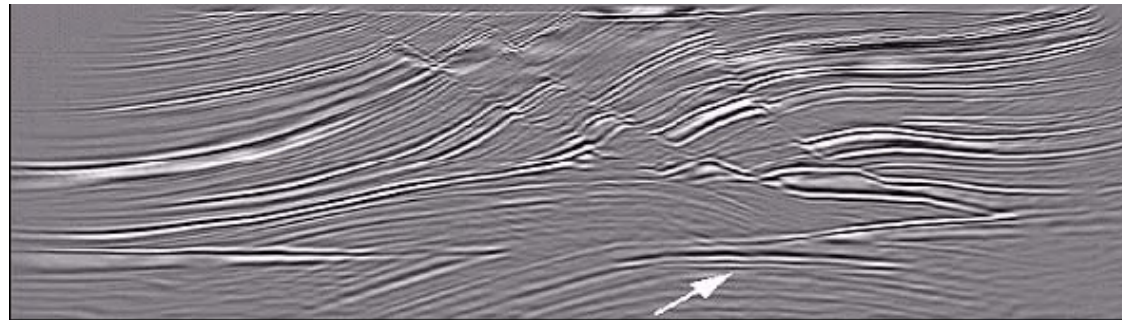


- Imaging radar : the only way to explore inaccessible regions of the Earth's surface
- Radar image of mountains in southeast Tibet
- Note the clarity and detail of the image, unencumbered by clouds or other atmospheric conditions that normally interfere with images in the visual band.



Imaging in Microwave Band

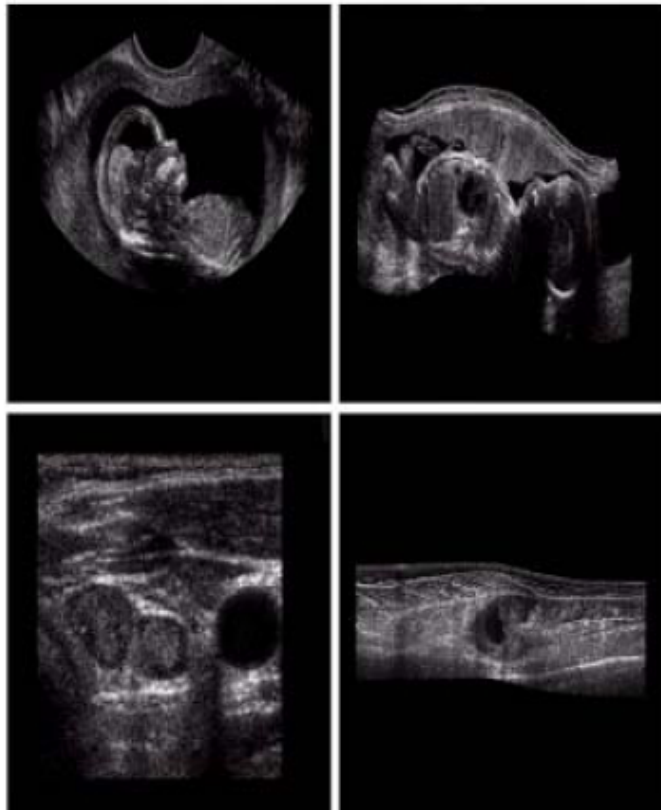
Geological applications : use sound in the low end of the sound spectrum (hundred of Hz) Mineral and oil exploration



Cross-sectional image of a seismic model.
The arrow points to a hydrocarbon (oil and/or gas) trap (bright spots)



Ultrasound Imaging



Manufacturing

Medicine

(a) Baby

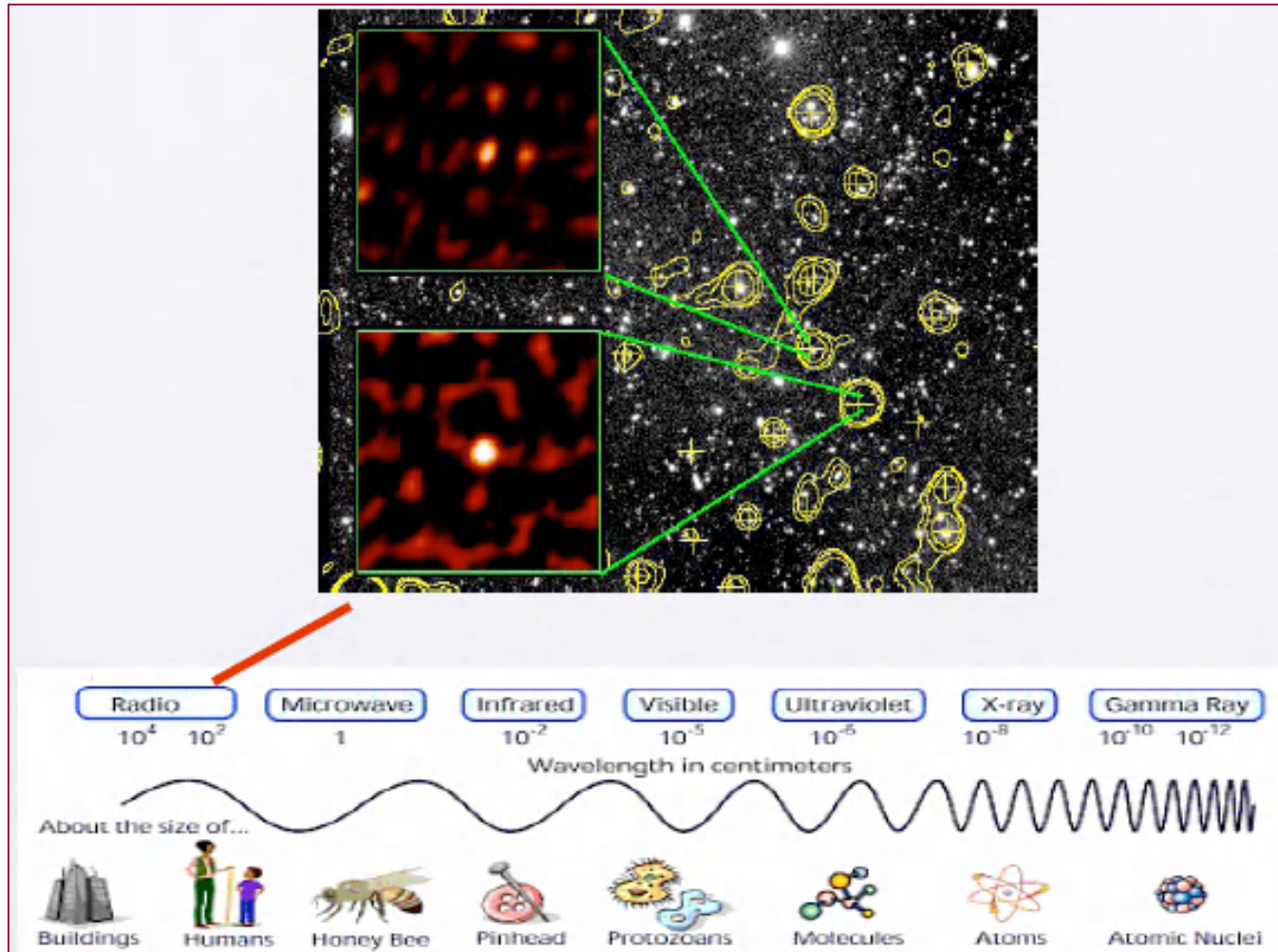
(b) Another view of baby

(c) Thyroids

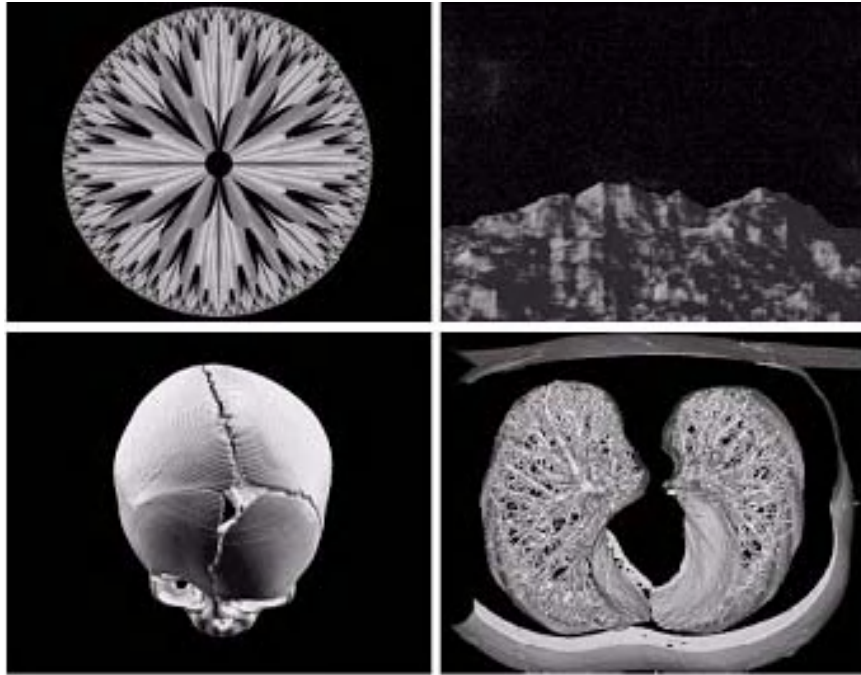
(d) Muscle layers showing lesion



Imagin in Radio Band



Generated Images by Computer



- Fractals : an iterative reproduction of a basic pattern according to some mathematical rules (a) and (b)
- 3-D computer modeling (c) and (d)



3 Types of Computerized Process

Low-level : input, output are images

Primitive operations such as image preprocessing to reduce noise, contrast enhancement, and image sharpening

Mid-level : inputs may be images, outputs are attributes extracted from those images

- Segmentation
- Description of objects
- Classification of individual objects

High-level :

- Image analysis



Fundamental Steps

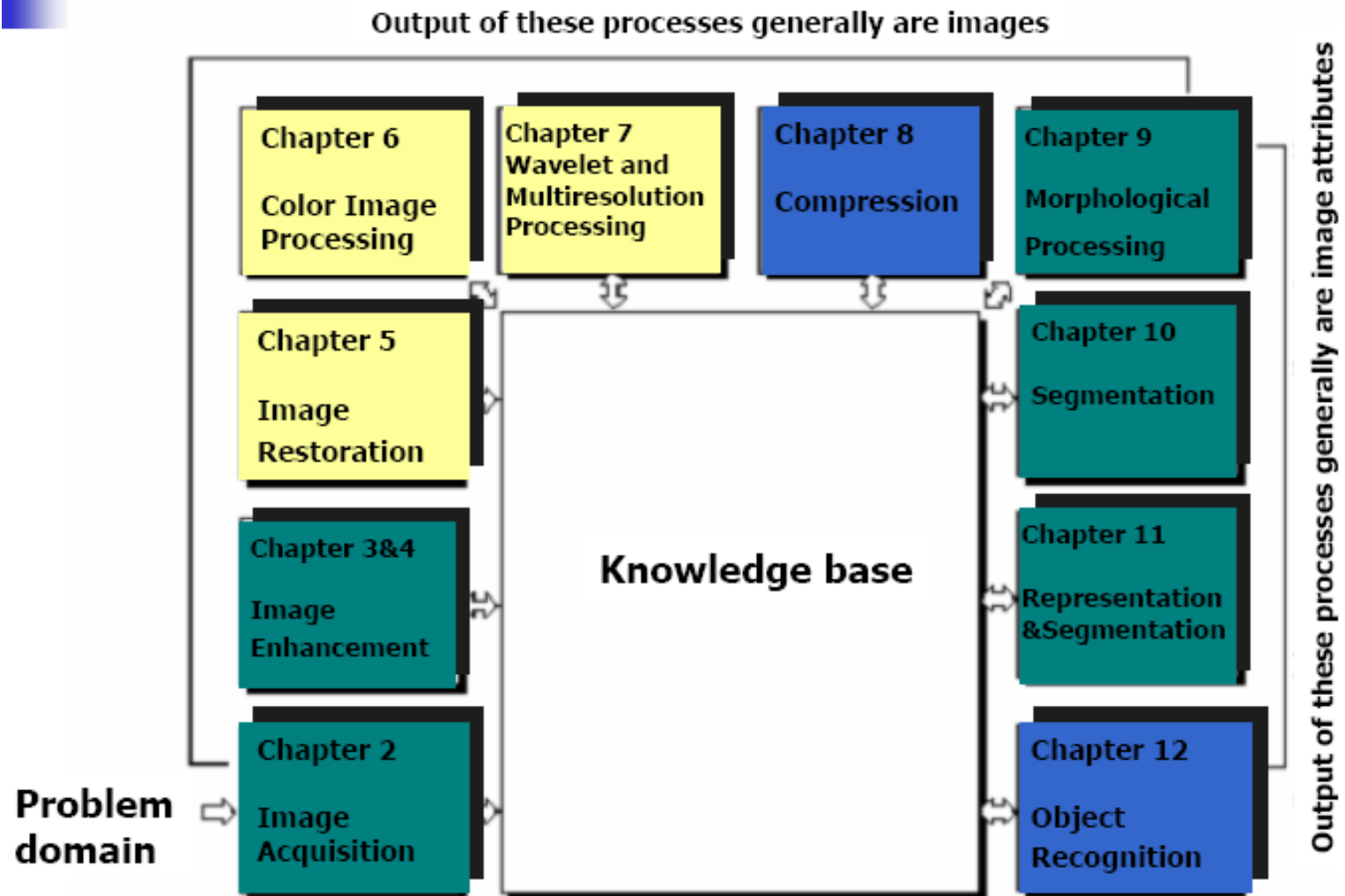


Image Acquisition

An 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 digitizes it.



Camera

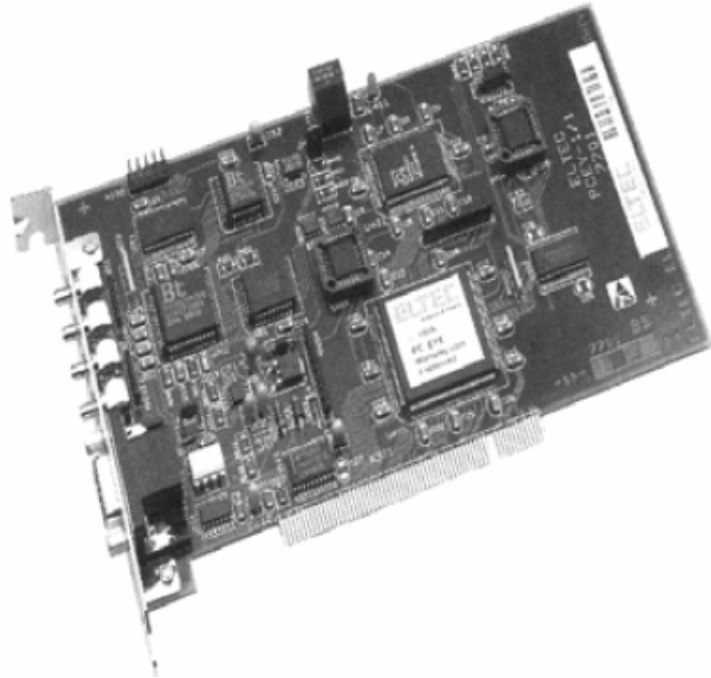


Camera consists of 2 parts

- A lens that collects the appropriate type of radiation emitted from the object of interest and that forms an image of the real object
- a semiconductor device – so called charged coupled device or CCD which converts the irradiance at the image plan into an electrical signal.



Frame Grabber



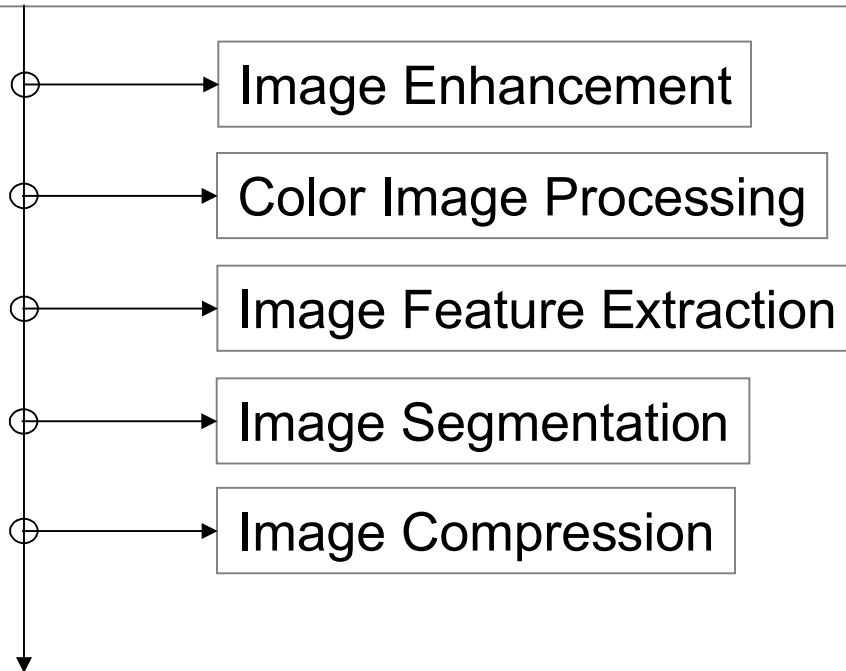
Frame grabber only needs circuits to digitize the electrical signal from the imaging sensor to store the image in the memory (RAM) of the computer.



Image Processing

Image processing adalah suatu pengolahan data yang masukannya berupa gambar dan luarannya juga gambar

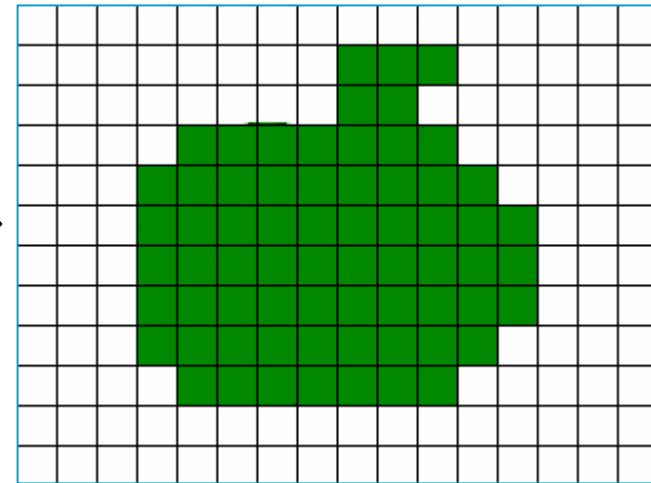
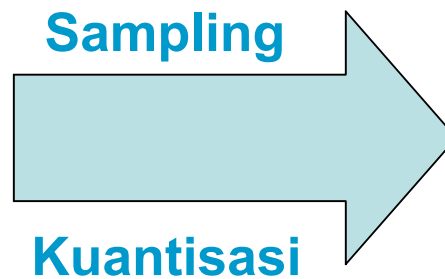
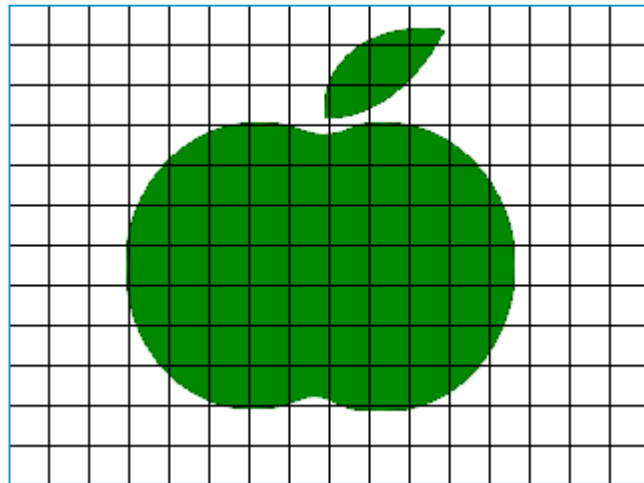
Tujuan dari image processing adalah memperbaiki informasi pada gambar sehingga mudah terbaca atau memperbaiki kualitas dari gambar itu sendiri



Computer Vision



Model Image



Sampling menunjukkan banyaknya pixel (blok) untuk mendefinisikan suatu gambar

Kuantisasi menunjukkan banyaknya derajat nilai pada setiap pixel (menunjukkan jumlah bit pada gambar digital → b/w dengan 2bit, grayscale dengan 8 bit, true color dengan 24 bit)



Image Enhancement

Proses untuk memperbaiki gambar seperti brightness, contrast, mengubah gambar menjadi gray-scale, inversi, reduksi noise, deteksi tepi dan sharpness

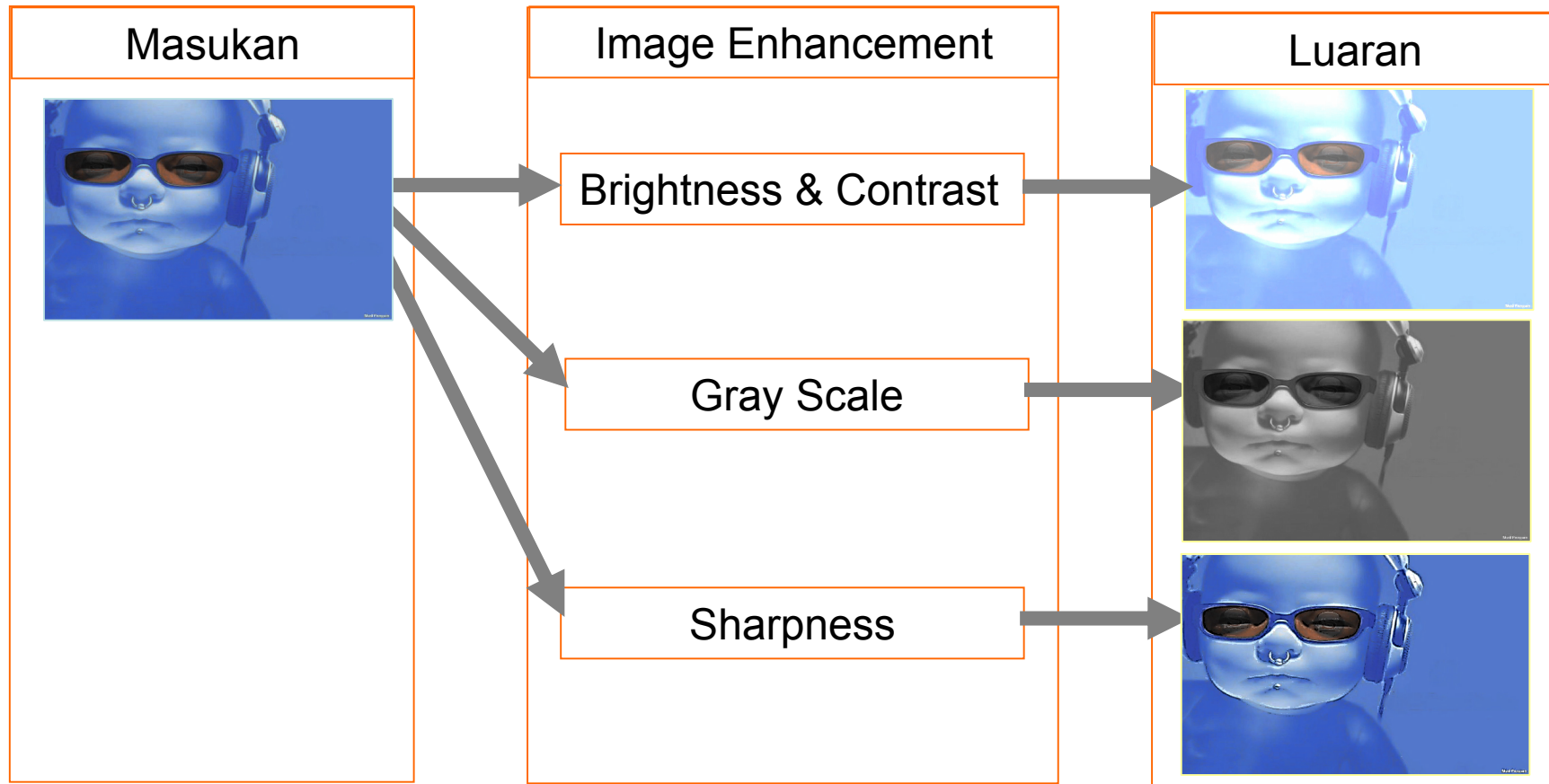


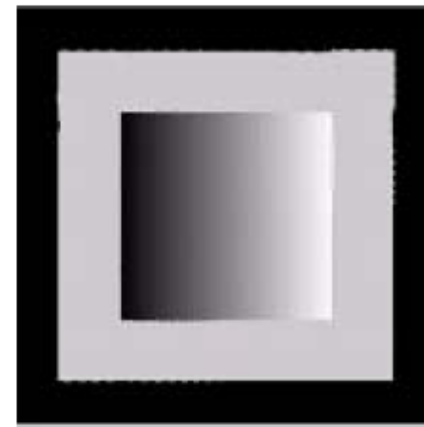
Image Restoration

Improving the appearance of an image

Tend to be based on mathematical or probabilistic models of image degradation



Distorted image



Restored image



Wavelet

Foundation for representing images in various degrees of resolution.

Used in image data compression and pyramidal representation (images are subdivided successively into smaller regions)



Compression

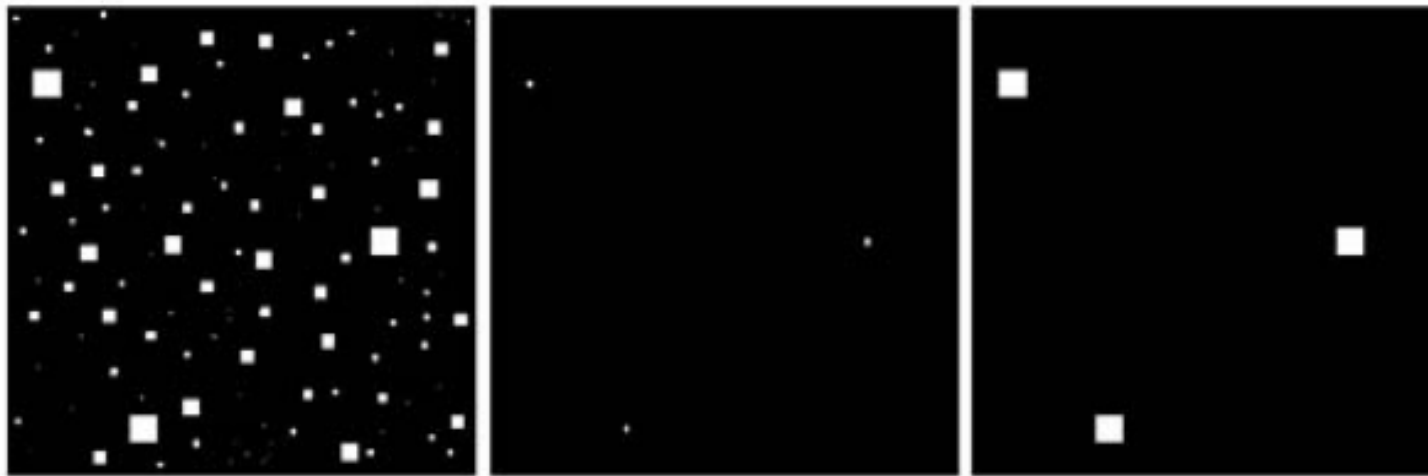
Reducing the storage required to save an image or the bandwidth required to transmit it.

Ex. JPEG (Joint Photographic Experts Group) image compression standard.



Morphological Processing

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



a b c

FIGURE 9.7 (a) Image of squares of size 1, 3, 5, 7, 9, and 15 pixels on the side. (b) Erosion of (a) with a square structuring element of 1's, 13 pixels on the side. (c) Dilation of (b) with the same structuring element.



Image Segmentation

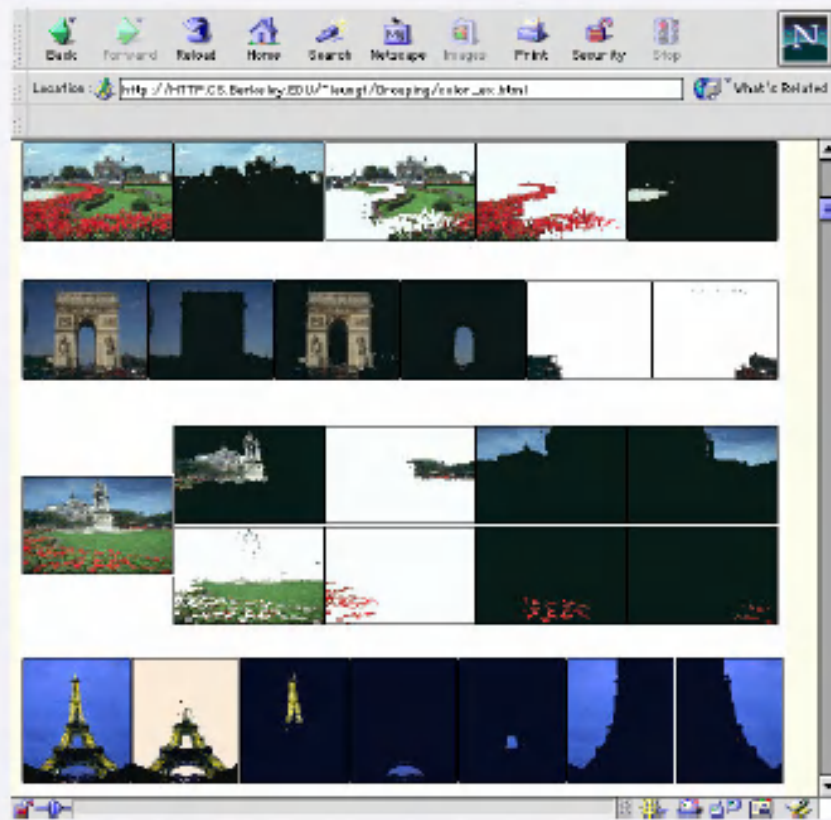
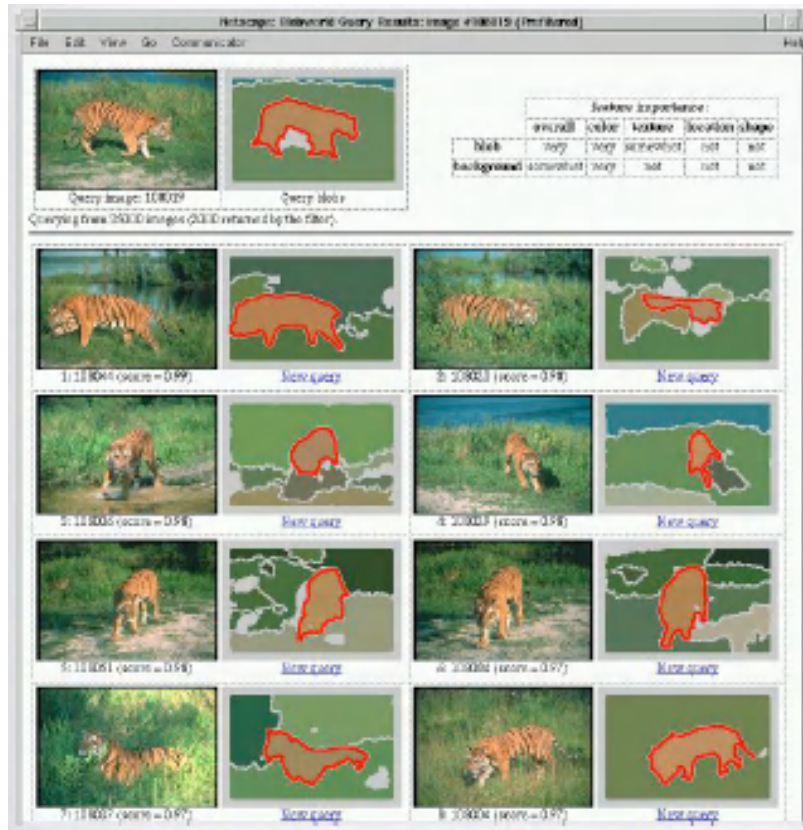
computer tries to separate objects from the image background.

- It is one of the most difficult tasks in DIP.
- A rugged segmentation procedure brings the process a long way toward successful solution of an image problem.
- Output of the segmentation stage is raw pixel data, constituting either the boundary of a region or all the points in the region itself.



Contoh Image Segmentation

Proses untuk mengelompokkan gambar sesuai dengan onyek gambarnya



Representation dan Description

Representation -> make a decision whether the data should be represented as a boundary or as a complete region.

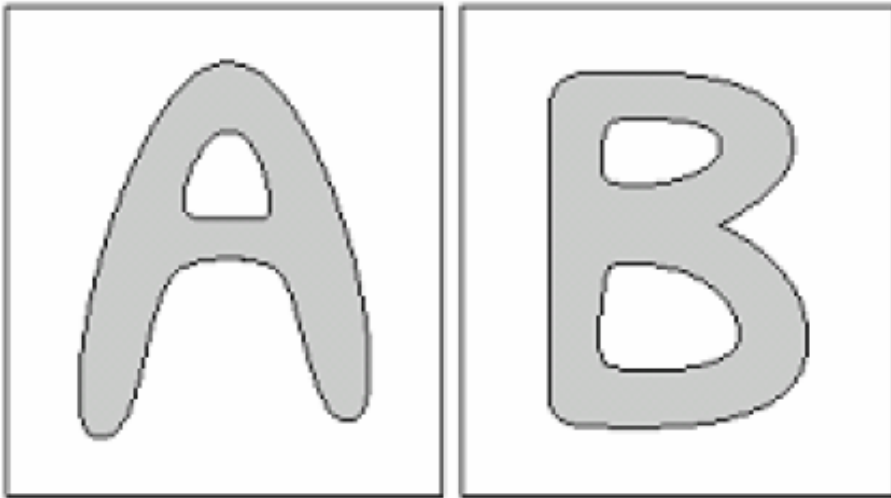
- Boundary representation -> focus on external shape characteristics, such as corners and inflections.

- Region representation -> focus on internal properties, such as texture or skeleton shape.



Representation dan Description

1 connected component, 1 hole



1 connected component, 2 holes

Representation + Description



transform raw data



a form suitable for
the Recognition
processing



Recognition & Interpretation

Recognition -> the process that assigns a label to an object based on the information provided by its descriptors.

Interpretation -> assigning meaning to an ensemble of recognized objects.



Knowledge Base

a problem domain -> detailing regions of an image where the information of interest is known to be located.

Help to limit the search



Persoalan di dalam Image Processing

- Capture
- Modeling
- Feature Extraction
- Image Segmentation

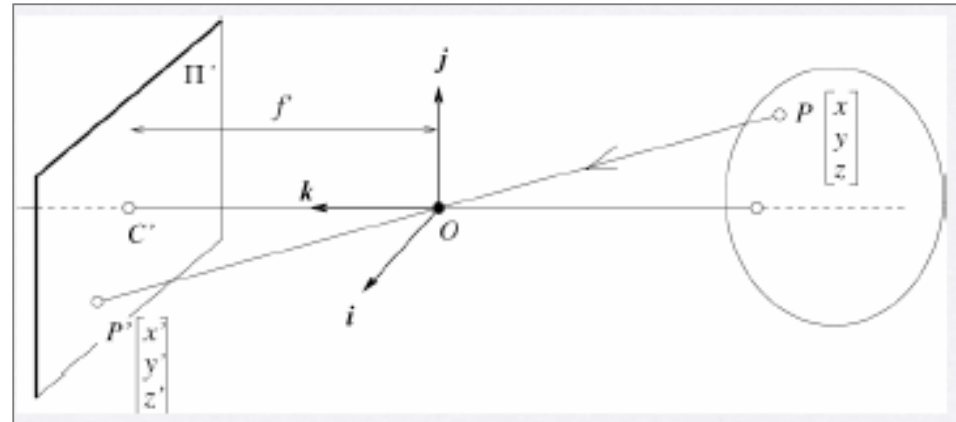
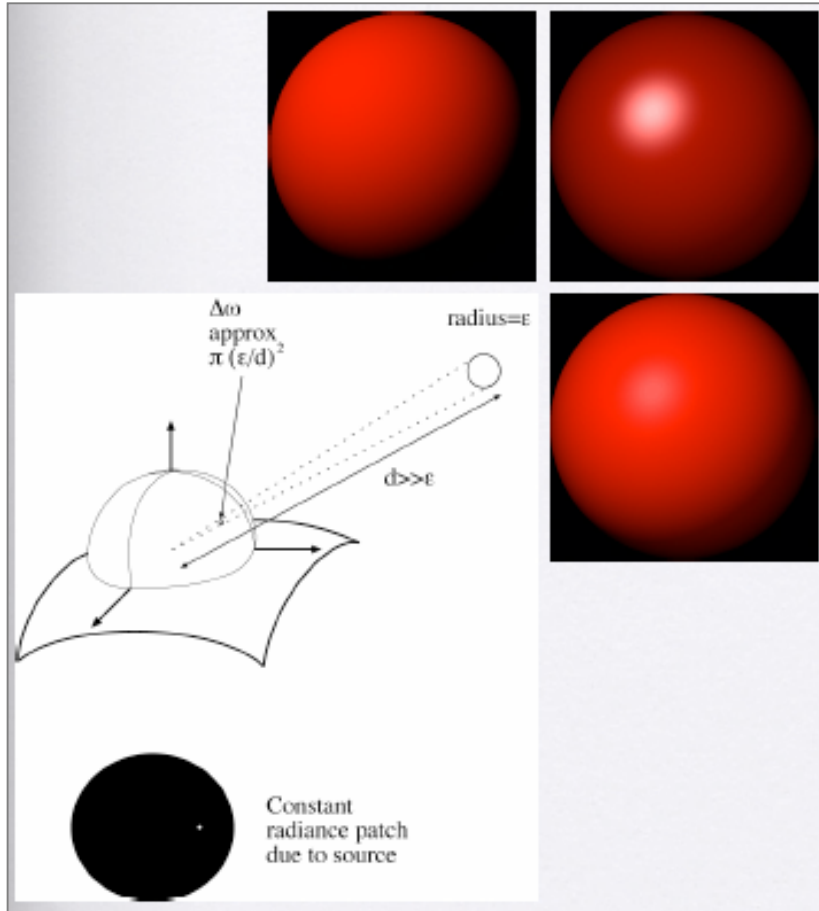


Permasalahan Capture

- Capture (Menangkap Gambar) merupakan proses awal dari image processing untuk mendapatkan gambar.
- Proses capture membutuhkan alat-alat capture yang baik seperti kamera, scanner, light-pen dan lainnya, agar diperoleh gambar yang baik.
- Gambar yang baik akan banyak membantu dalam proses selanjutnya.



Permasalahan Modeling

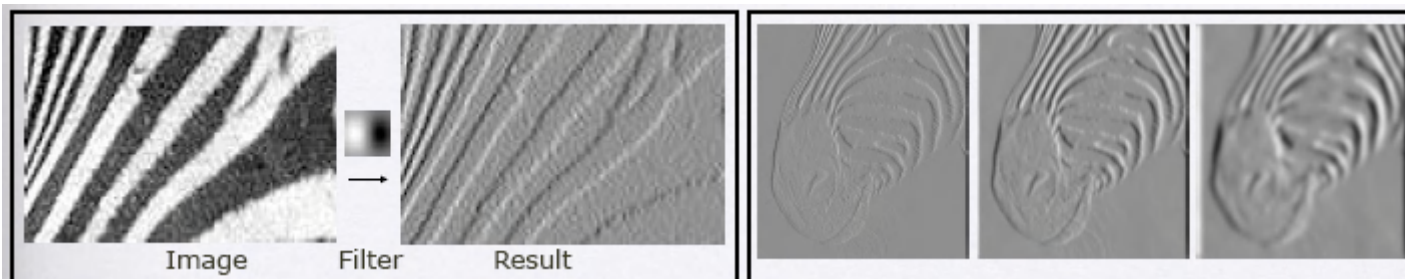


Dalam modeling diperlukan analisa matematika yang cukup rumit, khususnya pemakaian kalkulus, dan transformasi geometri. (inilah sebabnya di jurusan TI mata kuliah matematika menjadi sangat penting!!)



Permasalahan Feature Extraction

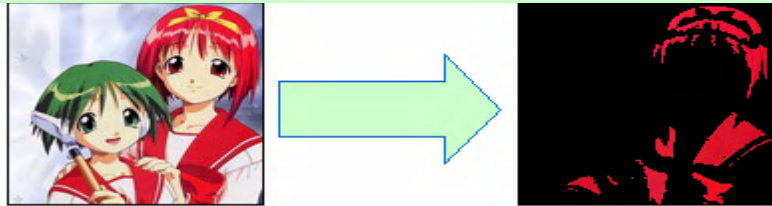
- Setiap gambar mempunyai karakteristik tersendiri, sehingga fitur tidak dapat bersifat general tetapi sangat tergantung pada model dan obyek gambar yang digunakan.
- Fitur dasar yang bisa diambil adalah warna, bentuk dan tekstur. Fitur yang lebih kompleks menggunakan segmentasi, clustering dan motion estimation.
- Pemakaian statistik dan probabilitas, pengolahan sinyal sampai pada machine learning diperlukan di sini.



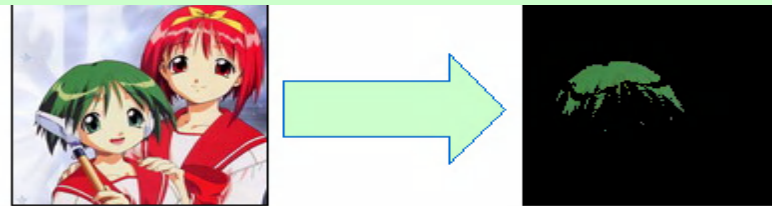
Fitur Warna

Fitur ini digunakan bila setiap obyek gambar mempunyai warna yang spesifik

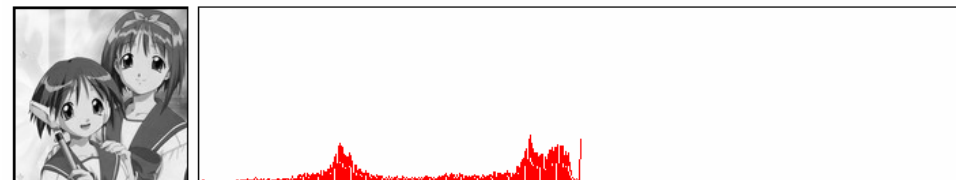
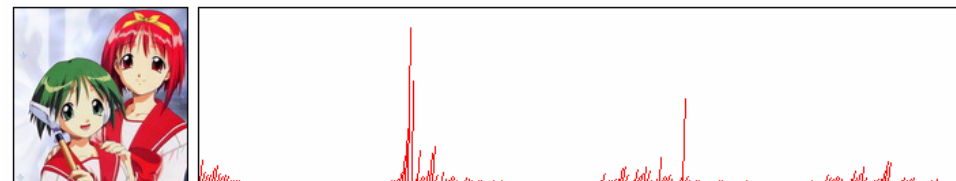
Color Thresholding Merah



Color Thresholding Hijau



Color Histogram



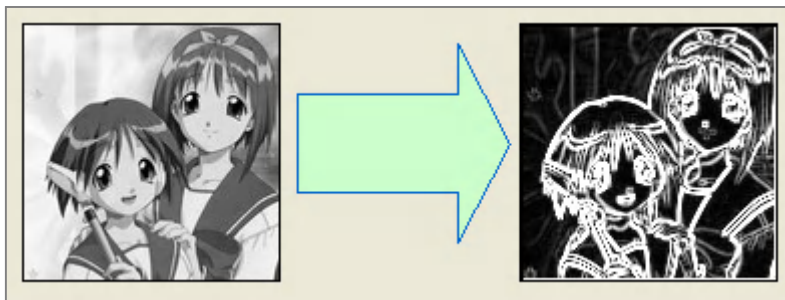
Gray-scale Histogram



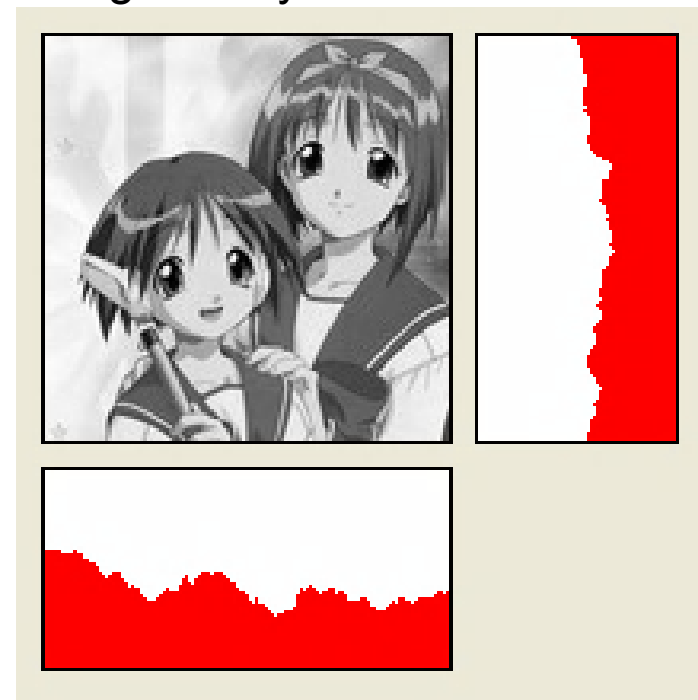
Fitur Bentuk

Fitur ini digunakan bila gambar setiap obyek mempunyai bentuk yang spesifik

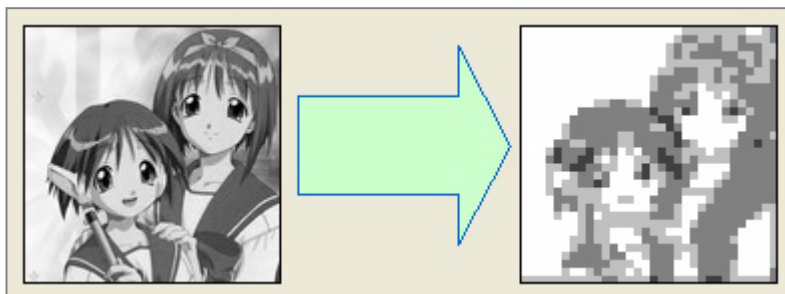
Deteksi Tepi



Integral Proyeksi



Kuantisasi Rata-rata

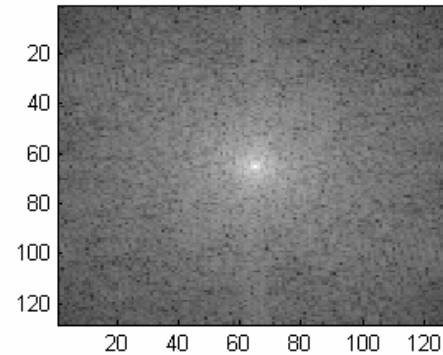


Fitur Tekstur

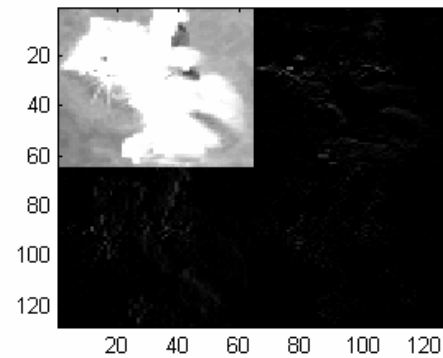
Image



FFT



Wavelets



Beberapa algoritma untuk mendapatkan fitur tekstur:

- (1) FFT
- (2) Wavelets
- (3) Image Filter
- (4) Filter Gabor

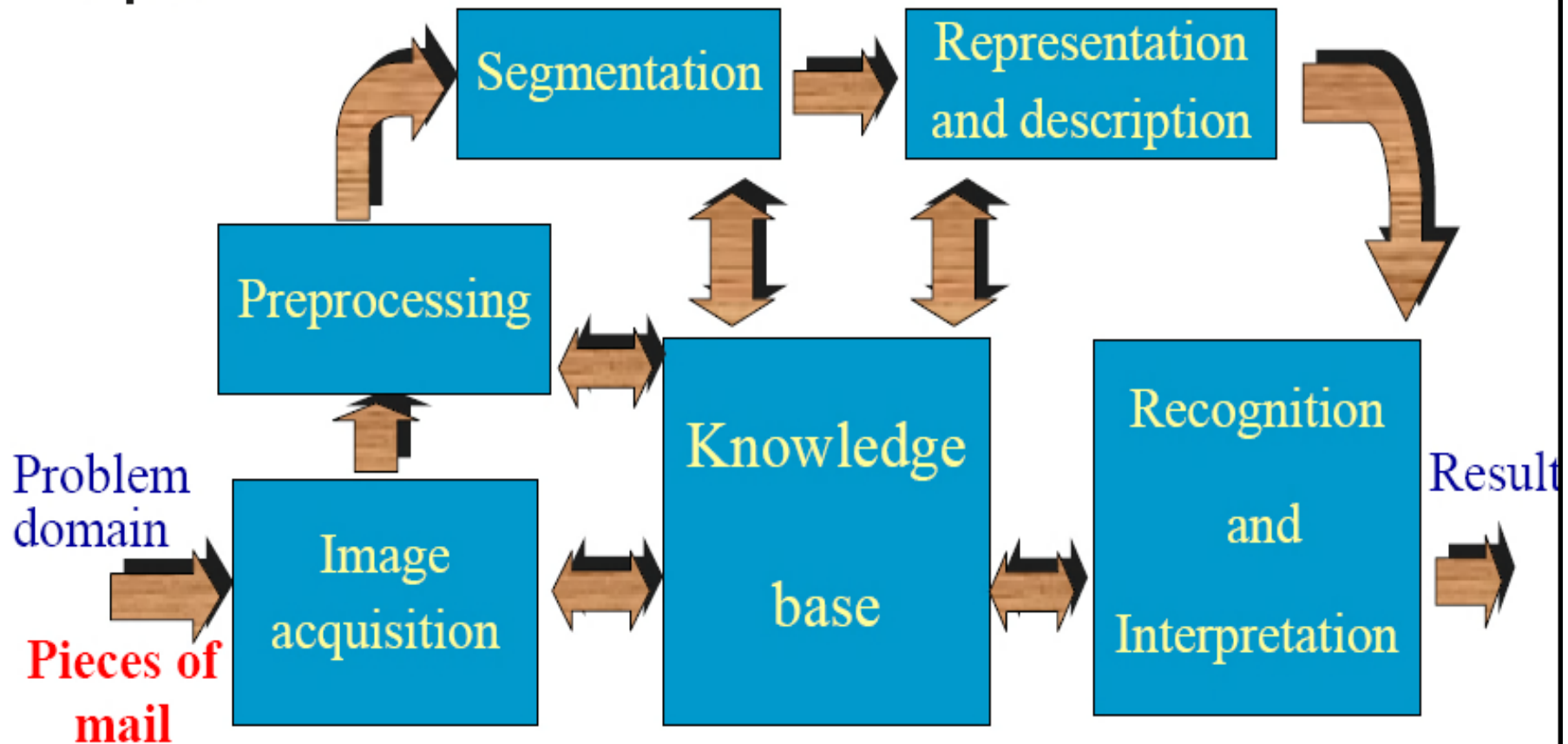


Permasalahan Image Segmentation

- Bagaimana memisahkan obyek gambar dengan backgroundnya
- Bagaimana memisahkan setiap obyek gambar.
- Teknik clustering apa yang sesuai dengan model dan obyek gambar yang digunakan



Ex : Postal Code Problem



Desired output = alphanumeric characters



APLIKASI IMAGE PROCESSING

- Biometric
- Medical Image
- Image Databases
- Robot Vision
- Motion Capture
- Document Analysis



Biometric

Face recognition
Iris scanning
Fingerprint recognition
Activity recognition



Medical Image

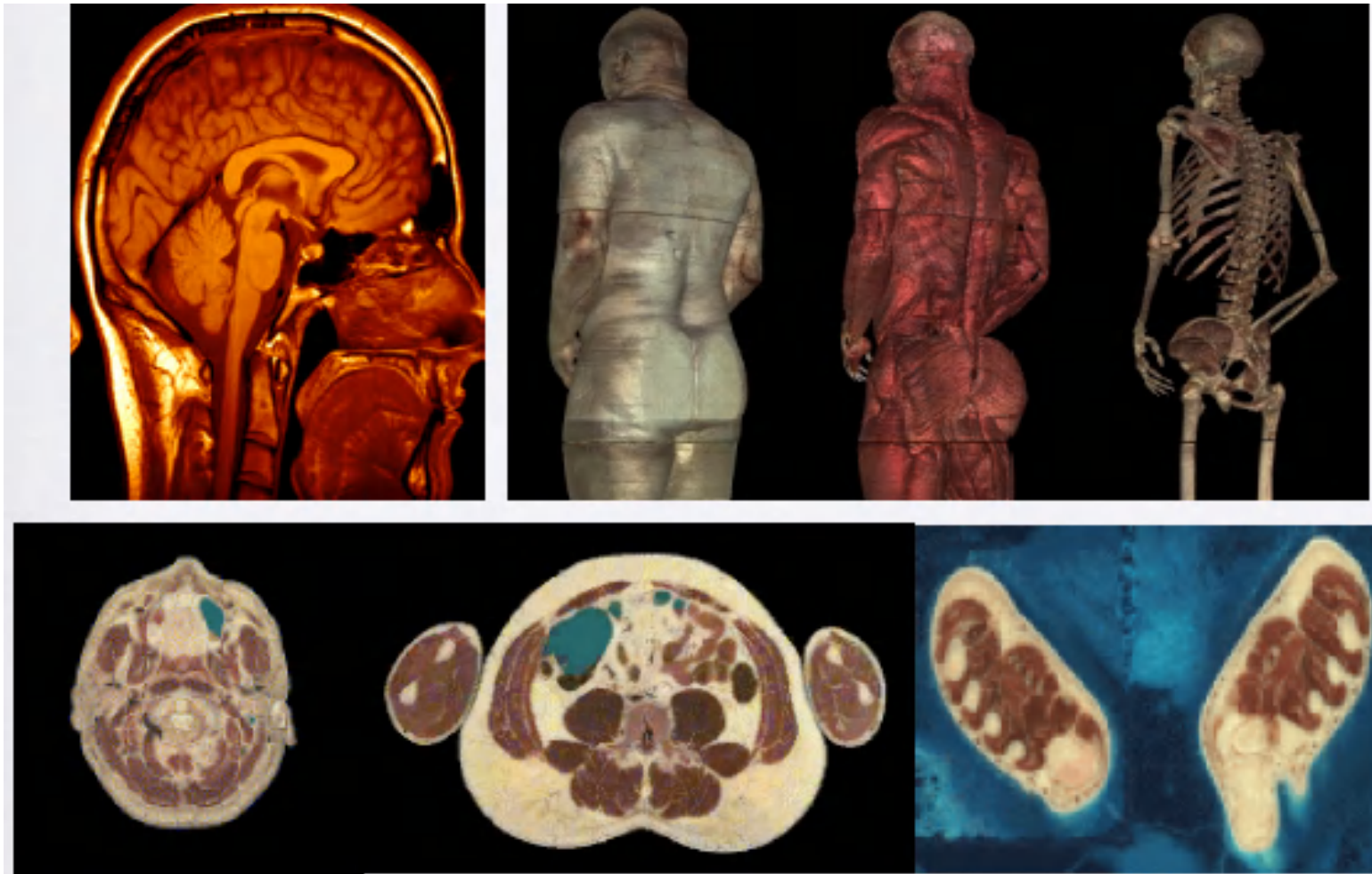


Image Databases

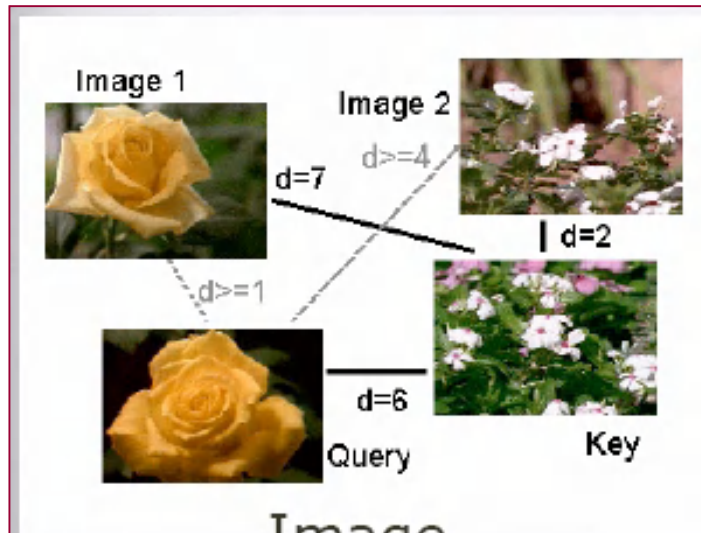
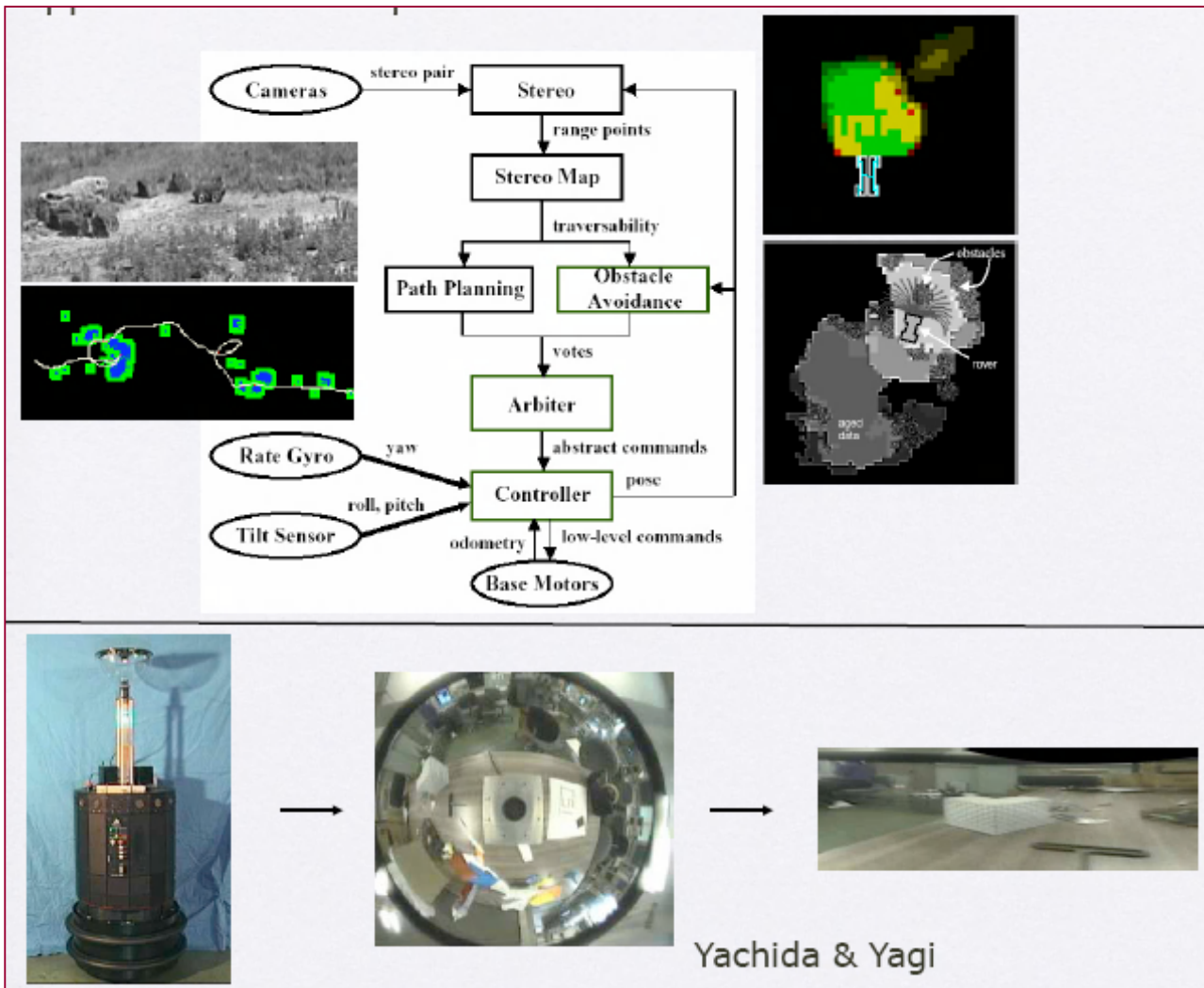


Image retrieval

From a search for horse pix in 100 horse images and 1086 non-horse images.



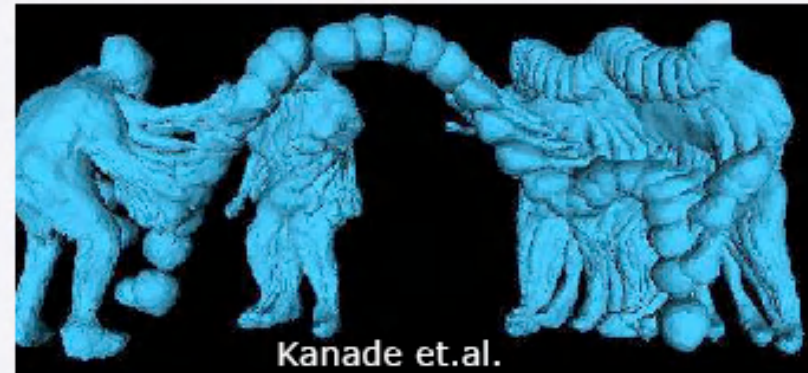
Robot Vision



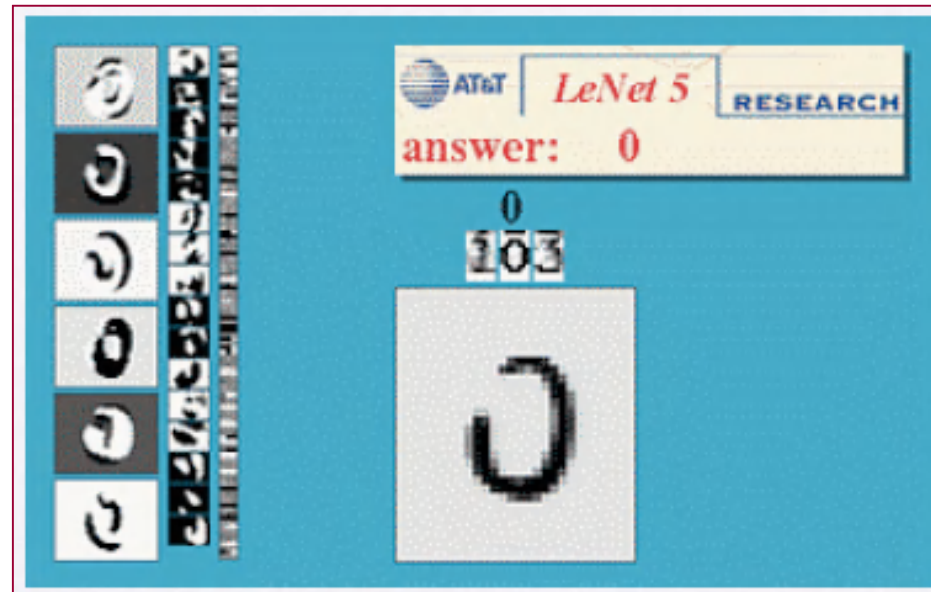
Yachida & Yagi



Motion Capture



Document Analysis



Tugas Pertemuan I

Cari dua paper aplikasi DIP/Computer Vision dan jelaskan (bagan) :

1. Acquisition
2. Preprocessing
3. Segmentation
4. Representation dan Description
5. Recognition dan Interpretation
6. Knowledge Base

Tidak harus semua bagian (1-6) ada/dipakai di paper (sesuai dengan papernya)

Syarat :

1. Paper paling lama th 2007
2. Tuliskan judul paper, pengarang, dan th nya
3. Bagan dan Penjelasannya, dikirim email ke nanarama71@yahoo.com, dikumpulkan pertemuan ke-2





Sekilas Info

Ada beberapa hal yang harus dikuasai sebelum menguasai materi di dalam image processing yaitu: matematika, aljabar, pengolahan sinyal, statistik dan pemrograman.



Bergabunglah dengan Kami



Laboratorium Computer Vision
Politeknik Elektronika Negeri Surabaya
PENS-ITS 2009