Introduction

Multimedia:

A technology which consist of
variety of media including
text, audio, video, graphics and animation
either separately or in combination
using computers
to communicate ideas or to disseminate information.

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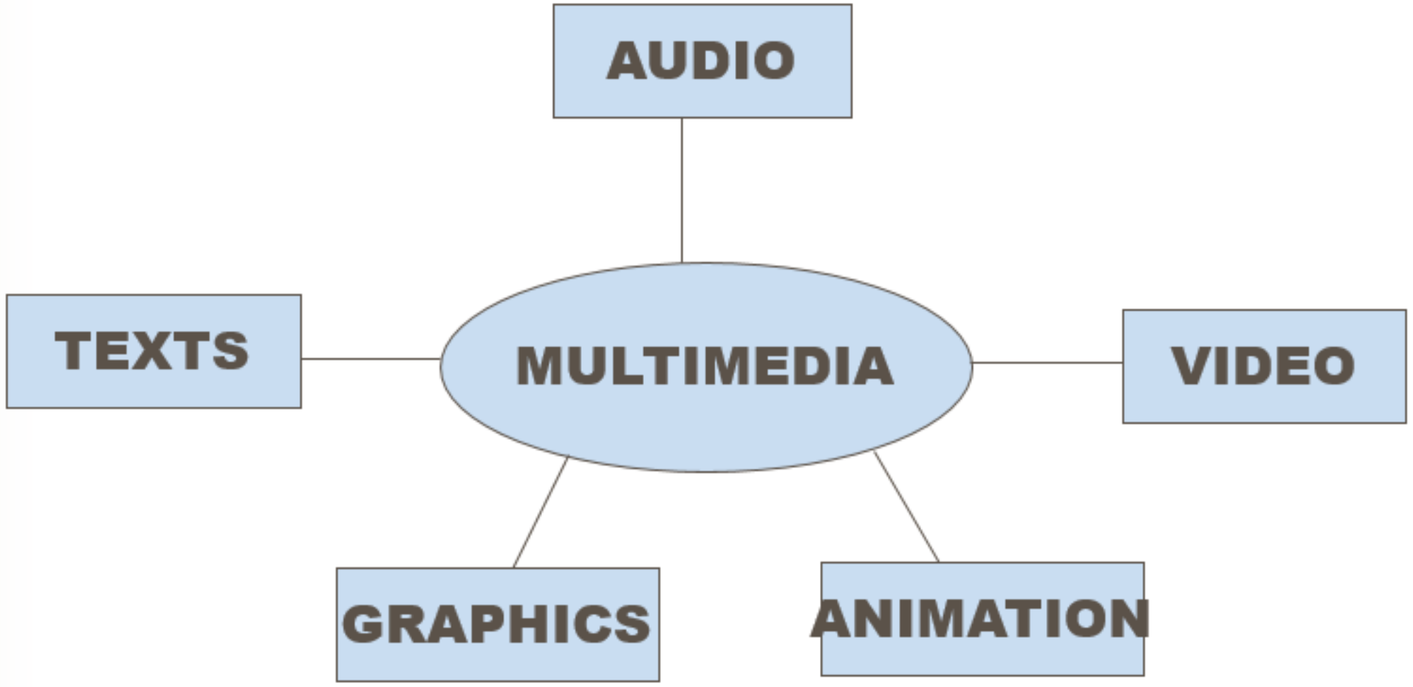
Multiple Facets of Multimedia



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Multiple Facets of Multimedia

(Conti…)

Audio : Speeches, music and other types of sounds. .
Audio element Is generally used to enhance the environment.

Text : The usual text- with some differences as compared to the print media.

Graphics : Pictures, photographic image and other art work.
It's this media that makes up a visual fascinated title, hence the extensive graphics is bundled with almost all of the multimedia titles.

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Multiple Facets of Multimedia

(Conti…)

Animation : The artificial movement of text or objects, created in virtual environment , using specialized software package.

Video : The actual video clips that could be embedded right over the application & can be played back..

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The most difficult part of multimedia computing is that, all these independent media clips have to be organized as a single sequential stream of information and delivered.

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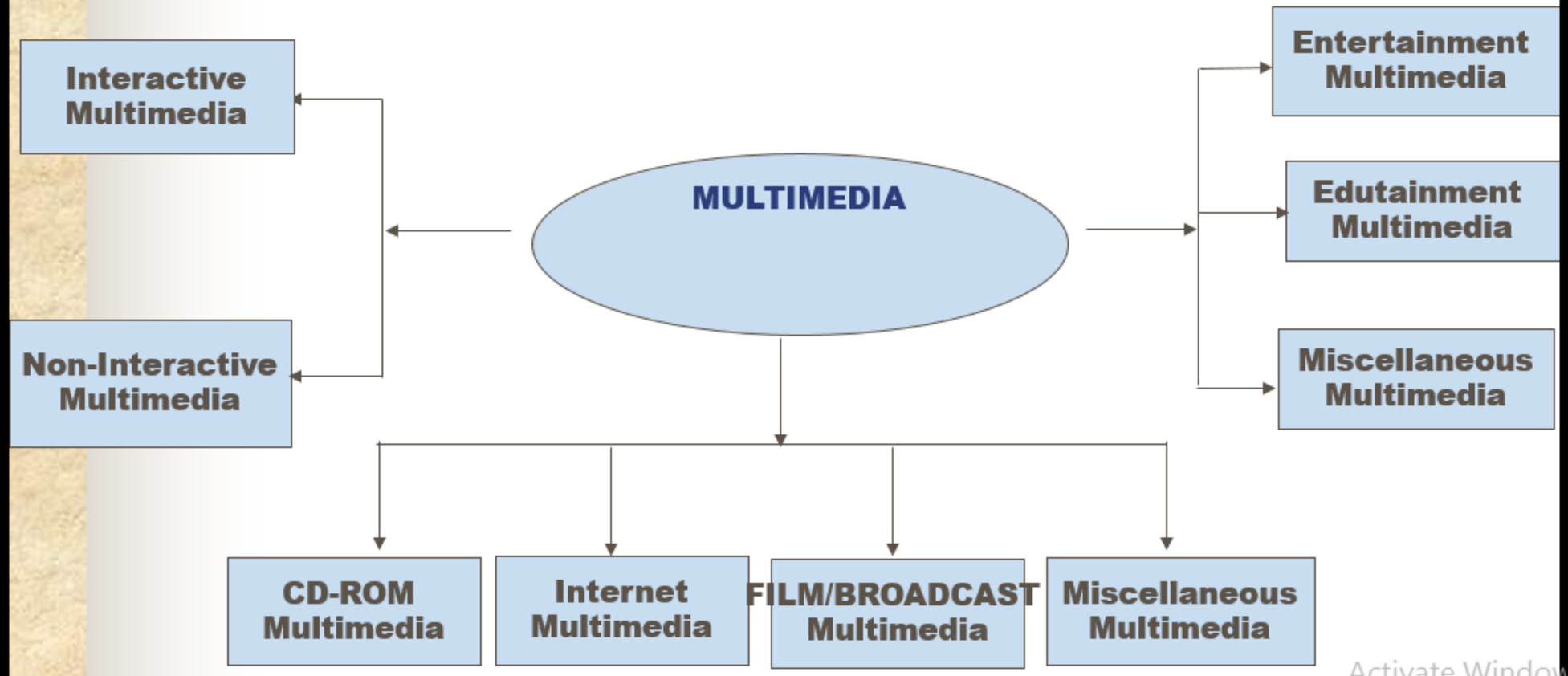
Classification of Multimedia



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Multimedia Hardware

- DISPLAY ADAPTOR CARD
- SOUND CARD
- CD CONTROLLER CARD
- GRAPHICS ACCELERATOR CARD
- MIDI INTERFACE CARD
- WAVE SYNTHESIS CARD
- VGA-TV ADAPTOR CARD

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Multimedia Peripheral Cards

Most of the multimedia hardware interface, take the form of Add-On Cards or Peripheral Cards.

These cards basically provides an analog-Digital interface between the external media handling devices like the tape or video recorder and the computer , so that the data can be transferred between the two.

- **USER LEVEL**
- **PROFESSIONAL LEVEL**

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- **USER LEVEL**

→ Display Adaptor cards : Color display

→ Sound Cards : Audio.

→ CD-ROM Drive : Compact Disc Reading

→ CD Controller Card : Compact Disc drive handling

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cont…

- **PROFESSIONAL LEVEL**

→Graphics Accelerator Card : Enhance the color display.

→ Video Capture Card : Video

→ MIDI Interface Card : Music

→ Wave Synthesis Card : Music and other audio special effects.

→ CD-ROM Writer : Compact Disc writing

→ VGA-TV Adaptor : Broadcast

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Multimedia System Configuration

- **Processor** : Minimum, an Intel Pentium 133 MHz microprocessor or equivalent. an MMX technology based 200 MHz Pentium processor or its equivalent may be better.

- **Display** : Minimum, a 14 " color monitor with 256 + colors at 640*480 resolution.

- **RAM** : Minimum 16 MB, 32 Mb is highly recommended ; 64 MB or more would be ideal.

- **Hard Disk** : Minimum 1.2 GB.

- **CD-ROM Drive** : Minimum a 10 speed drive(also called a 10X Drive-which implies that the Data Transfer Rate is 1500 KB/sec) with an access time of around 200 milliseconds or less).

- **Sound Card** : Minimum 16 bit card with 8 nodal synthesis, supported by 4 watt stereo speaker and a microphone; 32 bit Sound Card with Audio wave Technology would be better.

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Definitions

- **Multimedia Upgrade kits :**

  Set of items needed for multimedia computing as a single product at user level.

  This kits contain a CD-ROM drive, a sound card, a pair of speaker, a microphone and a set of associated software .

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MPC Standard: A minimum standard for multimedia platform(given by the multimedia PC marketing council of US)

Processor	25 MHz 486 SX
Hard Disk	160 MB
RAM	4MB
CD ROM	Double Speed
Vedio Card	640*480 Res.. (65536 colors)
Floppy Disk	3 1/2 ” High Density Drive
Joy Stick	Yes
Sound Card	16 Bits with 8 node synthesizer MIDI Playback

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Definitions

- **Device Driver :**

  Software that provides the necessary interface required for the interaction, between the operating system and the Multimedia hardware peripherals attached to the system.

- **Plug and Play :**

  A set of design specification incorporated with MS Windows for all multimedia hardware and software peripherals to ensure total compatibility between the devices.

- **MMX :**

  Multimedia Extension Technology

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Run Time Libraries & Players

They are meant for handling the actual multimedia files.

Players are those program that install their own set of program group and Icons in windows environment.

Runtime Lib. Files just add a line to the existing media player program

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Multimedia Software

Any type of software performing some multimedia functions can be called as Multimedia Software.

Varieties of Multimedia Software:

1) **Device driver software** : It is for multimedia peripherals.
2) **Run time libraries and players** :It is for multimedia file handling.
3) **Tools,packages and utilities** : It is for creation and editing various media file.
4) **Multimedia Applications:**

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Multimedia Software (Conti…)

Multimedia Applications:

1) Reference Multimedia
2) Training and classroom Multimedia
3) Gaming and Entertainment Multimedia
4) Presentation Multimedia
5) Kiosk Multimedia
6) Miscellaneous

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Introduction to Digital Medium

- **Analog Signal** : Continuously varying signals,used to record some media signals.

- **Digital Signal**: Signals constructed solely using zeroes and ones, which the computer can handle and understand.

- **Digitizing :** The process of converting analog signal to digital signals by way of taking discrete samples.

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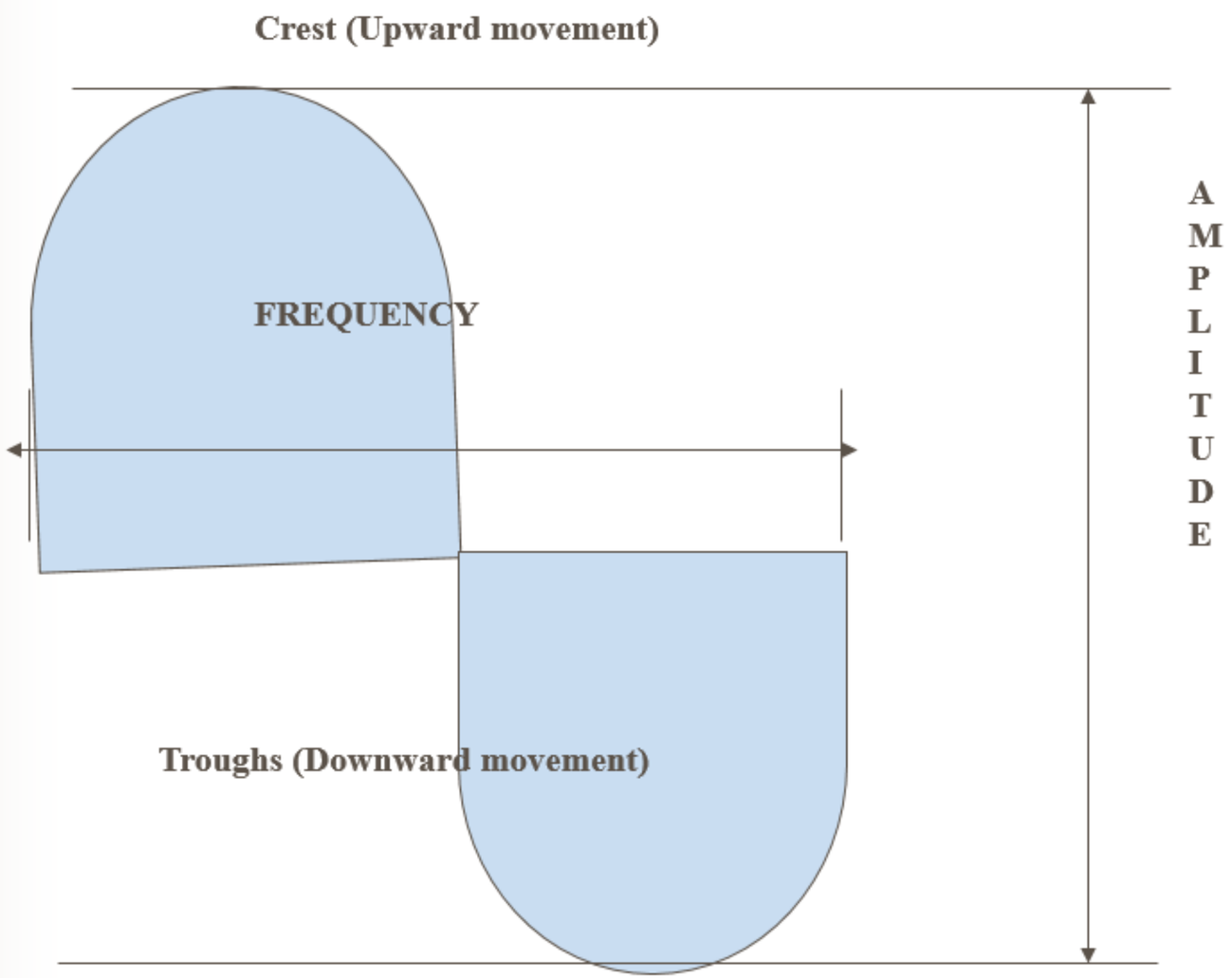
Path of the Single Analog Curve (Sin Curve)



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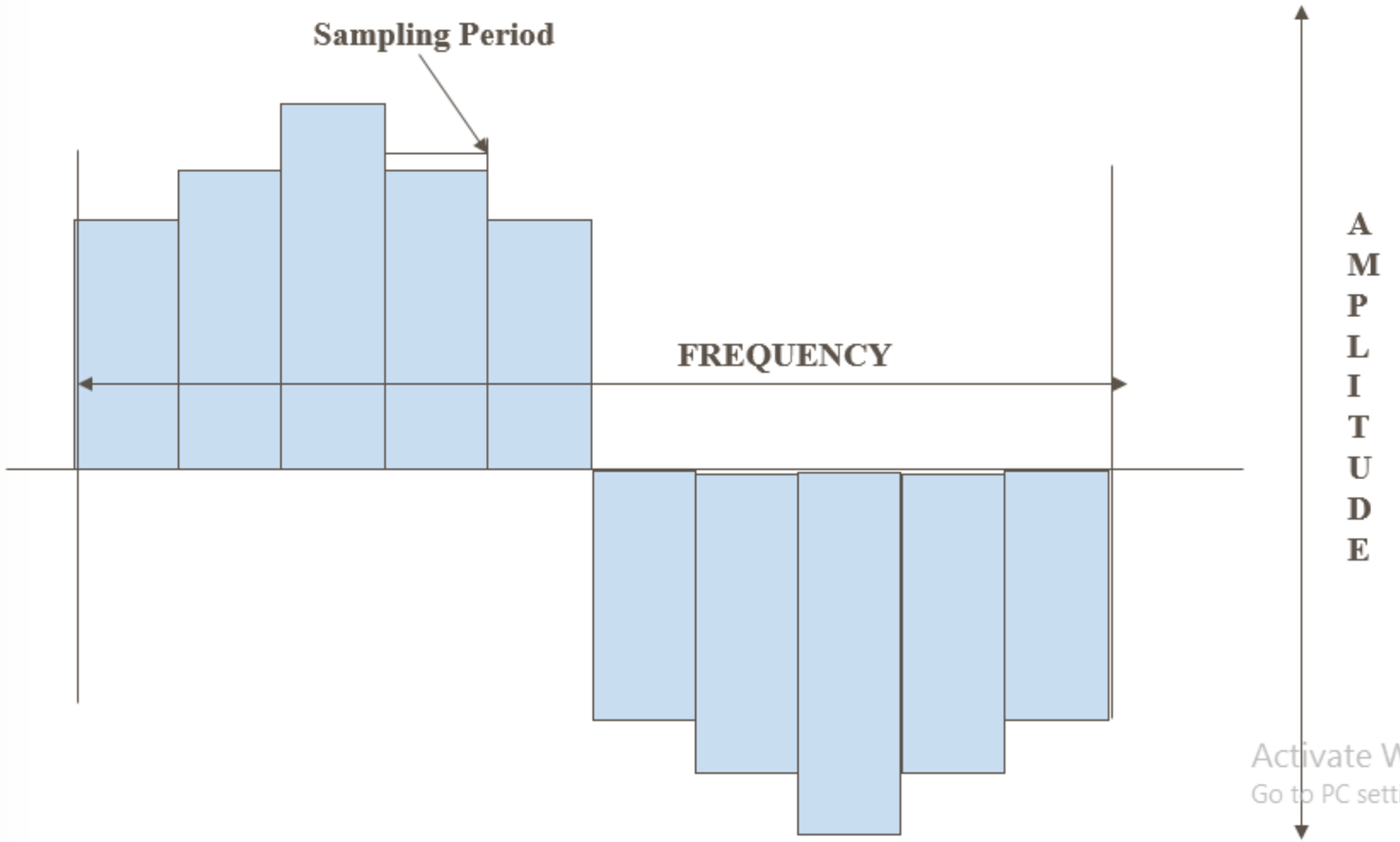
Digital Signal Representation



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Introduction to Digital Medium

- **Sampling Rate** : The time interval taken between two samples of the original analog data during digitizing. (Measured in terms of Hertz (Hz)

- **Sampling Size** : The number of computer zeroes and ones (Bits) required to represent a given signal in digital form.

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Digital Audio Technology

- **Digital Audio** :

  Digital Audio is the technology, by which sound signals are represented as a series of binary digital data i.e. Zeroes and Ones- which the computer can understood and comprehend.

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Digital Audio Technology

- **Advantages of Digital Audio:**

1) Digital Audio is less susceptible to degradation or distortion.
2) Editing audio with computers makes cutting,pasting and manipulating of the parent signals, very easy. Also a lot of special effect like the 'Echo' can be artificially added without the need of any hardware.
3) Digital audio is of superior quality during reproduction.
4) Digital audio can be stored in digital data, in more reliable medium like CD-ROM.

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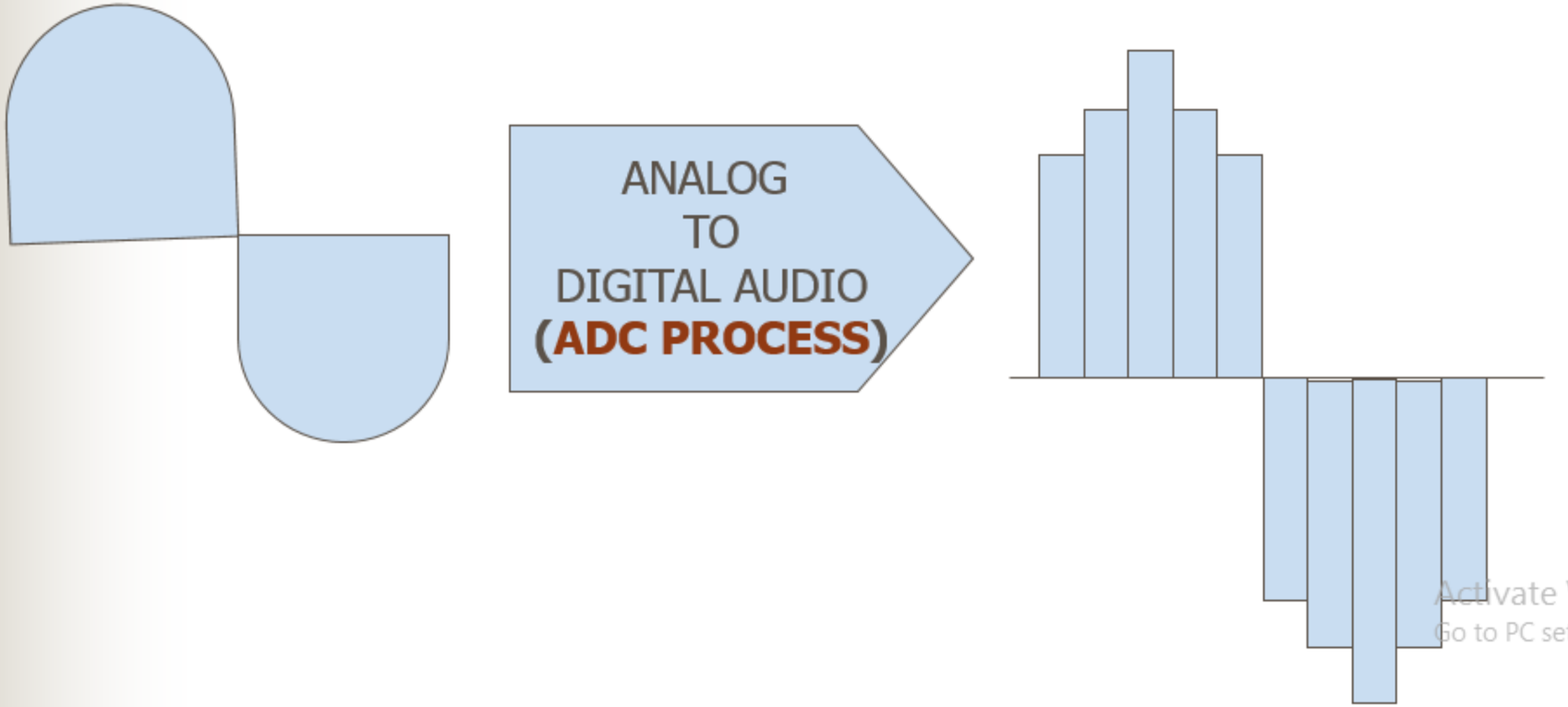
AUDIO RECORDING



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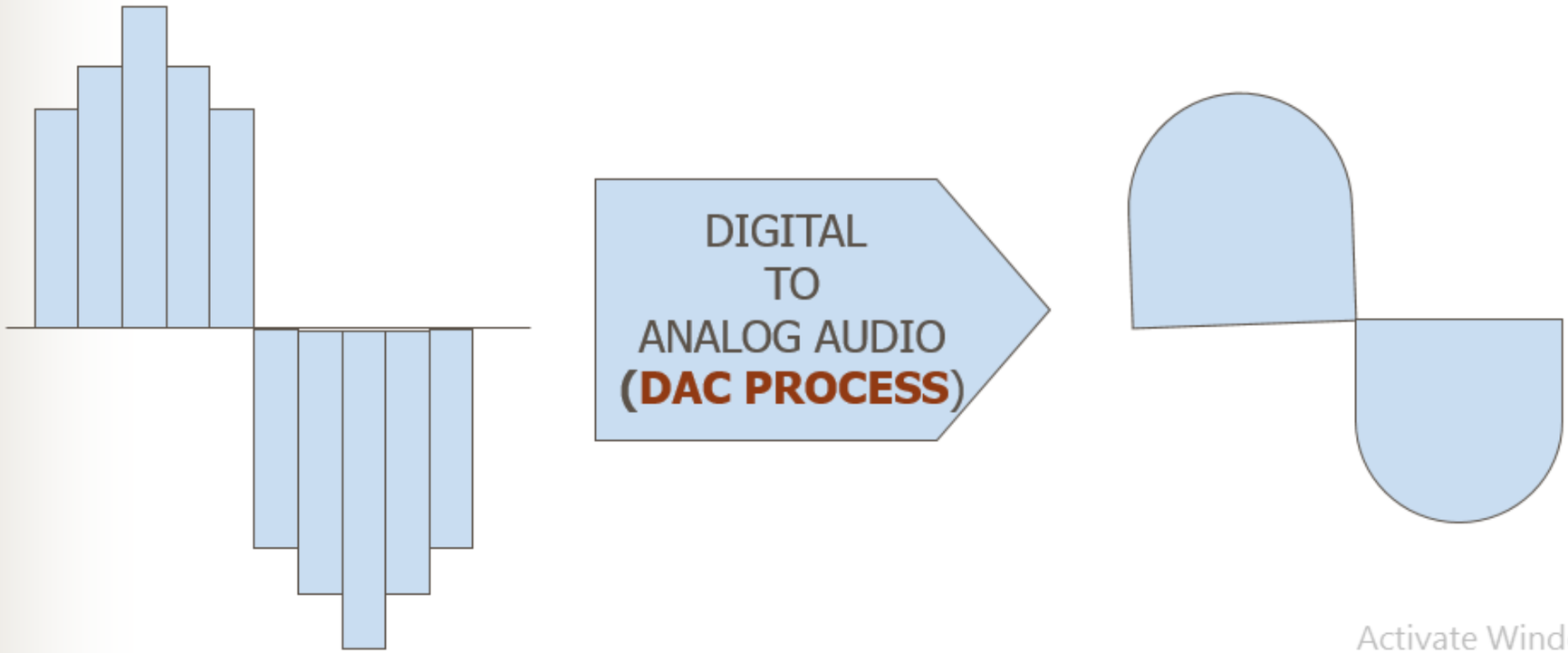
AUDIO PLAYBACK



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Digital Audio Parameters

- **Audio Sampling Rate :**

  The rate at which sound samples are recorded from the incoming analog audio source in Hertz (cycles per second).

- **Audio Sampling Size :**

  It refers to the no. of zeroes and ones used to record the incoming analog signal in bits of data.

- Mono and Stereo Audio Channelising:

  In mono Audio recordings / playback same sound signals are sent to both Left and Right channels of the recorders / speakers, But in stereo they're different.

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Digital Recording Pitfalls

- **Quantization** : The value of each sound sample, during A D C process, is rounded off to the nearest integer value. This is called quantisation and it sometimes produces an unwanted background noise.

- **Clipping** : During A D C, if the amplitude of the samples are greater than the intervals available, the wave is clipped in the top and bottom. This is called clipping and it sometimes results in severe distortions of fine music.

To avoid these kind of pitfalls the process parameters should be carefully assigned.

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Audio Cards

- "Audio Cards are electronic PCB boards that basically perform analog to digital conversion and digital to analog conversion, apart from a host of other functions."

- Three main types of audio cards are mainly used in multimedia application :

  1)Sound Cards :

  2) MIDI Interface Cards

  3) WAVE Synthesis Cards :

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Types of Audio Cards

Sound Cards :

It is essential parts of all multimedia capable computers.

Sound cards are basically meant for Digital Audio Recording/Amplification/Playback and number of other fundamental audio functions.

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Types of Audio Cards (Conti…)

MIDI Interface Cards :

It is special purpose cards exclusively meant for recording music directly from electronic instruments, mostly the electronic keyboards. The keyboard must be compatible with MIDI.

MIDI cards record music in a very special format that's exclusively meant for electronic music.

Advantage: The smallest dial size as compared to the sound card.

Disadvantage: Cannot record audio other than electronic music like speeches or wind instruments.

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Types of Audio Cards (Conti…)

WAVE Synthesis Cards :

They are exclusively meant for professional musician and not for the average multimedia users.

The WAVE Synthesis Cards can create professional music on their own, without the aid of any music instruments.

The music created is also of much superior quality.

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Sound Card Fundamentals

The process by which a sound card creates music is called the sound synthesis or the audio synthesis.

Types of sound synthesis or the audio synthesis Technology:

- ✓ FM Synthesis
- ✓ The Wavetable Synthesis

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FM Synthesis

By Blending around with a range of frequency modulations, the sound card manages to produce audio that tried to resemble the original analog sound data.

Disadvantages: **Generated Audio not quite natural.**

Advantages: **Low cost and Lack of better technologies.**

(Old and Outdated)

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The Wavetable Synthesis

Store digital samples of various instruments in RAM.

Each sample is a digital representation of the actual waveform recorded directly from the original instrument.

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The Wavetable Synthesis

Sounds are almost similar to original musical instruments.

Sound cards with this tech. are bundled with a wide variety of built in sound samples (i.e. actual recordings (Music banks)) of various music instruments.

When a Note from a particular instrument is played, the card actually looks up for an equivalent in it's wide collection of Digital audio samples and reconstructs the sound with that models.

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Difference between
a Wavetable Synthesis Sound card & the Wave Synthesis card

In the former case,

the technology is used for realistic reproduction of the original sound data,

in the latter,

the technology extends to much greater heights, bringing with it, hundreds of instruments

and

thousands and thousands

of possible permutations and combinations – making them an ideal companion in composing music.

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Creative's Family of Sound Cards

- ✓Sound Blaster Card
- ✓Sound Blaster Pro
- ✓Sound Blaster 16
- ✓Sound Blaster Multi CD / SCSI
- ✓Sound Blaster AWE 32
- ✓Sound Blaster AWE 64

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Digital Audio Playback & Recording

- Digital Audio Playback

  - Windows Media Player
    (With Windows OS)
  - Creative Group of Software Programs

All creative family of sound cards come bundled with their own set of system configurations & Audio Utility programs.

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Audio Software group of programs

Two Types:

One: Those meant for playback. They control one or more multimedia devices or files.

Creative calls these programs as

" Creative multimedia deck"

TWO: Those meant for audio editing and creation.

Advanced audio Program

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Audio Software group of programs

1) **Creative multimedia Deck** :

→ **Creative CD :** This program allows the user to playback Audio CD's from the CD-ROM drive and hear the playback speakers with or without amplification from sound card.

→ **Creative Wave :** This program is meant for .wav files playback.

→ **Creative MIDI :**This program allows the user to playback MIDI music files.

→ **Creative Remote :** It is combination of all the above player programs.

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Audio Software group of programs

2) **Advanced audio Program** :

→**Creative Mixer :** It allows the user to combine and manipulate sound from various audio sources.

→**Sound OLE :** This program can playback and record .wav files.

→**AWE Control Panel :**This program is capable of performing highly advanced functions like adding various special sound effects to MIDI files.

→ **Wave Studio :** It allows cutting,copying,pasting and all other editing operations over the existing .wav and .voc audio files.

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Digital Audio Recording

- ✓ **Introduction**
- ✓ **Need of Recording**
- ✓ **Setting Up the Recording Environment:**
  - **Mono Vs. Stereo Recording**
  - **Sampling Bits (8 / 16)**
  - **Sampling Frequency (Preferably 22 KHz to 44 KHz)**

- ✓ **Audio Recording Software**

Windows Sound recorder program

Creative Wave Studio or any professional recording software

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Digital Audio Editing

Need of Audio Editing

(to eradicate the shortcomings of recording process)

- ✓ Difficult to control external environment
- ✓ Every audio source is characterized by inconsistency
- ✓ Almost impossible to add special effects to the original recording
- ✓ Controlling the audio time duration is extremely difficult with the original sound sources

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Audio Editing Terminology

Trimming:

The process of removing the blank spaces before and / or after the required signals.

Splicing:

The process of removing unwanted sounds that have crept in, during the recording.

Reassembling:

The process of assembling several stray pieces of audio files together, to make up a single file.

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Audio Editing Terminology

Re sampling:

The process of reducing the sound quality from 32 bit recording to 16 bit or from 16 bit to 8 bit.

Time stretching

Fade ins and Fade outs:

The process of smoothing out the beginning and the end of audio files, for gradual transition effects.

Volume Control:

Increasing or decreasing the volume of either portions or whole of the recorded audio clips.

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Digital Audio Editing

- ✓ **Terminology**
  - **Trimming**
  - **Splicing**
  - **Reassembling**
  - **Volume Control**
  - **Time Streatching**
  - **Fade ins and fade Outs**
  - **Resampling**

- ✓ **Audio Editing Software**

Creative Wave Studio or any professional recording software

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Audio File Formats

.WAV - Wave File (Windows Digital Audio File Format)

.MID - MIDI File (Windows MIDI Music File Format)

.AIF - Audio Interchange File(Used on Apple macintosh Platforms)

.CMF - Creative Music File (Creative audio cards save songs in this format)

.VOC - Creative Voice File(Records Digital Audio; Compatible with all Creative's Sound Blaster cards.)

.MIF - MIDI File Format

.MOD - Module File. A MIDI File format, whose design is based on Wave Synthesis Technology.

Other MIDI File Formats : .WRK, .SNG, .SEQ, .POW, . MTS

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MULTIMEDIA TEXT

Texts play an important role in almost all multimedia project's . They are applied in multimedia project's in variety of way , to serve different purposes.

1. Texts in TITLES
2. Texts in MENU/NAVIGATION ITEMS
3. Texts in BUTTTON BARS OR EQUIVALENTS
4. Texts that DISPLAY VOLUME OF INFORMATION, SCIENTIFIC FORMULA

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DESIGNING TEXTS

This involves controlling two important characteristics of texts

1) Display

Display deals with 'HOW' part, like:
how the text is going to be represented at a given place, which font is used, with what color.

2) Content

Content deals with 'WHAT' part, like:
What text is going to represent.

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DISPLAY DESIGN CONSIDERATIONS

1) Controlling of two main display parameters:
   Fonts
   Color

2) Titling : It must be Anti-alised.
   (Antialising is the tech. of tracing the contour of the font profile using various shades of the font color, in such a way that jaggies are reduced to the minimum).
   Add special effects like drop shadows, cut outs & 3D effects.
   If possible animate the Title.

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CONTENT DESIGN CONSIDERATIONS

It involves controlling both qualitative & quantitative aspects of texts.

CONTROLLING QUALITATIVE ASPECTS:

1)Developing the contents to be presented
2)Deciding upon the Language to be used
3)Deciding the behavioral aspects of the Targeted audience
4) Editing the contents to suit their behavior &
5) Producing a sense of appeal relevant for the project, by controlling the tone of the language and the way of address the target audience.

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CONTENT DESIGN CONSIDERATIONS

CONTROLLING QUANTITATIVE ASPECTS:

1)Deciding the length of the text in each screen.
2)Deciding upon the total quantity of the matter to be distributed throughout the project.
3)Dividing the contents in required proportions, between the screens – for optimal distribution of contents..

Quantitative aspect of contents ultimately decide the total duration of the project, hence should be evaluated carefully.

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HYPERMEDIA

It is a well-defined structural arrangement of information in the forms of AUDIO, VIDEO, ANIMATIO GRAPHICS and other elements of multimedia pertaining a particular topic or related to it with relevant linkages in between them.

The linkages that exists between such different forms as well as different pieces of information are called **HYPERLINKS** .

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HYPERMEDIA cont…..

Hypermedia can be broadly classified as hypertexts & hyper graphics.

HYPERTEXTS :Text based information , interlinked by means of relevant hyperlinks between various Subtopics .

Those words, which carry hyperlinks to other sub-topics are called HOTWORDS.

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HYPERMEDIA cont…..

HYPER GRAPHICS:

The methodologies of interlinking graphics based information of a project , suitably with all other portions subtopics of the project by means of relevant hyperlinks between them.

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HYPERMEDIA cont…..

Hypermedia methodology enhances multimedia projects.

Hypertext feature is provided in titles with lots of text based information . It can be created either by proprietary programming or other supporting Authoring tools.

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HYPERMEDIA cont…..

Many text editing s/w tools are available for content Development , Title development & font design.

CONTENT:Microsoft & Corel's word perfect
TITLE : Adobe Photoshop,Corel's Photo Shop
3D TEXT & ANIMATION:3D studio , Light wave 3D

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Basic concepts for Color Display

Number of Colors

depends upon the memory capacity of the Video Controller Card

(Video Random Access Memory - VRAM)

VRAM space has to be shared by

color data & the resolution data.

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Color Resolution

VRAM requirement for various colors & resolutions

	Colors		
Resolution	8 bits	16 bits	24 bits
640 * 480	300 KB	600 KB	900 KB
800 * 600	470 KB	940 KB	1.4 MB
1024 * 768	768 KB	1.5 MB	2.3 MB
1280 * 1024	1.3 MB	2.6 MB	3.8 MB

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Color Monitor Parameters

Dot Pitch

Governs the sharpness of the color monitor. It is the physical distance between two actual picture elements (Actual Pixels).

Monitor Refresh Rate

It signifies the speed with which every line is illuminated, one after another. (measured in Hertz: 60 – 90)

Video mode

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Basic concepts for Color Display

Video mode or Color mode

The particular Combination of the total number of colors and resolution of the monitor is called the Video mode or color mode of the monitor.

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MULTIMEDIA GRAPHICS

"A Picture is worth a thousand words"

It includes all still pictures - like photographs, images & art works.

Graphics and digital images are used in multimedia projects, to serve two main purposes:

- ✓**For creating / enhancing the interface design (Interface Design Graphics)**
- ✓**For disseminating information, relevant to the project. (Content Design Graphics)**

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INTERFACE DESIGN GRAPHICS.

These graphics & digital images that are used for creating & enhancing the interface design are called

INTERFACE DESIGN GRAPHICS.

Activate Windows
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CONTENT DESIGN GRAPHICS.

Those used for disseminating information, relevant to the project are called CONTENT DESIGN GRAPHICS.

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CONTENT DESIGN GRAPHICS.

These info are directly related to the topic under development and are generally used to illustrate or explain a point or info that's under current discussion.

CDG enrich the application and help to maintain the pace, as user tries to explore various section of the project.

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SOURCES OF IMAGES

The sources of graphics images could be

i. **Photo graphic images** (Scanned or Digital photographs),
ii. **Clip art images** (Pictures drawn using specialized drawing packages),
iii. **3D graphic images** (Images developed using high end 3D Design Packages) **or**
iv. **Miscellaneous images** (all other types of images and pictures.

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Graphics

Raster Graphics
Vector Graphics

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MULTIMEDIA GRAPHICS cont…

Software tools are available for developing multimedia graphics can be broadly classified as

1) Image Editing/ Processing Tools
2) Digital Art / Painting Tools
3) 3D Graphics Tools
4) Image File Format Conversion Tools.

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HYPERGRAPHICS

The methodology of interlinking graphics based information of a project, suitably, with all other portions / sub-topics of the project, by means of relevant hyperlinks between them.

Portions of the image or picture, which carry hyper linkages to other portions of the project / sub topics are called Hot Spots.

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Scanner

Scanning is the process of converting picture data in papers to digital images.

Types of scanners:

- ✓ Sheet Fed Scanner
- ✓ Flat Bed Scanner
- ✓ Hand Held Scanner

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Graphics Editing Terminology

Selection:

The process selecting a particular portion from the whole image.

Layering:

Image is made up of one or more layers.
It gives immense power to a creative digital artist.
The biggest advantage is that one can edit a specific portion of the image without disturbing the rest.

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Graphics Editing Terminology

Anti-aliasing:

To smooth out the sharp edges resulting.

Image Filters:

Third party routines – written for specific image editing tools – using the APIs provided with the tool.

Re-sampling or Resizing:

The process of changing the size of the image, to suit the needs of the application at hand.

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Graphics Editing Terminology

Dithering:

The process of changing the RGB value of the color pixels that make up the image, to the closest matching color in predefined fixed color palette, using complex mathematical algorithms.

Masking:

The process of blocking out selected portions of the image, for a particular editing operation.

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Graphics Editing Terminology

Flipping:

The process of producing a mirror image of the graphics image.

Rotating:

The process of rotating the picture to required inclinations.

Zooming:

The process of enlarging a particular portion of the image.
(Size of the image remains same)

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Graphics Editing Terminology

Color corrections

(editing brightness, contrast, intensity, hue & saturation)

Drop shadows

(it produces shadows below or above the contours we define)

Bevel effects

(produce dramatic effects on ordinary image by changing the brightness and contrast over the edges of the image)

Emboss effects

(to emboss the contour of the image over a metal plane or a stone plane)

Deformations

(change the very contour of the image)

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Graphics Editing Terminology

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COMPUTER ANIMATION

Animations are incorporated into multimedia, to provide dynamically moving objects & characters, which is a majo limitations of graphics.

Computer Animations refer to literally any kind of animation created using computers .

Multimedia Animations refer to computer animations that can be put to use in multimedia / Titles.

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TYPES OF COMPUTERISED ANIMATIONS

CLASSIFICATION I

1) **CEL OR FRAME ANIMATION :**
The entire animation sequence is split up into different frames (or still images).
Animation sequence produced by displaying different frames of movements , one after another rapidly.

2) **OBJECT ANIMATION :**
Animation sequence produced by movement of an object over a general picture that is maintained as a back drop.

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TYPES OF COMPUTERISED ANIMATIONS

CLASSIFICATION II

Based on no. of planes:

a) 2D Animations

Animation created in 2D plane

b) 3D Animations

Animation created in 3D plane

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TYPES OF COMPUTERISED ANIMATIONS

CLASSIFICATION III

Based on MEDIA

a) Movie Animation
b) Television Animation
c) Multimedia Animation
d) Internet Animation

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Two and Three dimensional Animation Techniques

Two phases:

Phase I : Preliminary Procedures **(Common to both 2D and 3D)**

1. Conceptualizing:

   Imagine the animation sequence representing a situation.

2. Story Boarding:

   The concept of visualizing the animation sequence to be developed as a series of frames and exhibiting the same, roughly in paper.

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Two and Three dimensional Animation Techniques

3. Modulating or Capsuling:

   Divide the animation work into meaningful parts.

4. Keyframing:

   Frames in which, the movements of objects mature from one stage to another.

5. Planning :

   Decide modeling planning, Rendering planning, Format conversion planning etc.

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Two dimensional Animation Techniques

Phase II :Animation development Process

1. Decide the total number of frames to be engaged (or span) for the particular ani. Sequence.
2. Identify the key frames.
3. Develop the key frames.
4. Develop the in between frames.
5. Play back all the frames
6. Repeat step 4 & 5 continuously till all the the slots are developed.
7. Integrate and Test the entire animation sequence.
8. Linking and embedding the animation clip into the project.

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Three dimensional Animation Techniques

Phase – I is common

Phase II :Animation development Process

1. Modeling
2. Lighting & Cameras
3. Material Application & Texture Mapping
4. Keyframing & Animating
5. Rendering
6. Linking & Embedding

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Three dimensional Animation Development Process

1. **MODELLING:**

   Development of necessary 3D models.

2. **LIGHTING & CAMERAS**

   With 3D environment we have “LIGHTS” & CAMERAS on the artificial universe.

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Three dimensional Animation Development Process (Conti…)

LIGHTS : are used to illuminate the object to the required visibility.

There are various types of lights like

- spot light
- Ambient light etc..

The behavior of light over an object is affected by the ‘ material characteristic ‘ of the object.

CAMERAS : are used to view the object in 3D plane

There can be more than one light & cameras in animation

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Three dimensional Animation Development Process

(Conti…)

3. MATERIAL APPLICATION & TEXTURE MAPPING

MATERIAL APPLICATION :This concept is unique to 3D environments. All most all the professional s/w for 3D allow developers to set material attribute to the objects in 3D space.

TEXTURE MAPPING :is the technique of applying (or wrapping) 2D images (called maps) over 3D wire frame models .

e.g.. A particular 3D flooring in a model house, can be 'wrapped up' with marble texture so that the floor looks 'terribly real' during the rendering process.

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Three dimensional Animation Development Process

(Conti…)

4. KEYFRAMING & ANIMATING

3D s/w can develop the frames in between key frames on their own.
Once key frames are ready ,object can be animated.

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Three dimensional Animation Development Process

(Conti…)

5. RENDERING

Rendering in 3D jargons refers to the process of finally applying the
-Lights
-Material
-Cameras
-Animation
to a particular 3D scene , frame by frame and capturing the output as individual images.

These images will be the frames , which when displayed in sequence will result in animation of that particular object.

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Three dimensional Animation Development Process

(Conti…)

RENDERING is the final stage of any animation development process. Once rendered the frames can not be modified.

Several types of rendering & shading methodology are used by professional packages .

-GOURAUD SHADING

-PHONG SHADING

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Three dimensional Animation Development Process

(Conti…)

6. LINKING & EMBEDDING

The necessary animation clips are either linked or embedded into the multimedia project in the required places.

Proper care should be taken to ensure that losses do not occur during file format conversion ,if any

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Multimedia Video AND Project Design

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Video in Multimedia Projects (Need)

- The project has certain relevant sequences / material that
  - can be video graphed
  - Cannot be produced with the help of animation.
- The pro. has to be made attractive
- The pro has live lectures / demonstrations / other pre recorded material to be incorporated.

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Multimedia -Video

- Video enhances, dramatizes and gives impact in content design.

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Digitizing the Video Signal

- There are two basic approaches to delivering video on a computer screen – analogue and digital video.

  ·**Analogue video** is essentially a product of the television industry and therefore conforms to television standards.

  ·**Digital video** is a product of the computing industry and therefore conforms to digital data standards.

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Digitizing the Video Signal

- Video, like audio, is usually recorded and played as an analog signal.
- It must therefore be digitized in order to be incorporated into a multimedia title.
- A video source, such as video camera, VCR, TV, or videodisc, is connected to a video capture card in a computer.

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Digitizing the Video

Digital video production involves

- Shooting the necessary video sequences
- Video capture (Digitizing the analog signals)
- Digital video editing

Video capture is that technology by which video signals are converted to digital signals and fed into the computers, to be stored as video files in some multimedia video file format.

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Hardware / software requirement

- An analog source for video – VCR, Camcorder
- Video capture board
- Video capture software

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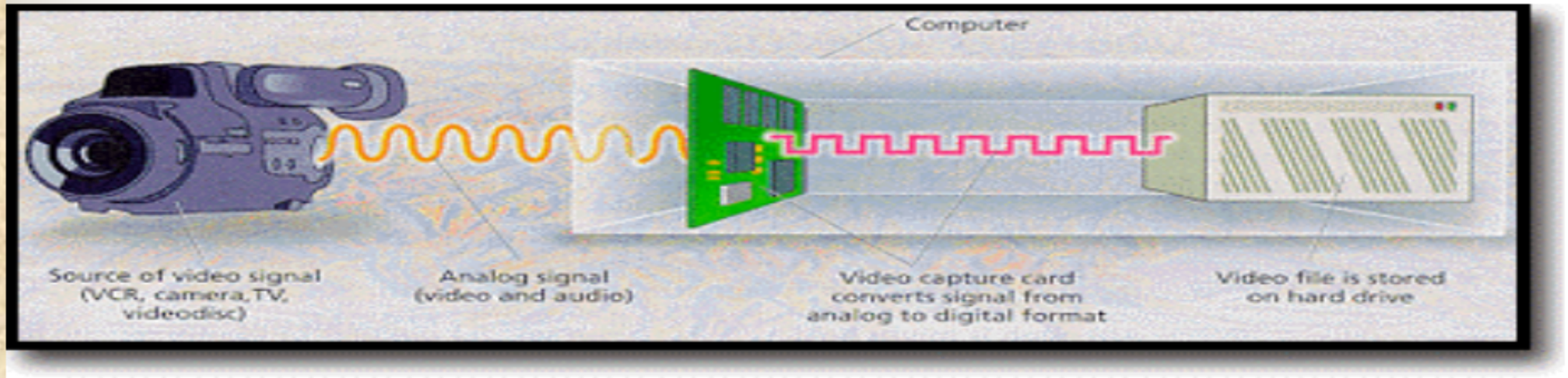
Digitizing the Video Signal



- As the video source is played, the analog signal is sent to the video card and converted into a digital file that is stored on the hard drive. At the same time, the sound from the video source is also digitized.

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Advantages of Digital Video

- One of the advantages of digitized video is that it can be easily edited.
- Analog video, such as a videotape, is linear; there is a beginning, middle, and end.
- If you want to edit it, you need to continually rewind, pause, and fast forward the tape to display the desired frames.

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Advantages of Digital Video

Other advantages:

- The video is stored as a standard computer file. Thus it can be copied with no loss in quality, and also can be transmitted over standard computer networks.
- Unlike analog video, digital video requires neither a video board in the computer nor an external device (which adds extra costs and complexity) such as a videodisc player.

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File Size

- The storage of video files requires a comparatively large amount of hard disk space.
- Digitized video files can be extremely large.
- A single second of high-quality color video that takes up only one-quarter of a computer screen can be as large as 1 MB.
- Several elements determine the file size; in addition to the length of the video, these include :

  Frame Rate , Frame Size , Color Depth

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Keywords

- Codec : Acronym for Compression – Decompression Algorithm for digital video files.
- Full motion Videos: Digital video files played back at a speed of 25-30 frames per second.

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Multimedia Projects

- It is typical s/w project,making use of multimedia technology using various media technologies & interactivity.

OR

- A typical s/w project,making use of m'media technology with specific aim of disseminating explicit information to a well defined homogeneous market segment using various media technology & interactivity.

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Multimedia Projects Design Concepts

It involves

- General Content design/Development
- Navigation structure design/development
- Media content design/development
- Interface design/development
- Story boarding techniques
- Program development or authoring
- Delivery design/Development

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General Content Design / Development

All types of information in all possible forms of media

Data Collection

Collect the relevant info. from all possible sources.

Data Analysis & Filtering

Edit/remove the data & filtered data.

Data Arrangement & sequence

Filtered data must be arranged in proper order.

Data Verification

Verify data (Backbone of the storyboard)

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Navigation Structure Design

- The general content sequence will be rearranged to suit the m'media application & develop environment.This process is called mapping or navigation mapping or NAV MAP.
- A NAV MAP containing all possible navigation paths of the project.
- NAV MAP can adopt any one of the following structures for their design

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Navigation Structure Design

Linear Structure

Users moves through Straight Line Path.

Hierarchical Structure

Provides top-down tree design

Non-linear Structure

Users can freely navigate any portion of the project.

Composite Structure

Combination of any 3 types of structure.

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Media Content Design/Development

- Media content refers to those portion of information in a project , that are going to use any media other than plain text.
- It involves decision regarding which media type is to be used for particular sequence or frame.
- Examples all audio clips, graphics, animations & video clips

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Interface Design/Development

- The front end of the project,that projects itself before the user , is called Interface Designing.
- The m'media info. That is available in various forms, has to be presented in a amicable manner to the user , so that he feels pleasure while consuming the info.This is the prime goal of creating interface design & if has to be developed,exclusively for the potential market segment.
- It includes Backdrops & Button Icons.

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Story Boarding Techniques

- This can be adopted in any phase of the projects.
- But for the best results, one should resort to this highly result oriented technique just before starting the actual "Mixing-up" process or Programming or authoring.

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Multimedia Programming /Authoring

- It is last stage of multimedia project production.

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Delivery Design/Development

- The media in which the project is going to be delivered,also forms a part of project design.
- Examples : Media is a CD-ROM.

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Multimedia Authoring

- It is the process of developing a s/w program,that will accept all the media elements involved with the m'media project under production,put them up in their respective places as advocate by the storyboard.
- M'media programming or authoring is the final stage of m'media project production .
- It is here,by making use of various package ,that the produce actually integrates all types of contents of project.It is the most important phase b'coz the output of this phase will be finally rendered title.

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Multimedia

Programming	Authoring
■ It is the process of development m'media s/w projects using any typical programming language tool. ■ e.g :Developing a media project using visual c++ or graphics editing s/w package like paint shop.	■ It refers to that process of developing a m'media project using specialized packages & utilities. ■ e.g : Developing a multimedia project using a "Multimedia Tool book".

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Steps that precedes media Authoring process

- The final form of story board contains all interface designs, NAV MAP structure & all other details approved by the project leader should be ready
- The media contents to be used in the Initial screens or frames like background Graphics/Digital Audio etc. must be ready.
- Decision on which authoring package to use have been finalized.

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Authoring Methodologies

- Every authoring tool,package,environment or platform uses some fundamental methodology , for developing project
- These methodologies can be grouped as :
- Frame or Page Based Authoring Tools.
- Time Based Authoring Tools.
- Icon Based Authoring Tools.

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Frame or Page Based Authoring Tools

- These tools let you to arrange the contents of the media project as individual frames or pages & Project is ultimately delivered as " A book " or collection of frame or pages.
- Individual pages can be linked.
- This methodology is the best suited for those projects, whose contents can be arranged as individual sequences & frames - one independent of another.
- Example : Multimedia tool book **(Open script).**

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Time Based Authoring Tools

- It allows the designer to arrange various media elements & events of the media project sequentially along a well defined time line.
- As the time advances, from 0 seconds , the event also begin to occur, one after another. the events may include media file updation & playback as well as transition of information, from one portion to another.
- Example Macromedia's Director(Lingo), Flash (Action script).

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Icon Based Authoring Tools

- It allows each & every event & elements belonging to a particular media project, to be arranged sequentially in the form of icons.
- These icons are arranged as per the basic NAV MAP structure adopted & are driven from one phase to other by means of events - Used for simple project.
- Example : Macromedia Author ware.

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Characteristics of Authoring Tools

Media Handling Feature

Many of the authoring tool or packages come bundled with programs for handling some of the media supported by media technology.These programs are called “Media Editor”.

Bundled Media Library

Almost all of the authoring tool,particularly CD-ROM contain lot of Media Clips.Like all general clips, audio , video, clips art, photo library.

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Characteristics of Authoring Tools

Mapping Feature

We know the various element of media project have to arrange,as per the NAV MAP structure adopted & the story-board has to be developed.

Programming Feature & Development

Facilities having scripting language.
like Lingo ,Open Script.

Segmentation Facility

To put segments of a project sequence.

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Characteristics of Authoring Tools

Compilation Feature & Run Time Players

Some authoring package permits .exe file.

So the project can be delivered easily with at revealing the underlying source code & some authoring tool come bundled with their own RUN Time Player.

Media Embedding Feature

To embedded the media files directly into the project so that they need not be distributed along with main program.

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Visual Preliminaries

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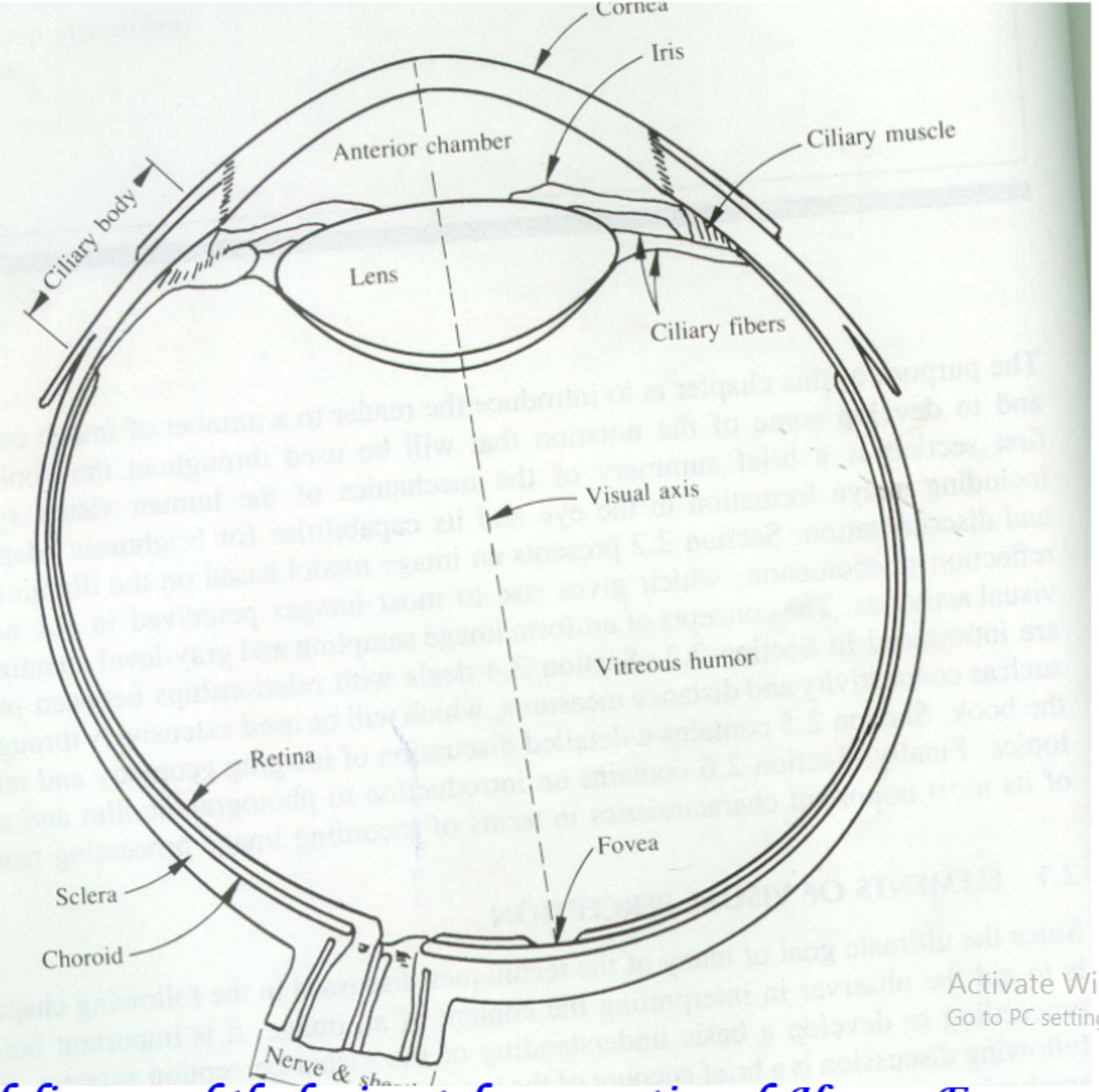

Simplified diagram of the horizontal cross-section of Human Eye

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- The shape of the eye is nearly spherical with a radius of 11 mm(approx.).
- The outer most layer, called sclera, is 1 mm thick opaque membrane and merges in to the transparent Cornea.
- The cornea is a tough, transparent tissue that covers the anterior surface of the eye.

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- The sclera is continuous with the cornea; it is an opaque membrane that enclosed the remainder of the optic globe.
- At the rare, the optic nerve penetrates the sclera on the nasal side.
- The choroids lies directly below the sclera. This membrane contains a network of blood vessels that serve as the major source of nutrition of the eye.

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- The choroids coat is heavily pigmented and hence helps to reduce the amount of extraneous light entering the eye and the backscatter within the optical globe.
- At its anterior extreme, the choroids is divided into the ciliary body and the iris diaphragm.
- The iris is nearly circular aperture which constitutes the pupil.
- It contracts and expands to control the amount of light entering the eye.

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- The innermost membrane of the eye is the retina.
- When the eye is properly focused , light from an object outside the eye is imaged on the retina.
- Pattern vision is afforded by the distribution of discrete light receptors over the surface of the retina.
- The retinal surface contains a mosaic of photoreceptor cells called rods and cones.

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- The number of cones in each eye is between 6 and 7 million.
- The number of rods ranges from 75 to 150 million.
- Cones are located primarily in the central portion of the retina, called fovea and are sensitive to color.

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- The cones are responsible to acute vision and the cone vision is known as photopic or bright-light vision.
- The rods give an overall appearance of the scene but are not involved in color vision. They are sensitive to low-levels of illumination. So the rod vision is known as scotopic or dim-light vision.

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- The double convex lens is made up of concentric layers of fibrous cells is suspended directly behind the pupil.
- The shape of the lens can be changed to vary the effective focal length, and thus variable viewing distance can be achieved by a single lens.

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- The shape of the lens is controlled by the fibres of the ciliary body.
- To focus on the distant objects the lens is made relatively flat. When an eye is looking at an object shape of the lens is controlled by appropriately such that a sharp and reverse image is formed on the retinal surface.

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- The photoreceptors convert light energy into electrical pulses through some photochemical reaction. These pulses are transmitted to the visual cortex through the optical nerve.
- The information reaching the visual cortex are finally decoded by the brain.

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Brightness adaptation and Contrast

- When human eye senses are, in general, intensity images.
- Intensity and brightness are two different phenomena.

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Brightness adaptation and Contrast

- Intensity of a light source depends on the total amount of light emitted and the solid angle from which it is emitted.
- Thus intensity is a physical property and can be measured.

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Brightness is a psycho-visual concept and may be described as the sensation to the light intensity.

The contrast may be defined as the difference in perceived brightness.

Detection of a bright spot depends not only on the brightness, size and duration but also on the contrast between the spot and the background.

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The spot can be detected only when the contrast is grater than a threshold, called just noticeable difference, depending on the average brightness of the surrounding.

This dependence is known as brightness adaptation.

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The brightness perceived by human visual system is a logarithmic function of intensity incident on the eye.

In psychology, contrast sensitivity of the eye refers to the ratio of the difference in brightness B1 (of object) and brightness B (of its immediate surroundings) to B.

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The ability of human visual system to detect fine spectral details is known as *acuity*.

If human visual system were linear and its response to simple stimuli such as points, lines, edges or sinusoids were known, then the delectability of complex visual stimuli could be predicted.

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The response to sinusoids is particularly important because it is associated with the resolution, one of the important parameter relevant to acuity of the human visual system.

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Texture and pattern Discrimination

Texture refers to coarseness of surface.

It can describe arrangement of grains or constituent particles in the material.

Visual texture is defined as a repetitive arrangement of some basic patterns. This repetition may not be random.

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Introduction

- A major portion of information received by a human from the environment is visual.
- The process of receiving and analyzing visual information by the human is referred to as sight, perception or understanding.
- The process of receiving and analyzing visual information by digital computer is called digital image processing and image analysis.

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Introduction

- Modern digital technology has made it possible to manipulate multi-dimensional signals with systems that range from simple digital circuits to advanced parallel computers.
- The goal of this manipulation can be divided into three categories:
- Image Processing *image in -> image out*
- Image Analysis *image in -> measurements out*
- Image Understanding ***image in -> high-level description out***

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Digital Images

- Computer images can be divided into two classes: Natural and Artificial.
- Artificial images are created exclusively by computer processes and are usually called graphic images.
- A natural image is one digitized from an analog image such as a photograph, drawing, painting, television and motion pictures, schematics, maps and so on.
- DIs are a very important medium for representing information.

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Digital Images

- A digital image is a picture that may be stored in, displayed on, or otherwise processed by a computer.
- A PIXEL is the basic unit of a digital image.
- A pixel by itself does not convey much info. The context in which the pixel is found or its arrangement in the overall image is what determines what it depicts.
- Each pixel is a discrete sample of the continuous signal of an analog image.
- I.e each pixel contains one or more numbers that measure the value of the signal for that portion of the image.
- Converting an analog medium into a discrete numeric form requires both sampling and quantinizing.

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Digital Images

- Most images depict how things look as a function of light reflecting from the objects.
- Even so images may be derived from other names of the electromagnetic spectrum like x-ray, radar etc.
- Pixels are usually arranged as rectangular units in 2-D grid.
- Image refers to a 2-dimensional light intensity function f(x,y), with f as the amplitude (e.g. brightness) of the image at the *real* coordinate position (*x*,*y*).
- The amplitudes of a given image will almost always be either real numbers or integer numbers

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Digital image

- We may consider a digital image as a matrix whose row and column indices identify a point in the image and the corresponding matrix element value identifies the gray level at that point.
- A digital image is an array of real and complex numbers represented by a finite number of bits.

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Imaging

- It is the process of acquiring images.
- Imaging is shorthand for image acquisition, the process of sensing our surroundings then representing the measurements that are made in the form of an image.

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Digital image Processing

- It generally refers to processing of a two dimensional picture by a computer.
- In broad context, it implies digital processing of any two dimensional data.

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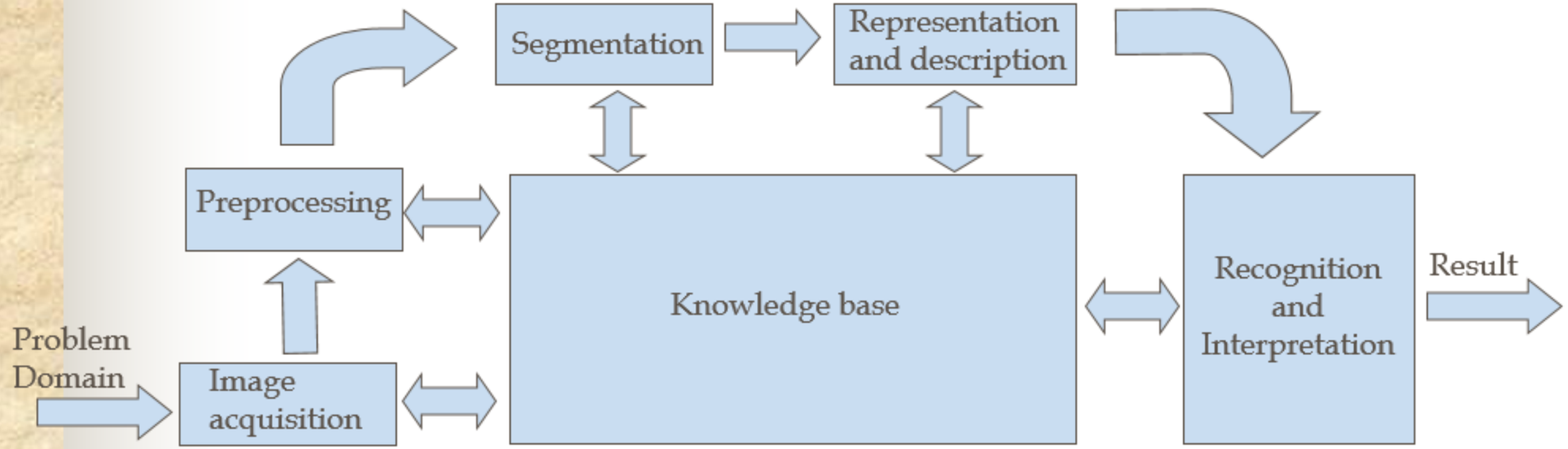
Fundamental Steps in Image Processing



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Stages of Image Processing and Analysis

- **Discretization and representation**: Converting visual information into a discrete form; suitable for computer processing; approximating visual information to save storage space as well as time requirement in subsequent processing.
- **Processing**: Improving image quality by filtering etc; compressing data to save storage and channel capacity during transmission.
- **Analysis**: Extracting image features; qualifying shapes, registration and recognition.

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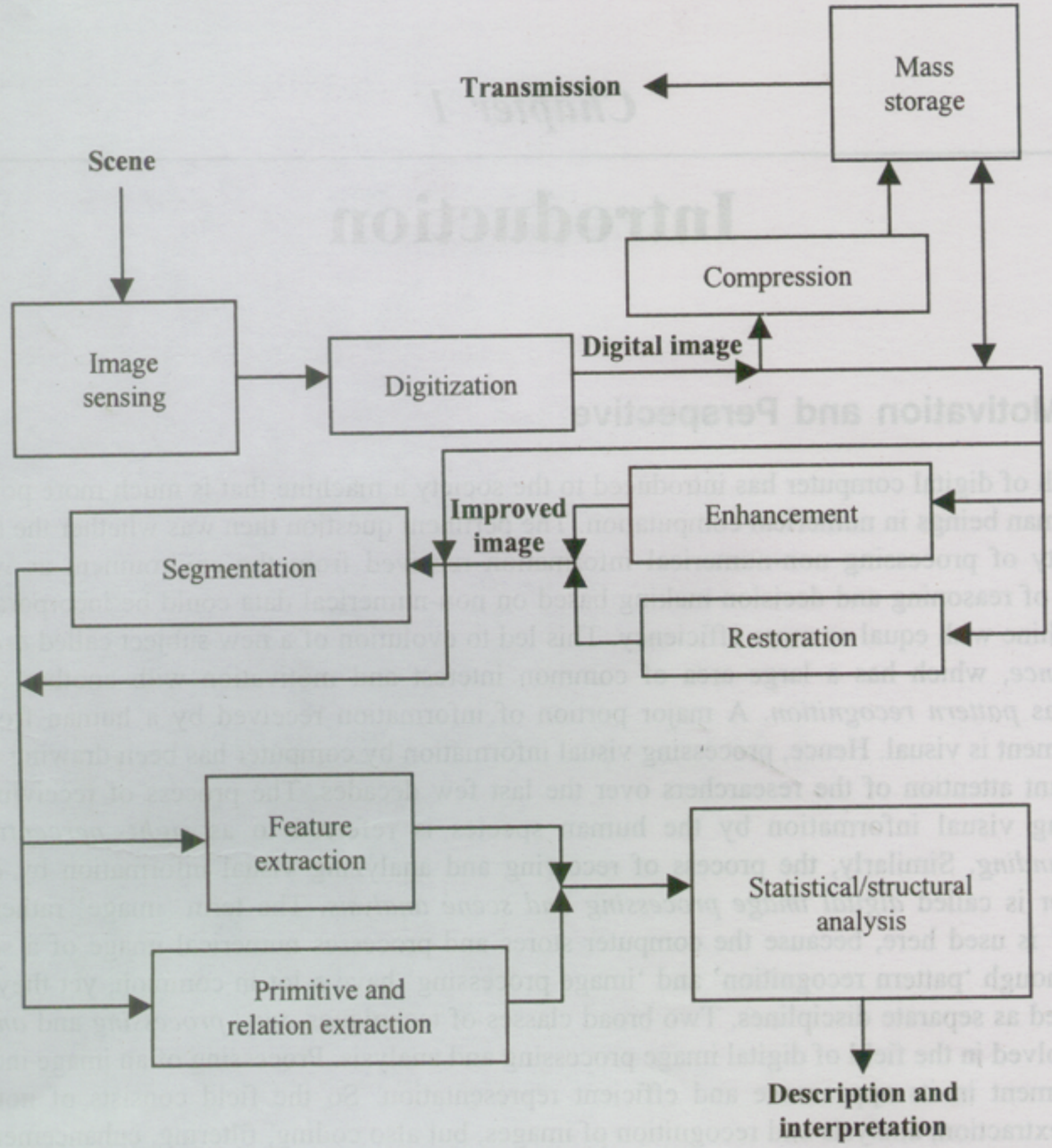

ig. 1.1 Different stages of image processing and analysis scheme. Information flow along the outgoing link from each block.

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Applications

1. *Office automation:* optical character recognition; document processing; cursive script recognition; logo and icon recognition; identification of address area on envelop; etc.
2. *Industrial automation:* automatic inspection system; non-destructive testing; automatic assembling; process related to VLSI manufacturing; PCB checking; robotics; oil and natural gas exploration; seismography; process control applications; etc.
3. *Bio-medical:* ECG, EEG, EMG analysis; cytological, histological and stereological applications; automated radiology and pathology; X-ray image analysis; mass screening of medical images such as chromosome slides for detection of various diseases, mammograms, cancer smears; CAT, MRI, PET, SPECT, USG and other tomographic images; routine screening of plant samples; 3-d reconstruction and analysis; etc.

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Applications

4. *Remote sensing:* natural resources survey and management; estimation related to agriculture, hydrology, forestry, mineralogy; urban planning; environment and pollution control; cartography, registration of satellite images with terrain maps; monitoring traffic along roads, docks and airfields; etc.
5. *Scientific applications:* high energy physics; bubble chamber and other forms of track analysis; etc.
6. *Criminology:* finger print identification; human face registration and matching; forensic investigation; etc.
7. *Astronomy and space applications:* restoration of images suffering from geometric and photometric distortions; computing close-up picture of planetary surfaces; etc.
8. *Meteorology:* short-term weather forecasting, long-term climatic change detection from satellite and other remote sensing data; cloud pattern analysis; etc.

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Applications

investigation, etc.

7. *Astronomy and space applications:* restoration of images suffering from geometric and photometric distortions; computing close-up picture of planetary surfaces; etc.
8. *Meteorology:* short-term weather forecasting, long-term climatic change detection from satellite and other remote sensing data; cloud pattern analysis; etc.
9. *Information technology:* facsimile image transmission, videotex; video-conferencing and videophones; etc.
10. *Entertainment and consumer electronics:* HDTV; multimedia and video-editing; etc.
11. *Printing and graphic arts:* colour fidelity in desktop publishing; art conservation and dissemination; etc.
12. *Military applications:* missile guidance and detection; target identification; navigation of pilotless vehicle; reconnaissance; and range finding; etc.

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Components of Image Processing system.

- Image Sensor
- Digitizer
- Processor
- Display Unit

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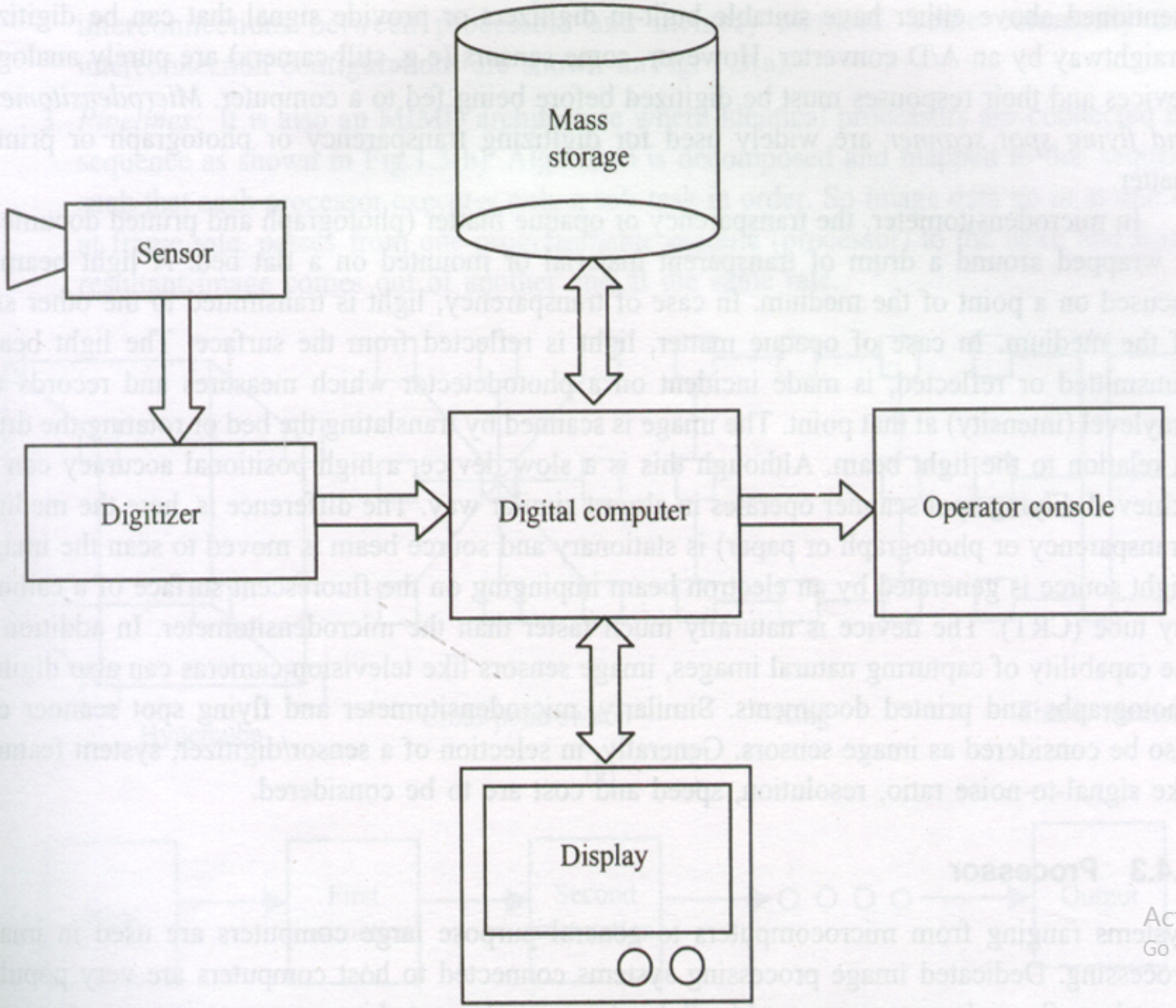

Fig. 1.2 A general-purpose image processing system.

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Components of Image Processing system.

- **Image Sensor:** Image sensor intercepts the radiant energy propagating from the scene and transforms it to produce an intensity image.
- **Digitizer:** is required input images to a digital computer, produces digital image composed of intensity values at discrete positions.
- **Processor**: systems ranging from microcomputers to purpose large computers are used in image processing.
- **Display UNIT:** A display device produces and shows a visual form of numerical values stored in computer as image array.

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Image Representation and Modeling

- In Image representation one is concerned with characterization of the quantity that each picture element (pixel) represents.
- An important consideration in image representation is the fidelity or intelligibility criteria for measuring the quality of an image or the performance of a processing technique. Specification of such measures requires models of perception of contrast, spatial frequencies, color and so on.

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Image Representation and Modeling

- The fundamental requirement of digital processing is that images must be sampled and quantized.
- The sampling rate (number of pixels per unit area) has to be large enough to preserve the useful information in an image. It is determined by the bandwidth of the image.
- Image quantization is the analog to digital conversion of a sampled image to a finite number of gray levels.

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Image Enhancement

- In Image enhancement the goal is to accentuate certain image features for subsequent analysis or for image display.

  E.g. Contrast, edge enhancement, pseudocoloring, noise filtering, sharpening, magnifying, etc.

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Image Restoration

- Image restoration refers to removal or minimization of known degradations in an image.
- This include deblurring of images degraded by the limitations of a sensor or its environment, noise filtering and correction of geometric distortion or non linearities due to sensors.

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Image Analysis

- It is concerned with making quantitative measurements from an image to produce a description of it.
- Image analysis techniques require extraction of certain features that aid in the identification of the object.

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Image Reconstruction

- Image reconstruction from projections is a special class of image restoration problems where a two or higher dimensional object is reconstructed from several one-dimensional projections.

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Image Data Compression

- Image data compression techniques are concerned with reduction of the number of bits required to store or transmit images without any appreciable loss of information.

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Digitizing

- Digitizing is the process of converting a continuos signal (such as sound or video, etc) into distinct units that the compute or other electronic equipment can process.
- There are many ways to digitize things. E.g. microphone, which digitizes sound.
- The scanner can digitize photos and other images
- A digital camera is able to bring video into the computer.
- You can also digitize 3D objects. For that you use a 3D digitizer.

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Digitization

- An image g(x,y) that is detected and recorded by a sensor is primarily a continuous tone intensity pattern formed on a 2-dim. Plane.
- This image must be converted into a form which is suitable for computer programming.
- The method for converting an image which is continuous in space as well as in its value, into a discrete numerical form is called image *digitization*.

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Digitization

This conversion may be considered as two step process.

✓Taking measurements at regularly spaced intervals, called ***Sampling*** and

✓Mapping the measured intensity to one of finite number of discrete levels called ***quantization.***

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Digitization

Sampling is a process by which image formed over a patch in continuous domain is mapped into a discrete point with integer coordinates.

This process involves two important choices:

✓***Sampling interval***

✓***Tessellation*** *(the spatial arrangement of the sample points)*

- The sampling theorem provides a mathematical basis for the first one.
- The second choice is influenced by the connectivity and the metric to be used in the discrete domain.

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Digitization

- Image sampling may be defined as the selection of a set of discrete locations in the continuous two-dim space and intensity at these locations only will be considered for processing by computer.

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Quantization.

- The values obtained by sampling a continuous function usually comprise an infinite set of real numbers ranging from a minimum to a maximum depending on sensor's calibration.
- These values must be represented by a finite number of bits to store and to process.

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Quantization.

- The mapping from the real numbers to finite range of integers or in other words the process of amplitude digitization is called ***quantization***.
- The transformation is increasing but non-reversible.
- A single image can be sampled and quantized at different rates at different parts of the image. This is known as non-uniform sampling and non-uniform quantization.

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Visual detail in the Digital Image

- The people working with digital images come across the parameter called ***resolution.***
- The resolution is of **TWO** kinds:

✓ ***Spatial resolution***

(related to the sampling interval)

✓ ***Graylevel (Intensity) resolution***

(related to the quantization levels)

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Spatial resolution

- Spatial resolution is related to the resolving power to distinguish image details.
- As image processing is a multidisciplinary field, there are many ways to specify spatial resolution, each one is application oriented.

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Spatial resolution

- In remote sensing, it is common to specify the **spatial resolution as the size each pixel represents in the real world by the terms *ground resolution element* and *ground resolution distance***.
- As an example the LANDSAT has resolution ranging from 30 m to 120 m.
- In this case as smaller the resolution distance, the better one can resolve image spatial contents.

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Spatial resolution

- In medical imaging, the resolution is also used as in remote sensing, but using millimeters as their standard unit.
- Typical CT (Computer Tomography) Scanners have pixel size of 1 mm.
- In document industry, the resolution is used as number of pixels per world dimension.
- As an example desktop scanners has resolution of 600 dpi (dots per inch).

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Image : Image is a two-dimensional light-intensity function, denoted by $f(x, y)$, where the value or amplitude of f at coordinates (x, y) gives the intensity of the image at that point.

$$0 < f(x, y) < \infty \text{ (because light is a form of energy)}$$

Nature of $f(x, y)$ is characterized by

1. The amount of source light incident on the scene being viewed

   illumination component i(x, y) **,** determined by light source

2. The amount of light reflected by the objects in the scene.

   reflectance component r(x, y), characteristics of the object in a scene

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$$f(x, y) = i(x, y)\, r(x, y) \text{ where } 0 < i(x, y) < \infty \text{ and } 0 < r(x, y) < 1 \ldots (1)$$

Gray level : The intensity of a monochrome image *f* at coordinates *(x, y)* is called the Gray level (*l*) of the Image at that point.

From (1) $Lmin < l < Lmax$ **[*Lmin, Lmax*] – Gray Scale**

In practice we shift the interval numerically to [0 , L]

$l = 0 \Rightarrow$ **Black** $l = L \Rightarrow$ **white**

Contrast : Contrast is the local change in the brightness and is defined as the ratio between average brightness of an object and the background brightness.

For same perception high brightness required high contrast

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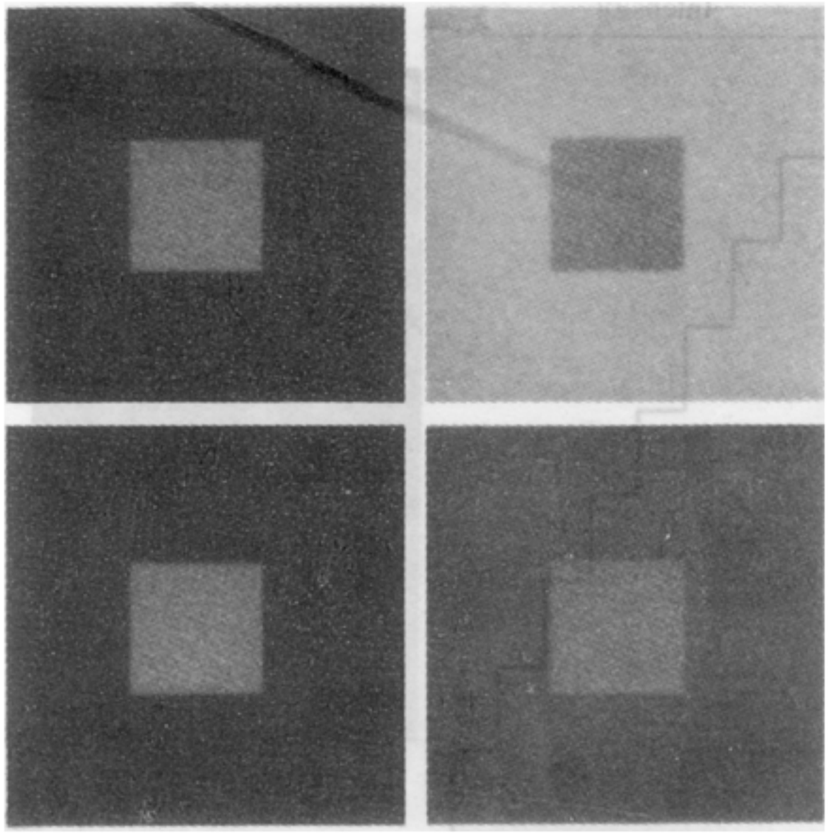

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Resolution : In optics it is defined as the inverse value of a maximum viewing angle between the viewer and two proximate points which human cannot distinguish and so fuse together.

For human,

the distance between two distinguishable points ≈ 0.16 mm

To make image suitable for computer processing, *f(x, y)* must be digitized both spatially and in amplitude.

Image Sampling : Digitization of the spatial coordinate *(x , y)*

Gray level Quantization : Amplitude digitization

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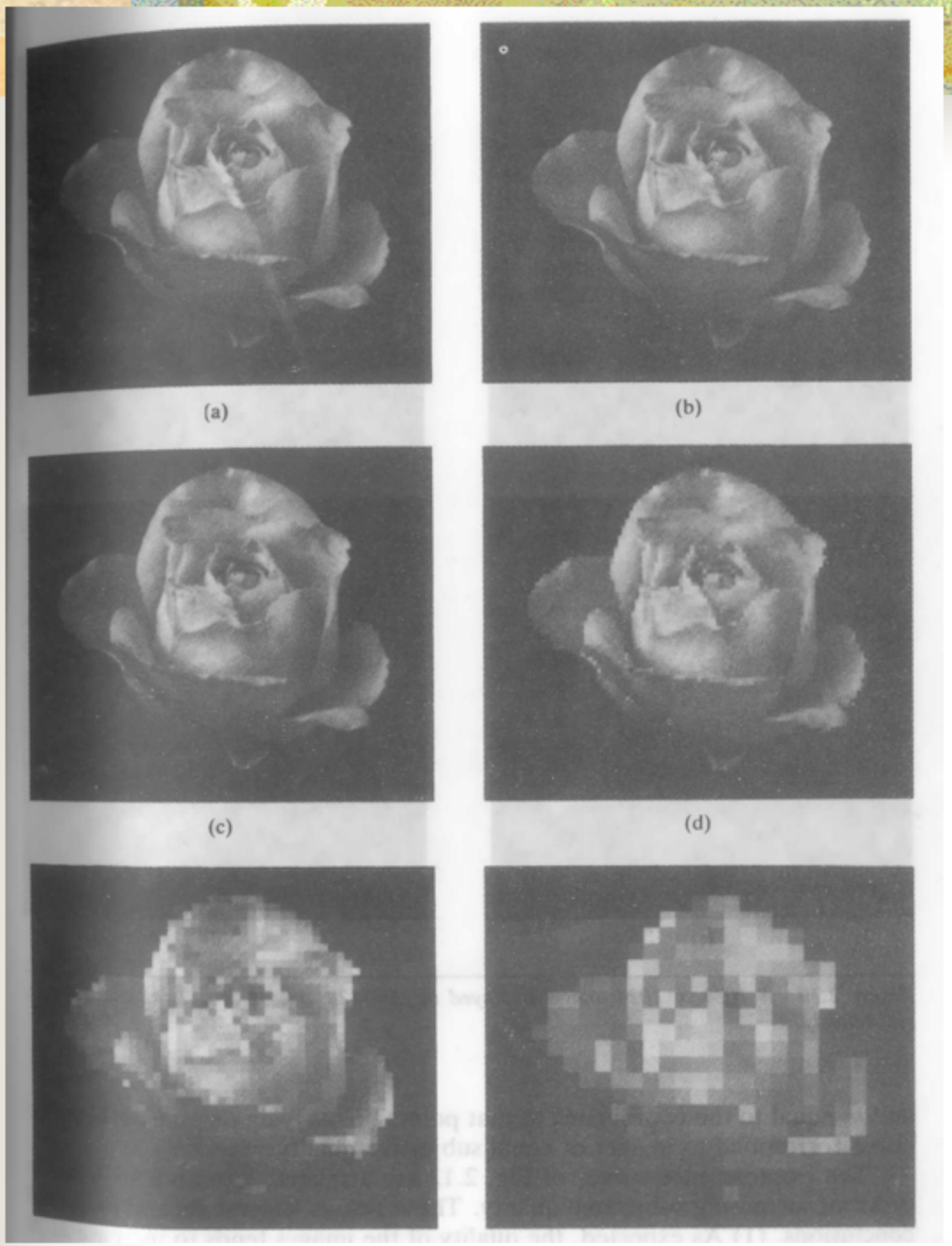

Same Picture with Different Contrast

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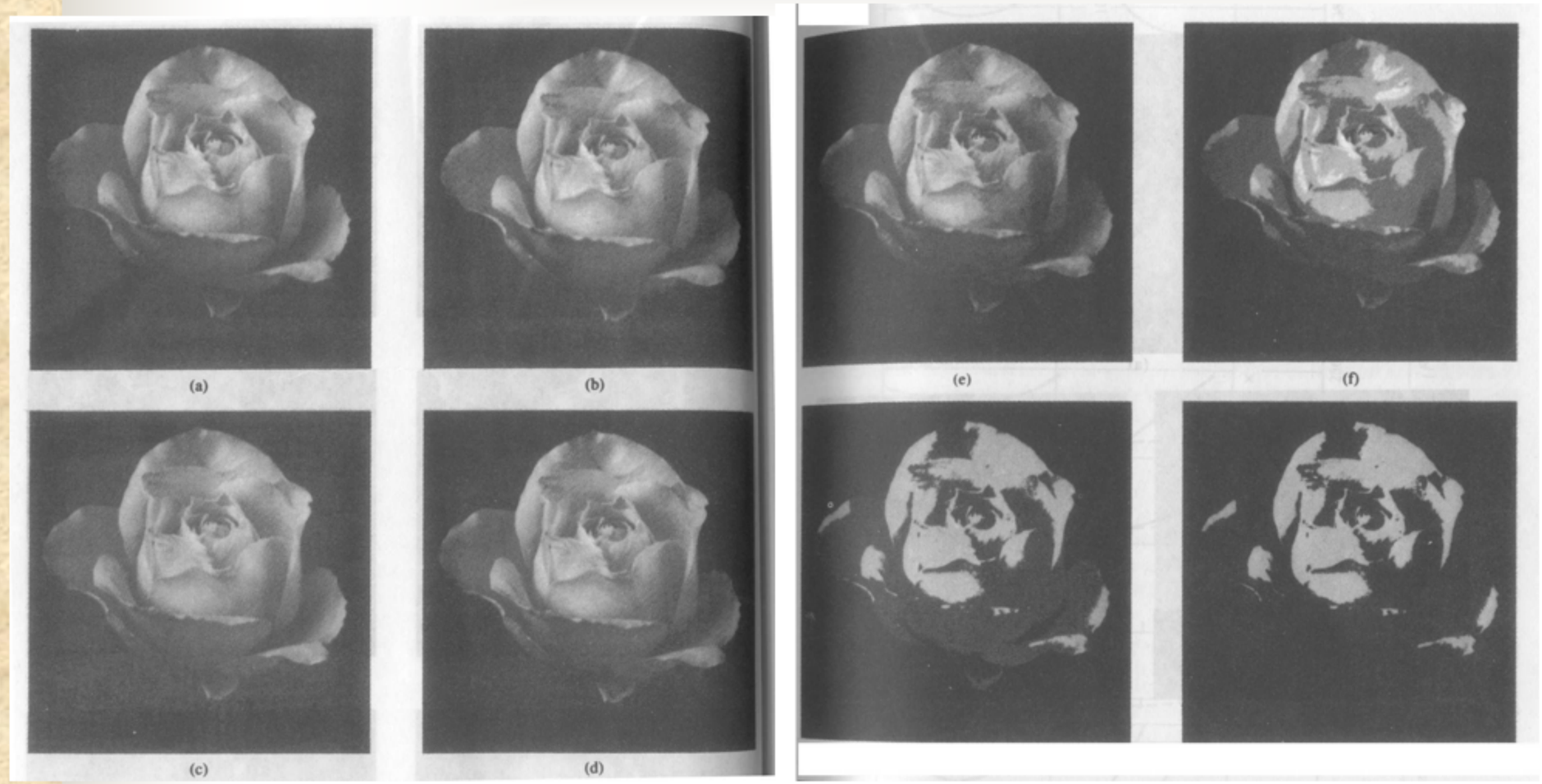

Same Picture with Different Gray Scales

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$$f(x,y) = \underbrace{\begin{bmatrix} f(0,0) & f(0,1) & \cdots & f(0,M-1) \\ f(1,0) & f(1,1) & \cdots & f(1,M-1) \\ \vdots & \vdots & & \vdots \\ f(N-1,0) & f(N-1,1) & \cdots & f(N-1,M-1) \end{bmatrix}}_{\text{Digital Image}} \text{ N x M}$$

The Matrix will be N x M x 3 if the image is colored

- A digital image is composed of *pixels* which can be thought of as small dots on the screen.
- A digital image is an instruction of how to color each pixel.

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Image Processing

Image Enhancement

- Contrast Indnetification
- Noise reduction or Smoothing
- Sharpening

Recognition

- Cross Ratio Invariance
- Statistical Methods
- Neural Networks

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Image Processing

- When ever an image is converted from one form to another, such as, digitizing, transmission etc. some form of degradation occurs in at the output.
- Process to improve quality of the image so that it gets the appropriate form for specific application is called ***Image Enhancement***

i.e. improvement of the appearance of an image by increasing dominance of some features or by decreasing ambiguity between different regions of the image.

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Image Processing

- Improvement in the quality of degraded images can be achieved by the application of ***restoration*** and/or ***enhancement*** technique.
- ***Restoration*** may defined a san attempt to estimate the original image by applying effective inversion of the degrading phenomenon.
- This requires an priori model of the degradation process.
- When no such knowledge is available the quality may be improved for specific application by some ad hoc processes called ***image enhancement.***

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Image Enhancement

- In Image enhancement the goal is to accentuate certain image features for subsequent analysis or for image display. E.g. Contrast, edge enhancement, pseudocoloring, noise filtering, sharpening, magnifying, etc.
- The enhancement of certain features may be achieved by the cost of suppressing others.

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Image Enhancement

- The enhancement techniques can be divided into *THREE* categories:

✓Contrast Intecification

✓Noise reduction or Smoothing

✓Edge Sharpening or crispening

- The algorithms are developed using one of the two basic approaches :

✓**Spatial-domain techniques**

✓**Frequency-domain techniques.**

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Contrast Intensification

- One of the most common defect found in the recorded image is its **POOR CONTRAST**.
- The effect of such defect is reflected on the range and shape of the gray level histogram of the recorded image
- Contrast can be improved by scaling the gray level of each pixel, so that image gray level occupy entire dynamic range available
- This operation is called **HISTOGRAM STRETCHING.**

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Histogram :

Histogram of an image is to compute an array *H[0,1,2,…,k-1] (k = No. of gray-levels in the image)* such that *H[i]* is the number of pixels in the image with gray level *i*. *(k is assumed to be power of 2)*

Why Histogramming ?

- Histogram gives the global description of the appearance of the image.
- It is very much useful in many areas of image processing and Analysis.
- One of its application is in *image enhancement*.

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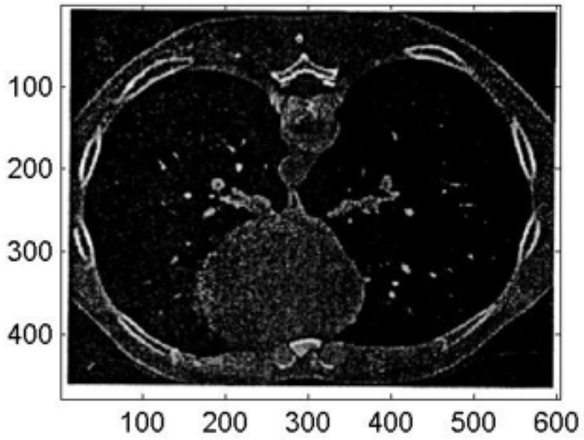

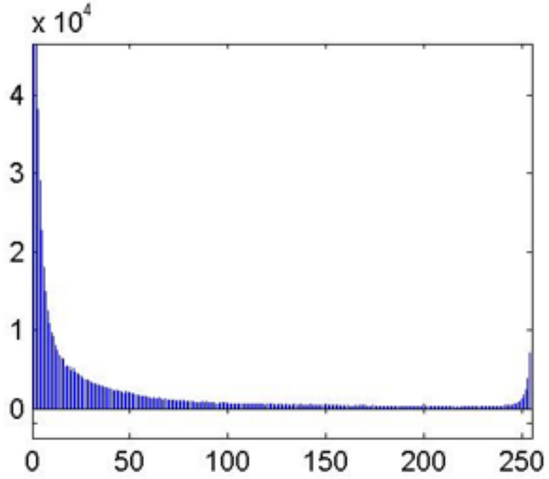

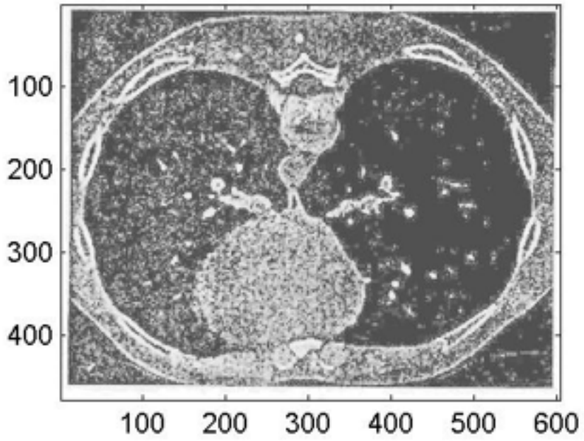

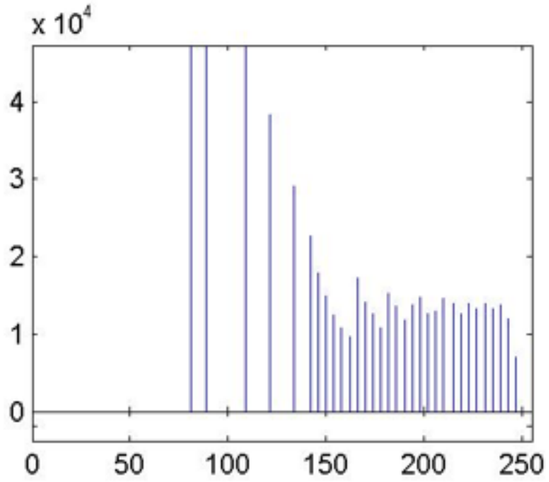

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Smoothing, Sharpening and Noise Reduction

The stored image may contain random *"noise"* or result of other undesirable effects

Smoothing Suppresses large fluctuations in intensity over the image area

Reducing the high-frequency content.

It will blur the Image

Sharpening Accentuates the transitions, enhancing the detail

Reducing the low-frequency content

To accentuate changes through differentiation

Noise Reduction: Suppresses a noise signal present in the image.

It can be of various forms

May be a random Signal

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Registration

- Registration established feature based corr. between related image pairs.
- It is also a process of mapping between a temporal sequence of image frames.
- Establishing a corr. Means matching of identical shapes in the related image pair.
- This requires geometric transformation of one image onto the other.

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Registration

- This geometric transformation enables mapping between related image pairs so that accuracy of matching could be determined.
- The transformation needs a set of features in both the images.
- These features are known as *landmarks*.

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Geometric Transformation

- The mapping between a related pairs is achieved using geometric transformation.
- The analysis is based on the familiar pinhole camera model of image formation.
- The transformation is restricted to planner models and are part of plane-to-plane collineations.
- I.e a line remains line even after object-to-image projections.

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Geometric Transformation

- Change in view point or relative motion between the camera and object planes introduces distortion in the features of an image.
- The g.t. models are used to parameterize this object-to-image distortion.
- However, certain features of object shape remain intact or preserved even after such transformations. These features are known as invariants.

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Mapping

- As we know mapping is a process of transformation between related image pairs.
- The process of mapping involves the two-steps:

✓ *Detection and matching of a set of landmarks.*

✓ *Establishing trans. Between corr. Landmarks.*

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Detection and matching of a set of landmarks

- Landmarks are object specific stable features present in the image. So, the process of detection of them depends on the specific application.

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Detection and matching of a set of landmarks

- The basic philosophy of landmark detection seems from the idea of invariance i.e. the identification of features which remains *almost intact* in the related image pairs.
- At the same time the features must be *easily identifiable*.
- The features should be in the form of *geometric primitives or in terms of intensity values*.

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Applications of landmark detection and matching

- *Two important application of it are in the areas of Biomedical and Satellite Image Processing.*
- *In both the cases the main objective is to achieve registration of images so that imaged information is enhanced.*
- *Let us see the various reg. Techniques in both of these areas.*

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Image Fusion

- Image fusion means fuses more than one image and make one.
- Clinical Diagnosis and Treatment of radio therapeutic patients usually requires exhaustive exploration of biomedical images with varieties of signal modalities.
- Single modality does not provide a complete set of information and this inadequacy of information makes biomedical image insufficient for use in clinical interpretation and diagnosis of disease.
- A computed topography(CT) image, for example is suitable for visualization of ventricular systems, and skull and bone like hard structures; whereas a MR image is more suitable for visualizing cerebral tissues accurately.

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Multi Modal Image Fusion

- This is why Image Fusion of both the images is required for thorough inspection of the regions of interest in the images of biological organs.
- Fusing constructs image out of constituting images of different modalities subject to some geometrical and biomedical constraints.
- Thus a successfully fused image contains all the features that are visualized in at least one of the constituting modalities.

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Image Analysis

- *Examine image data to facilitate solving a vision problem.*
- *This can be done by feture extraction or pattern classification.*
- *Feture extraction is a process of acquiring high-level image information like shape or color information.*
- *Pattern classification is the act of taking this high-level information and identifying objects within the image.*

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Image understanding

- *Image understanding is a process of discovering, identifying, and understanding patterns that are relevant to the performance of an image-based task.*
- *One of the principal goals of image understanding by computer is to endow a machine with a capability to approximate, in some sense, a similar capability in human beings.*

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