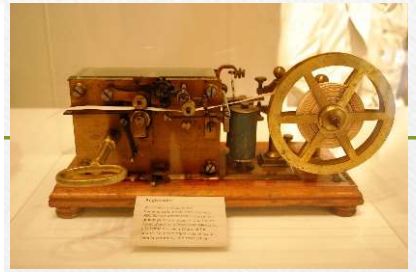
Sejarah dan Pengantar Citra

Pengolahan citra digital dan visi computer

Team Teaching PCVK 2023/2024

Sejarah

FIGURE 1.1 A digital picture produced in 1921 from a coded tape by a telegraph printer with special type faces. (McFarlane.[†])



Telegraph Printer

- 1.1 – Halftone Pattern
- 1.2 – Improve Quality and Resolution

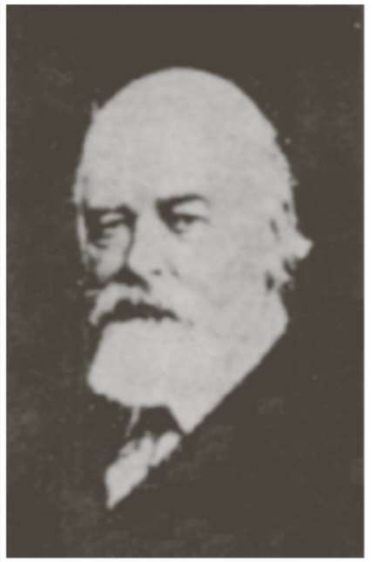


FIGURE 1.2 A digital picture made in 1922 from a tape punched after the signals had crossed the Atlantic twice. (McFarlane.)

FIGURE 1.3
Unretouched cable picture of Generals Pershing and Foch, transmitted in 1929 from London to New York by 15-tone equipment. (McFarlane.)

- 1.3 – 15 tone equipment
- Digital image require so much storage and computational power
- DIP dependent on storage, display, transmission tech.

FIGURE 1.4 The first picture of the moon by a U.S. spacecraft. *Ranger 7* took this image on July 31, 1964 at 9 : 09 A.M. EDT, about 17 minutes before impacting the lunar surface. (Courtesy of NASA.)

- Using geometric correction (transformasi citra jarak jauh)
- Improved methods used to enhance and restore image
- 1960 and early 1970s DIP be used in medical image, remote Earth resource observation, and astronomy

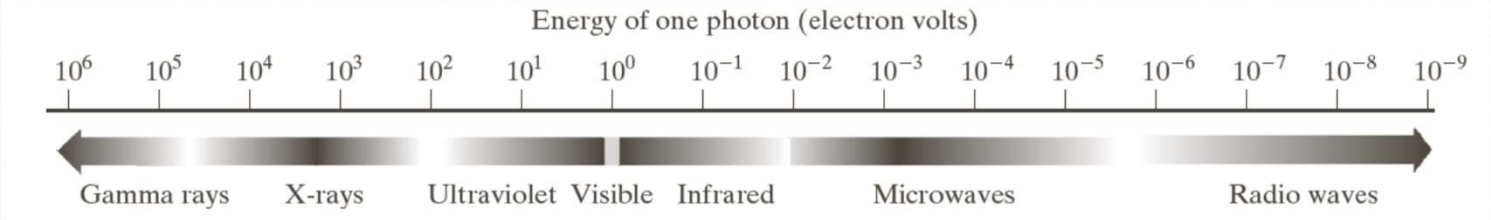


FIGURE 1.5 The electromagnetic spectrum arranged according to energy per photon.

- Gammar rays : nuclear medicine, astronomical observation
- X-Rays : used for medical diagnostic used extensively in industry and astronomy
- Ultraviolet band : include lithography, industrial inspection, microscopy, lasers, biological imaging, astronomical observation
- Infrared band : light microscopy, astronomy, remote sensing, industry, and law enforcement
- Microwave Band : Works like flash camera
- Radio Band : used for madicide and astronomy like MRI (magnetic Resonance Imaging)

- Complete bone scan obtained by using gamma ray detector

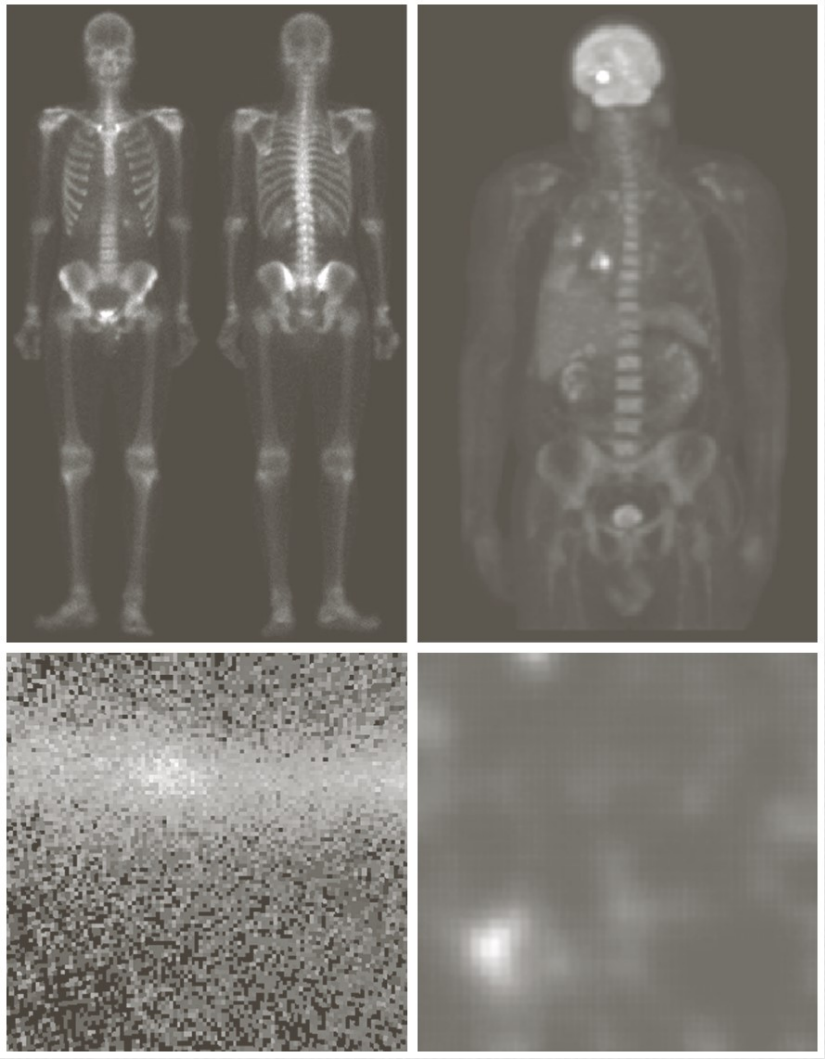


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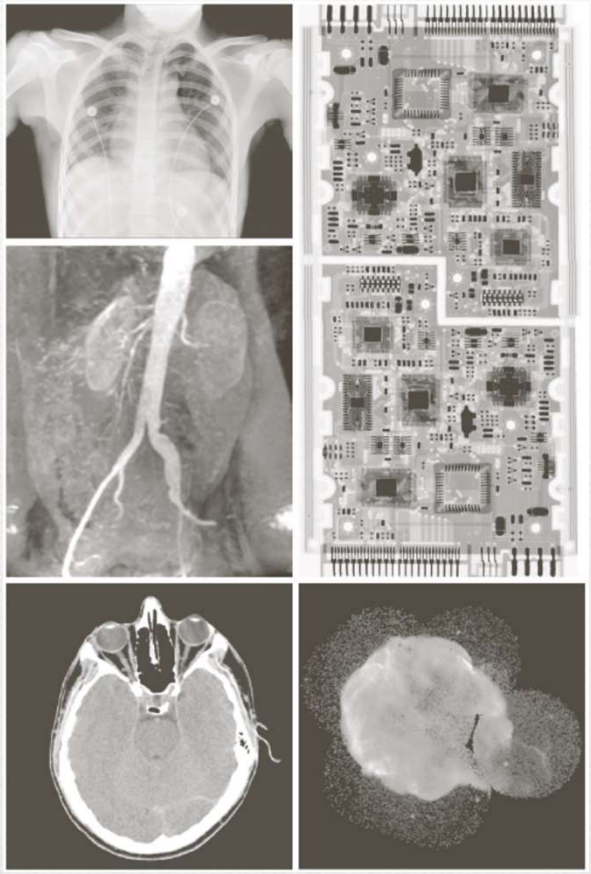
FIGURE 1.6 Examples of gamma-ray imaging. (a) Bone scan. (b) PET image. (c) Cygnus Loop. (d) Gamma radiation (bright spot) from a reactor valve. (Images courtesy of (a) G.E. Medical Systems, (b) Dr. Michael E. Casey, CTI PET Systems, (c) NASA, (d) Professors Zhong He and David K. Wehe, University of Michigan.)

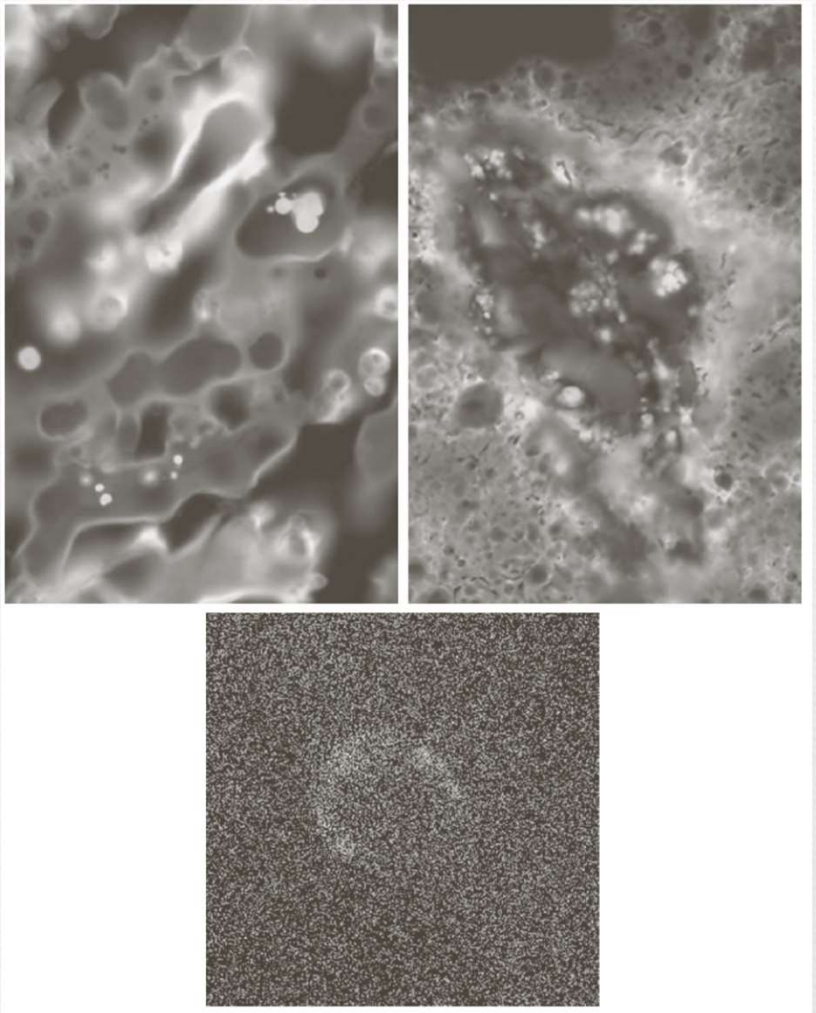
- Obtained using X rays detector



a b c d e

FIGURE 1.7 Examples of X-ray imaging. (a) Chest X-ray. (b) Aortic angiogram. (c) Head CT. (d) Circuit boards. (e) Cygnus Loop. (Images courtesy of (a) and (c) Dr. David R. Pickens, Dept. of Radiology & Radiological Sciences, Vanderbilt University Medical Center; (b) Dr. Thomas R. Gest, Division of Anatomical Sciences, University of Michigan Medical School; (d) Mr. Joseph E. Pascente, Lixi, Inc.; and (e) NASA.)

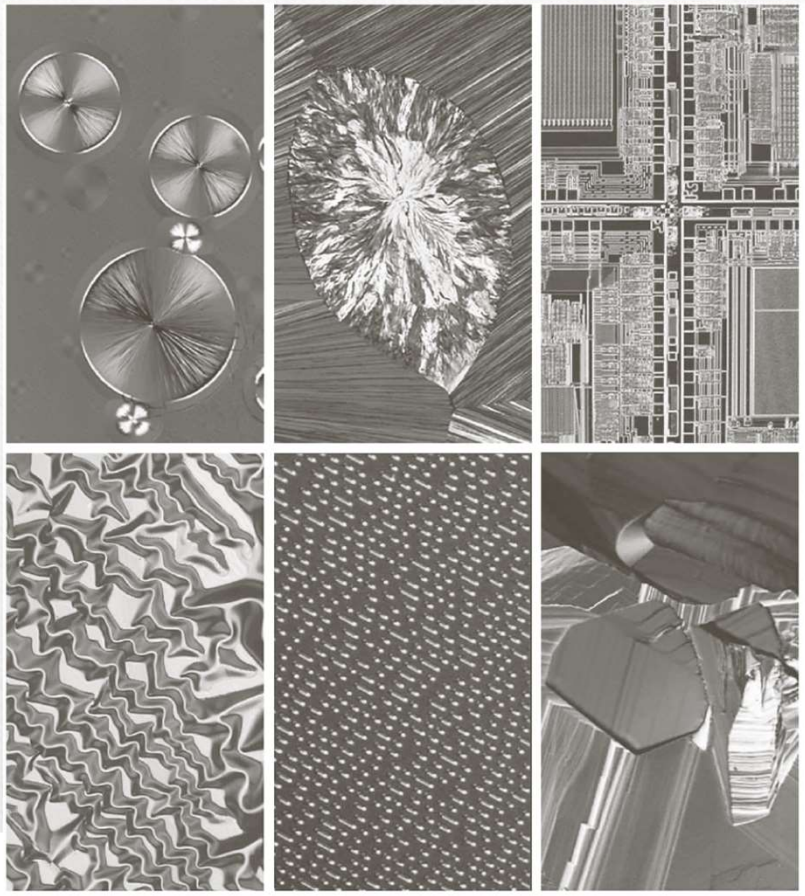
- Obtained using Ultraviolet detector



a b
c

FIGURE 1.8
Examples of ultraviolet imaging.
(a) Normal corn.
(b) Smut corn.
(c) Cygnus Loop.
(Images courtesy of (a) and (b) Dr. Michael W. Davidson, Florida State University, (c) NASA.)

- Obtained using Infrared detector



d e f

FIGURE 1.9 Examples of light microscopy images. (a) Taxol (anticancer agent), magnified 250×. (b) Cholesterol—40×. (c) Microprocessor—60×. (d) Nickel oxide thin film—600×. (e) Surface of audio CD—1750×. (f) Organic superconductor—450×. (Images courtesy of Dr. Michael W. Davidson, Florida State University.)

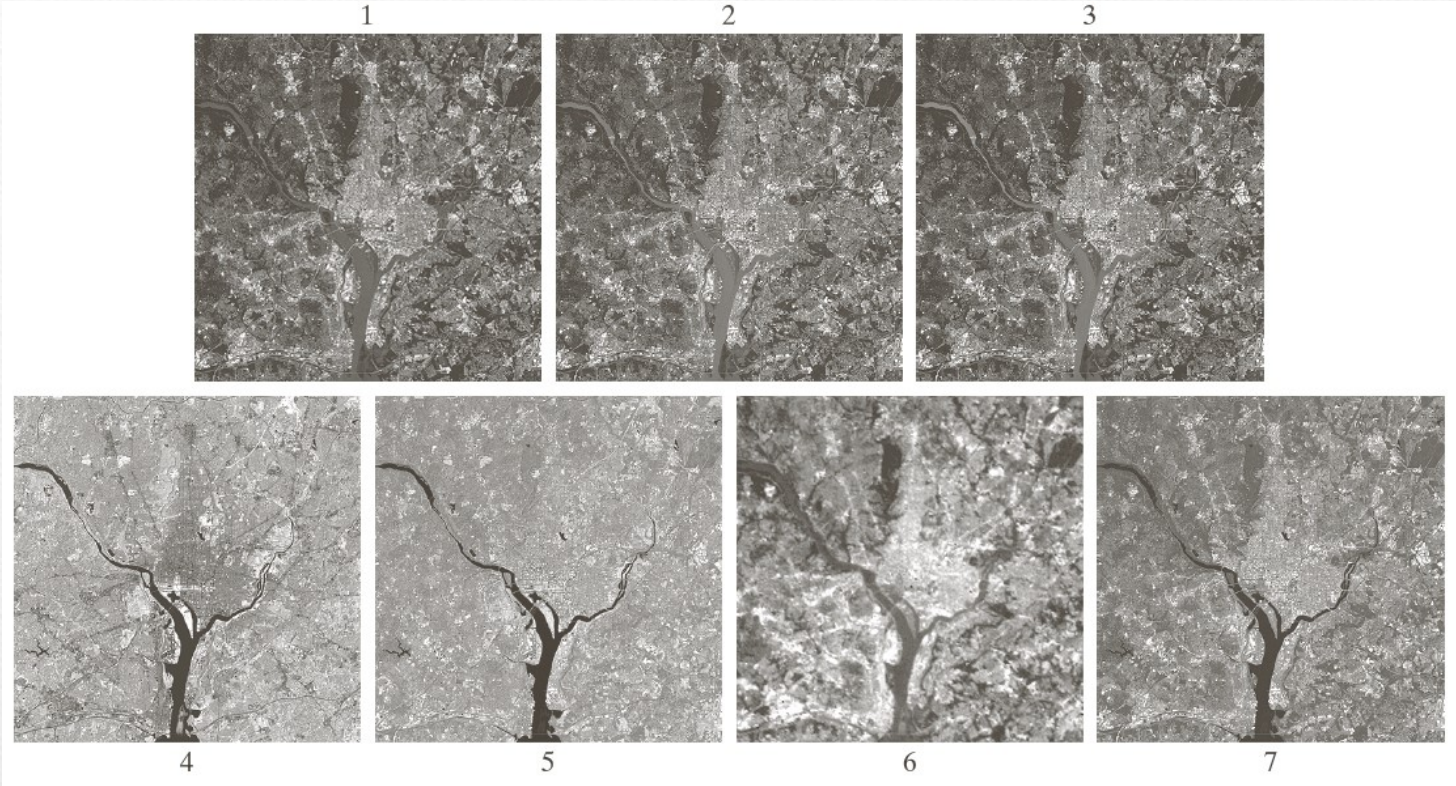


FIGURE 1.10 LANDSAT satellite images of the Washington, D.C. area. The numbers refer to the thematic bands in Table 1.1. (Images courtesy of NASA.)

- Obtained using Infrared detector

Band No.	Name	Wavelength (μm)	Characteristics and Uses
1	Visible blue	0.45–0.52	Maximum water penetration
2	Visible green	0.52–0.60	Good for measuring plant vigor
3	Visible red	0.63–0.69	Vegetation discrimination
4	Near infrared	0.76–0.90	Biomass and shoreline mapping
5	Middle infrared	1.55–1.75	Moisture content of soil and vegetation
6	Thermal infrared	10.4–12.5	Soil moisture; thermal mapping
7	Middle infrared	2.08–2.35	Mineral mapping

TABLE 1.1 Thematic bands in NASA's LANDSAT satellite.

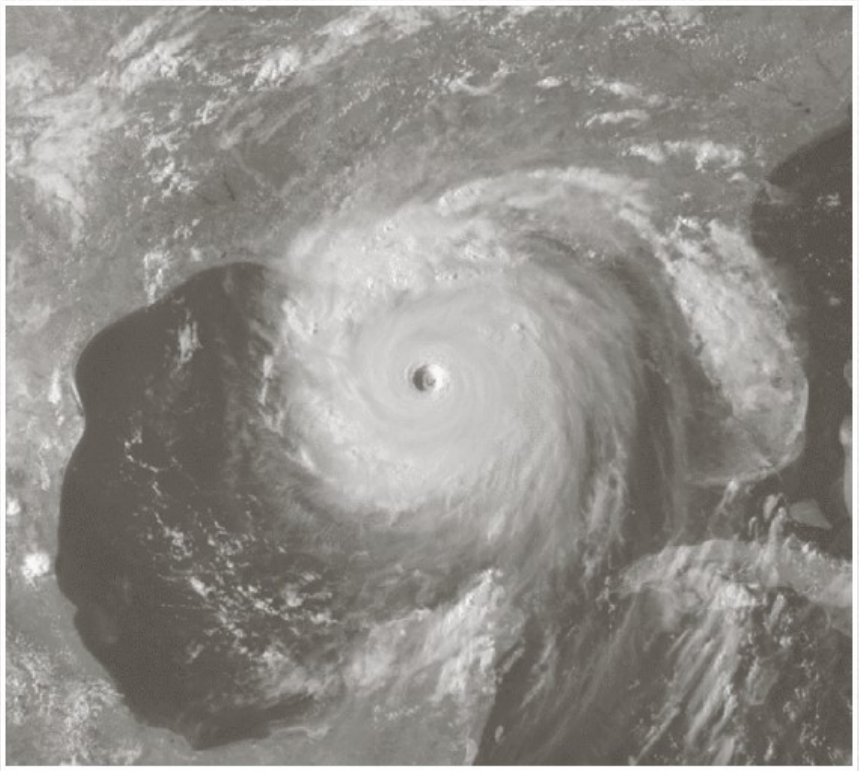


FIGURE 1.11
Satellite image of Hurricane Katrina taken on August 29, 2005. (Courtesy of NOAA.)

- Obtained using Infrared detector

- Obtained using Infrared detector

FIGURE 1.12
Infrared satellite images of the Americas. The small gray map is provided for reference. (Courtesy of NOAA.)

- Obtained using Infrared detector

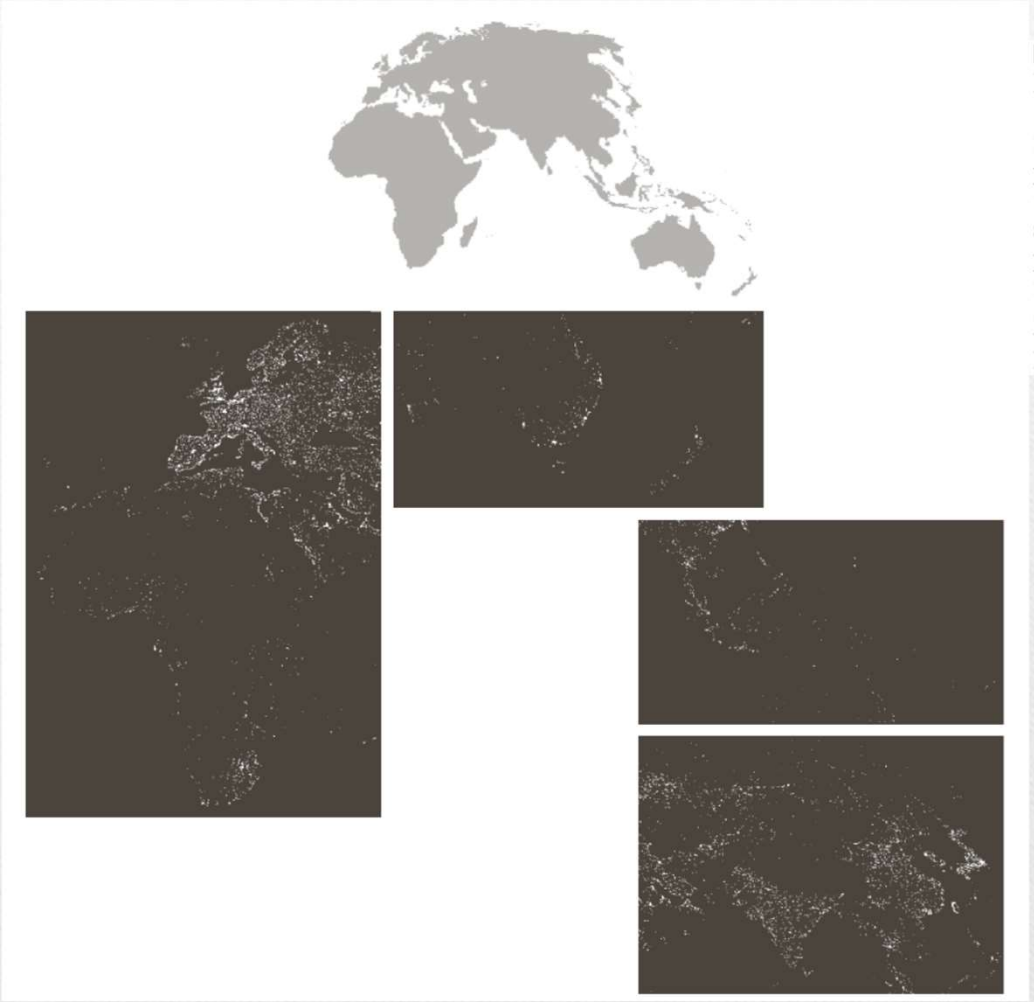
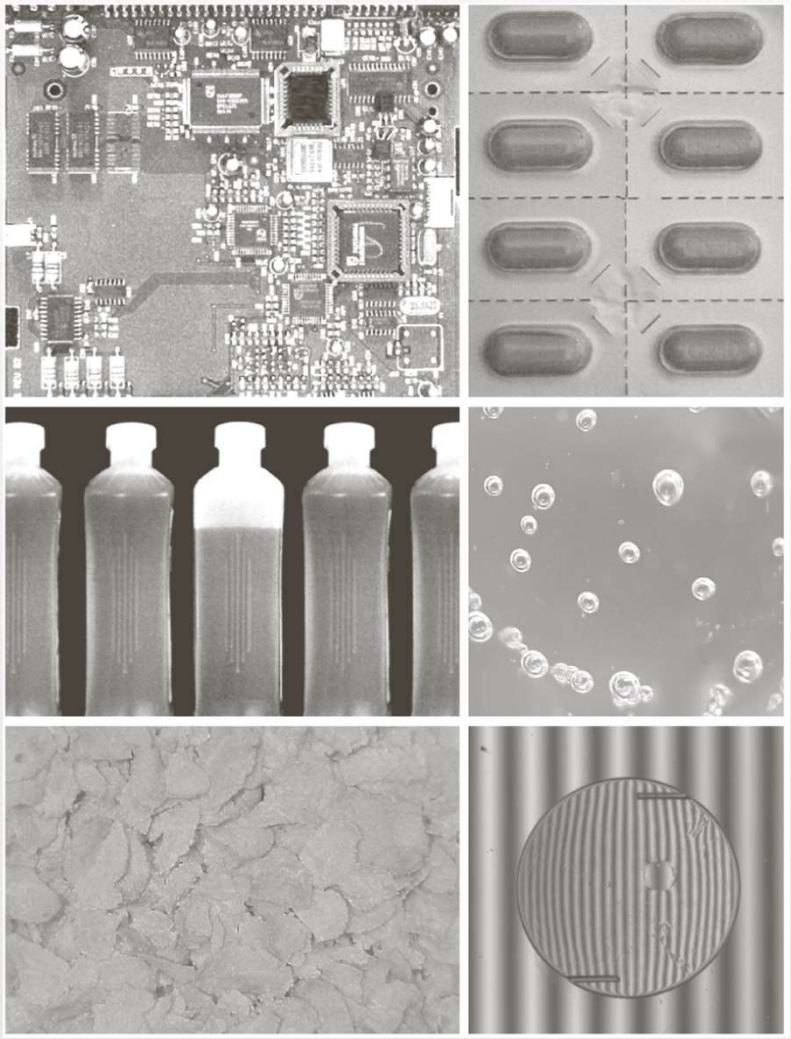


FIGURE 1.13
Infrared satellite images of the remaining populated part of the world. The small gray map is provided for reference. (Courtesy of NOAA.)

- Obtained using Infrared detector



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c d
e f

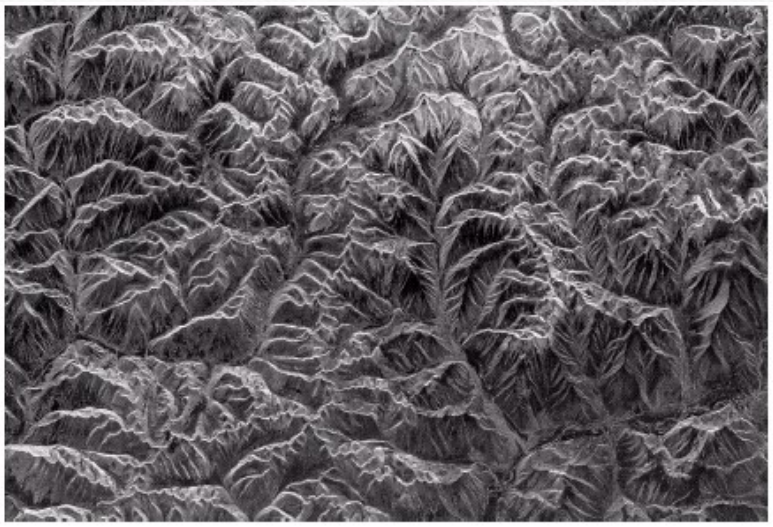
FIGURE 1.14
Some examples of manufactured goods often checked using digital image processing.
(a) A circuit board controller.
(b) Packaged pills.
(c) Bottles.
(d) Air bubbles in a clear-plastic product.
(e) Cereal.
(f) Image of intraocular implant.
(Fig. (f) courtesy of Mr. Pete Sites, Perceptics Corporation.)

- Obtained using Infrared detector

a b
c
d

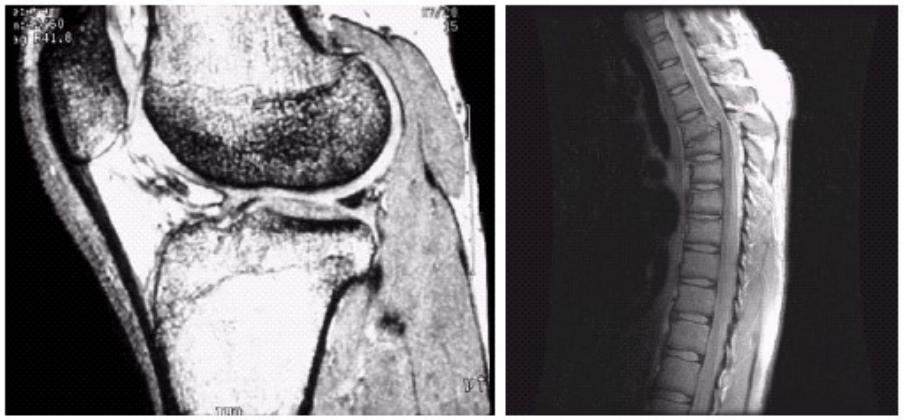
FIGURE 1.15
Some additional examples of imaging in the visual spectrum. (a) Thumb print. (b) Paper currency. (c) and (d) Automated license plate reading. (Figure (a) courtesy of the National Institute of Standards and Technology. Figures (c) and (d) courtesy of Dr. Juan Herrera, Perceptics Corporation.)

FIGURE 1.16
Spaceborne radar image of mountains in southeast Tibet. (Courtesy of NASA.)



- Obtained using microwave detector

- Obtained using Radio detector



a b

FIGURE 1.17 MRI images of a human (a) knee, and (b) spine. (Image (a) courtesy of Dr. Thomas R. Gest, Division of Anatomical Sciences, University of Michigan Medical School, and (b) Dr. David R. Pickens, Department of Radiology and Radiological Sciences, Vanderbilt University Medical Center.)

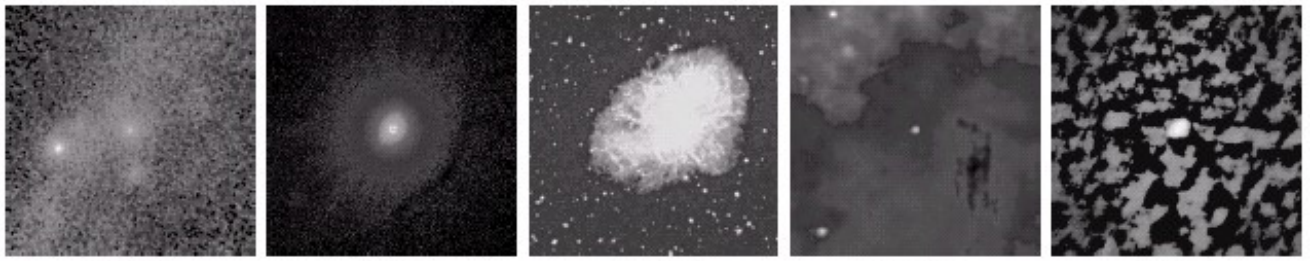
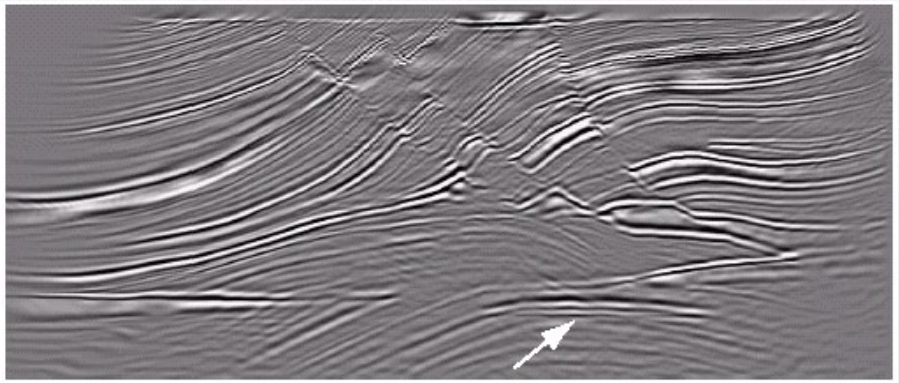


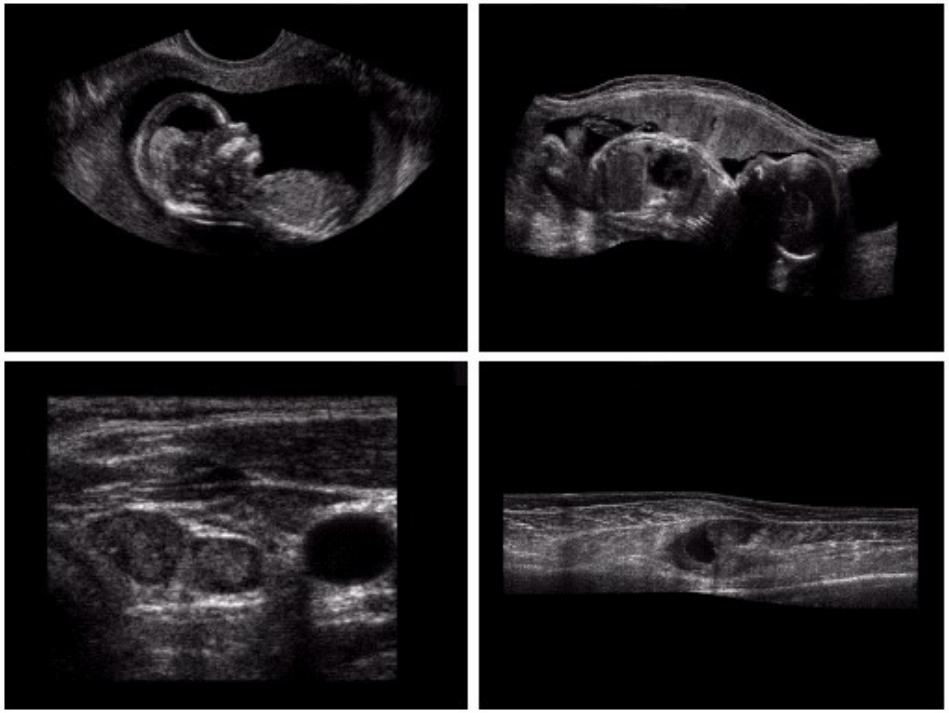
FIGURE 1.18 Images of the Crab Pulsar (in the center of images) covering the electromagnetic spectrum. (Courtesy of NASA.)

- Obtained using Radio detector

FIGURE 1.19
Cross-sectional image of a seismic model. The arrow points to a hydrocarbon (oil and/or gas) trap. (Courtesy of Dr. Curtis Ober, Sandia National Laboratories.)



- Obtained using Radio detector



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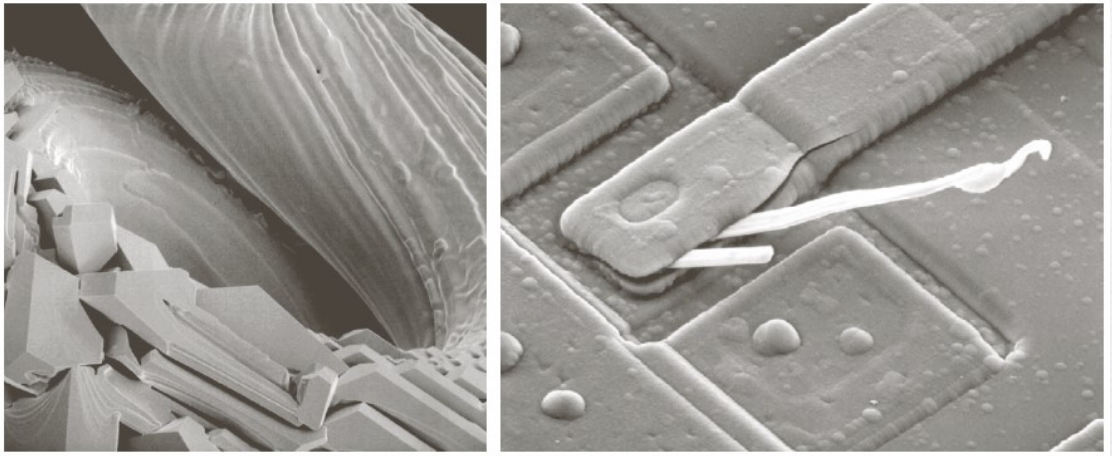
c d

FIGURE 1.20
Examples of ultrasound imaging. (a) Baby. (2) Another view of baby. (c) Thyroids. (d) Muscle layers showing lesion. (Courtesy of Siemens Medical Systems, Inc., Ultrasound Group.)

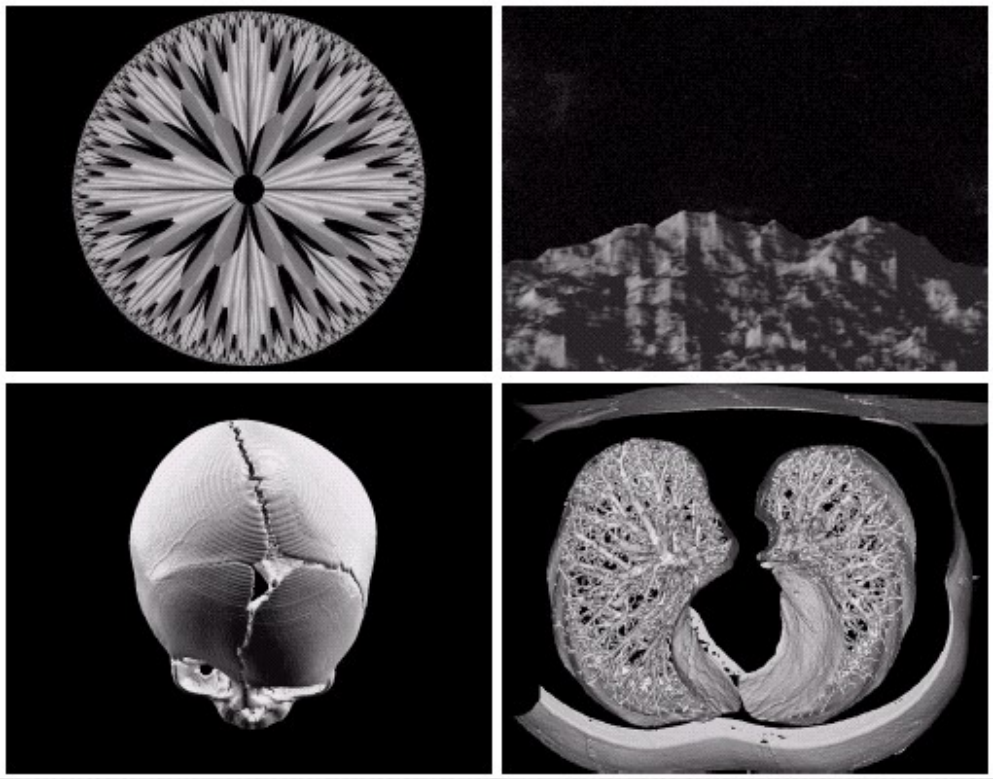
- Obtained using Radio detector



a b

FIGURE 1.21 (a) 250× SEM image of a tungsten filament following thermal failure (note the shattered pieces on the lower left). (b) 2500× SEM image of damaged integrated circuit. The white fibers are oxides resulting from thermal destruction. (Figure (a) courtesy of Mr. Michael Shaffer, Department of Geological Sciences, University of Oregon, Eugene; (b) courtesy of Dr. J. M. Hudak, McMaster University, Hamilton, Ontario, Canada.)

- Circuit Obtained using Radio detector



a b
c d

FIGURE 1.22
(a) and (b) Fractal images. (c) and (d) Images generated from 3-D computer models of the objects shown. (Figures (a) and (b) courtesy of Ms. Melissa D. Binde, Swarthmore College, (c) and (d) courtesy of NASA.)

- Circuit Obtained using Radio detector

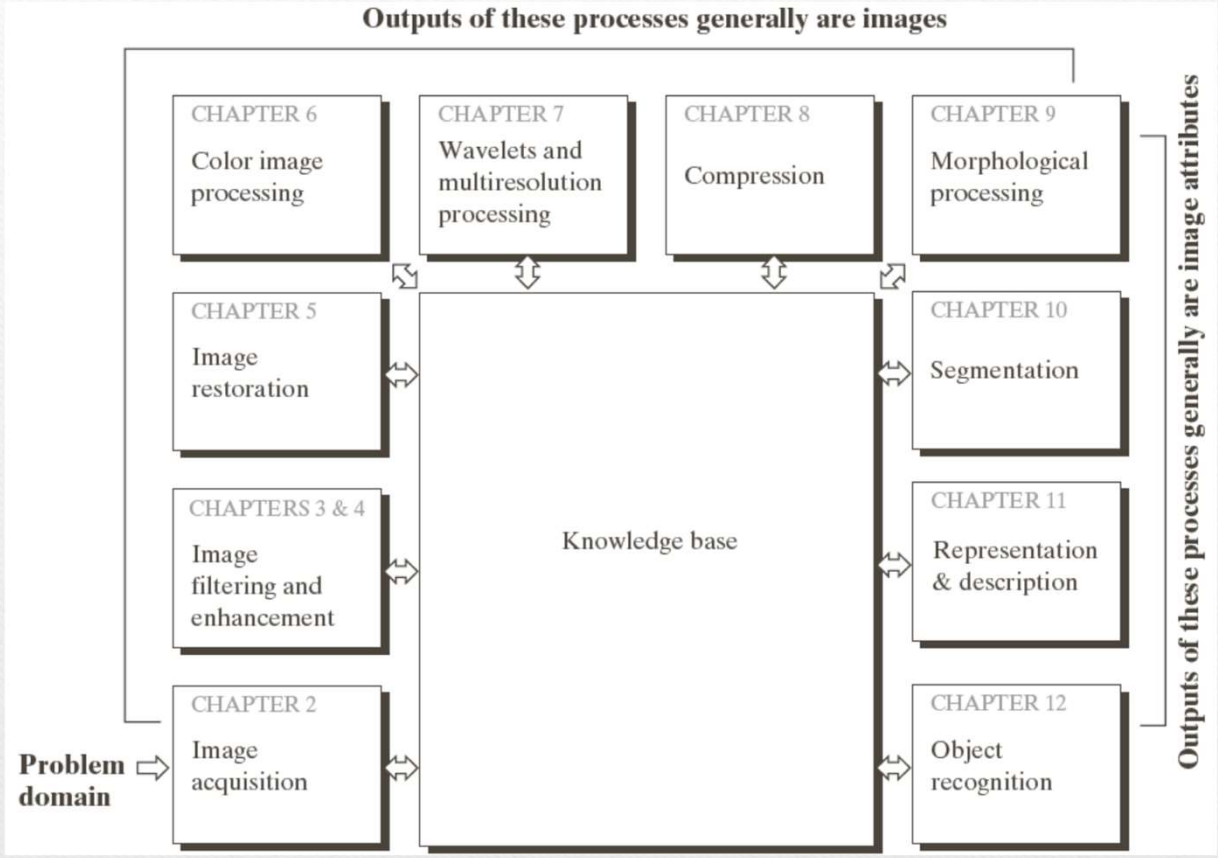


FIGURE 1.23 Fundamental steps in digital image processing. The chapter(s) indicated in the boxes is where the material described in the box is discussed.

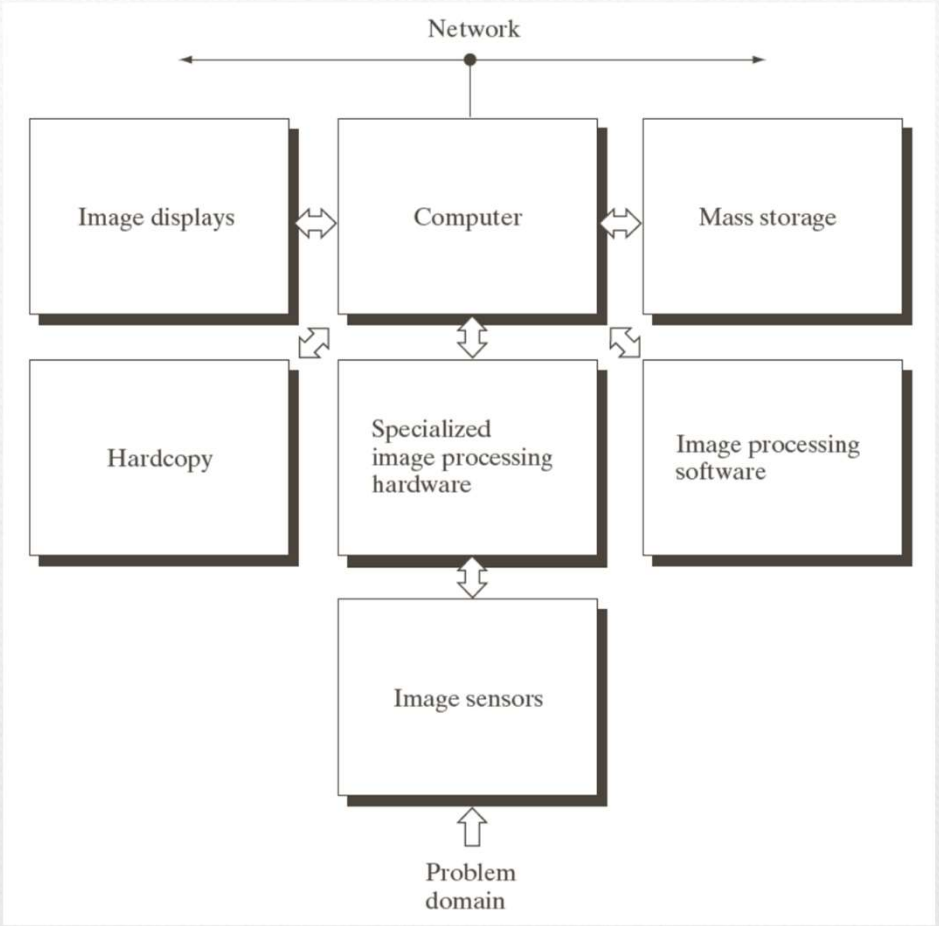
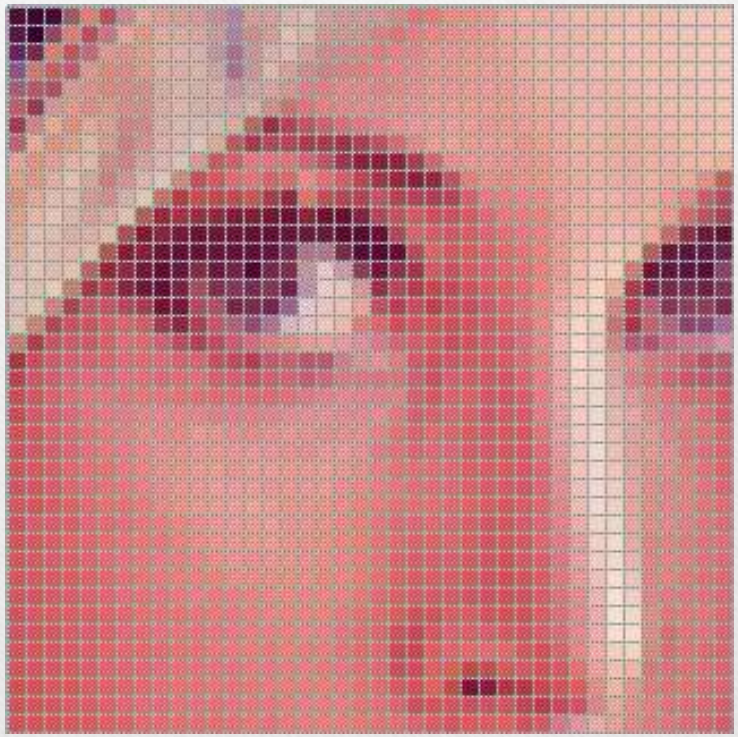


FIGURE 1.24
Components of a general-purpose image processing system.

Pengantar Citra Digital

Pengertian Citra Digital

- Citra Digital (Citra Raster) adalah representasi numerik dari citra dua dimensi. Nilai numerik yang direpresentasikan umumnya adalah nilai biner 8 bit
- Nilai biner ini disimpan pada elemen citra yang sering disebut sebagai pixel.
- Citra digital berisi pixel yang jumlah baris dan kolomnya tetap. Pixel adalah elemen gambar terkecil dari citra digital.
- Pixel disimpan pada memory computer sebagai map raster, yaitu array dua dimensi bertipe integer.

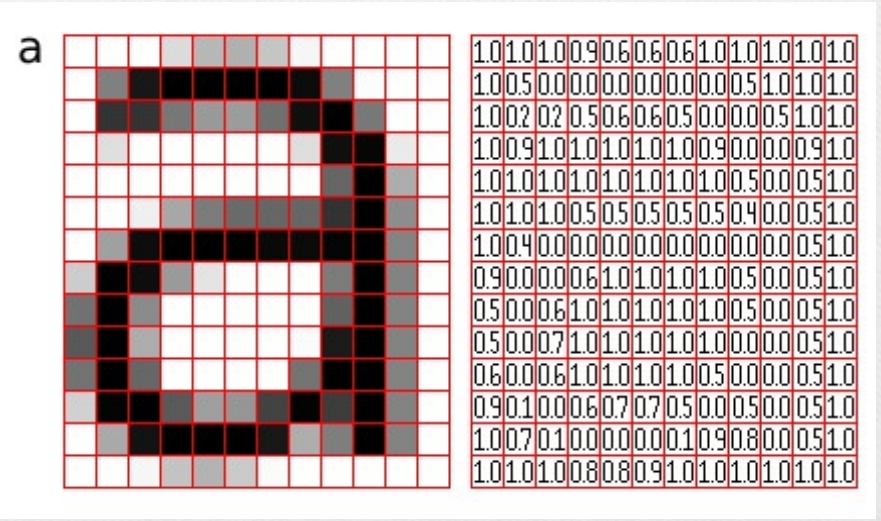


Akuisisi dan Warna Dasar Citra

- Citra Raster diakuisisi menggunakan berbagai macam perangkat input dan teknik, seperti digital camera, scanner, radar, camera infra merah, dan lain sebagainya.
- Pengolahan Citra Digital adalah ilmu yang mempelajari algoritma transformasi citra.
- Citra digital yang umum digunakan pada pengolahan citra adalah Citra biner, Citra Keabuan, dan Citra Berwarna RGB (Red, Green, dan Blue).
- Citra biner adalah citra yang memiliki 2 warna saja, yaitu hitam dan putih. Jika direpresentasikan dengan nilai biner 8bit adalah warna hitam bernilai 0000 0000, dan putih bernilai 1111 1111. biasa ditampilkan dengan nilai normalisasi 0 dan 1, atau decimal 0 dan 255, atau heksadesimal 00x dan FFx.

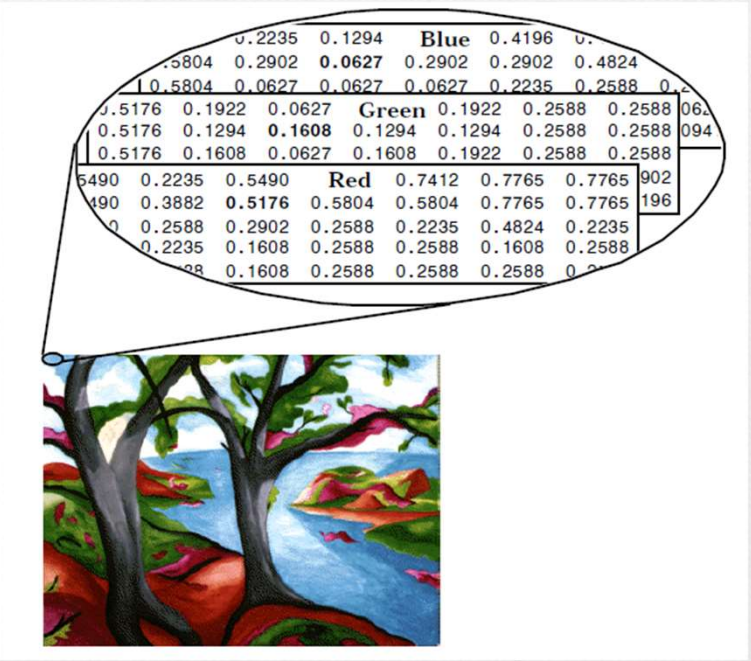
Citra Keabuan

- Citra keabuan adalah citra yang memiliki derajat keabuan sebanyak 256 warna.
- Dimulai dengan warna terkecilnya yaitu hitam, dan warna terbesarnya adalah putih.
- Pada gambar berikut ditunjukkan representasi nilai normalisasi citra keabuan dimana 1.0 menyatakan warna putih, 0.0 menyatakan warna hitam, dan nilai antara 0.0 – 1.0 menyatakan warna derajat keabuannya.



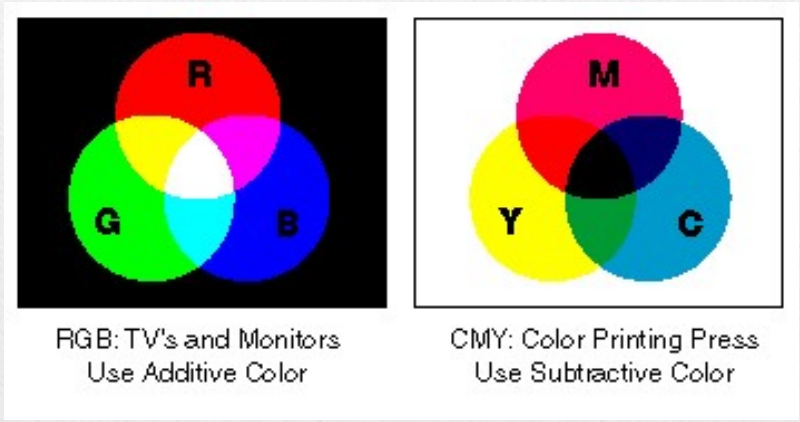
Citra Berwarna RGB

- Citra berwarna RGB adalah citra yang memiliki 3 level / channel warna direpresentasikan dengan resolusi citra 3 dimensi.
- Pada citra digital, level pertama digunakan untuk menyimpan warna R (Red / merah), Level kedua digunakan untuk menyimpan warna G (Green / hijau), dan level ketiga digunakan untuk menyimpan warna B (Blue / biru).
- Pada perangkat keluaran seperti LCD Monitor, RGB disusun secara array dan berukuran sangat kecil.
- Representasi nilainya disimpan dalam nilai biner. Warna Hitam direpresentasikan dengan R = 0000 0000, G = 0000 0000, dan B = 0000 0000. Warna Merah direpresentasikan dengan R = 1111 1111, G = 0000 0000, dan B = 0000 0000.
- Karena memiliki 3 level, maka ukuran file citra RGB dibandingkan dengan citra keabuan adalah 3:1 dengan jumlah pixel (resolusi citra) yang sama.



Citra Berwarna RGB

- Warna lain selain Merah, hijau, dan biru adalah campuran dari ketiga warna tersebut. Perhatikan gambar berikut, warna kuning adalah campuran dari warna merah dan hijau. Kuning direpresentasikan dengan nilai R = 1111 1111, G = 1111 1111, dan B = 0000 0000.



Perangkat Lunak Citra Digital

- Citra digital dapat ditampilkan pada berbagai macam perangkat lunak penampil citra (Image Viewer). Web Browser dapat menampilkan standard citra format internet secara langsung seperti GIF, JPEG, dan PNG. Beberapa browser dapat menampilkan SVG yang merupakan format standard W3C. Beberapa citra sains saat ini dapat berukuran sangat besar (sebagai contoh 46 giga pixel ukuran citra dari galaxy BimaSakti, berukuran 194 GB).

Python

- Bahasa Python termasuk bahasa pemrograman trend di beberapa tahun terakhir ini.
- Python memiliki ciri khusus jika dibandingkan dengan bahasa lain dalam hal penulisan kode program yang memiliki aturan mengenai indentasi, tipe data, tuple, dan dictionary.
- Kelebihan Python dibandingkan dengan bahasa pemrograman lain terutama terlihat dalam hal penanganan modul, serta keunggulan Python yang merupakan produk yang opensource, free, dan multiplatform.
- Python memiliki beberapa keunggulan antara lain : Terdapat modul-modul yang telah disediakan oleh Python; tata bahasa lebih mudah dipahami; layout yang dimiliki lebih mudah untuk ditinjau ulang dan dikembangkan; berorientasi obyek; pengolahan memori dilakukan secara modular; dapat dibangun dengan bahasa lain Python sendiri ataupun C/C++.modul-modul tersebut dapat dibangun dengan bahasa Python maupun C/C++; serta kelebihan lain.

Google Colab

- Google Collaboratory atau Google Colab merupakan *tools* yang berbasis *cloud* dan bersifat *free*.
- Google Colab dibuat dengan *environment* jupyter dan mendukung banyak pustaka (*library*) yang dibutuhkan dalam lingkungan pengembangan *Artificial Intelegence* (AI).
- Google Colab memungkinkan penggunanya untuk menulis dan mengeksekusi Python di *browser* (Chrome, Firefox dan Safari) tanpa memerlukan konfigurasi, dapat mengakses GPU secara gratis, serta dapat berbagi kode program (kolaborasi tim) dengan mudah.
- Google Colab dapat mengeksekusi, menulis, menyimpan bahkan membagikan kode program yang telah dibuat melalui google drive.
- Penulisan kode program Python serta eksekusi kode program tersebut tidak memerlukan proses instalasi dengan mendownload installer pada komputer. Instalasi tidak perlu dilakukan karena semua proses dilakukan di cloud.
- Selain itu fungsionalitas tambahan Python dapat juga memanfaatkan built-in library yang ada pada Google Colab