Multimedia hand written

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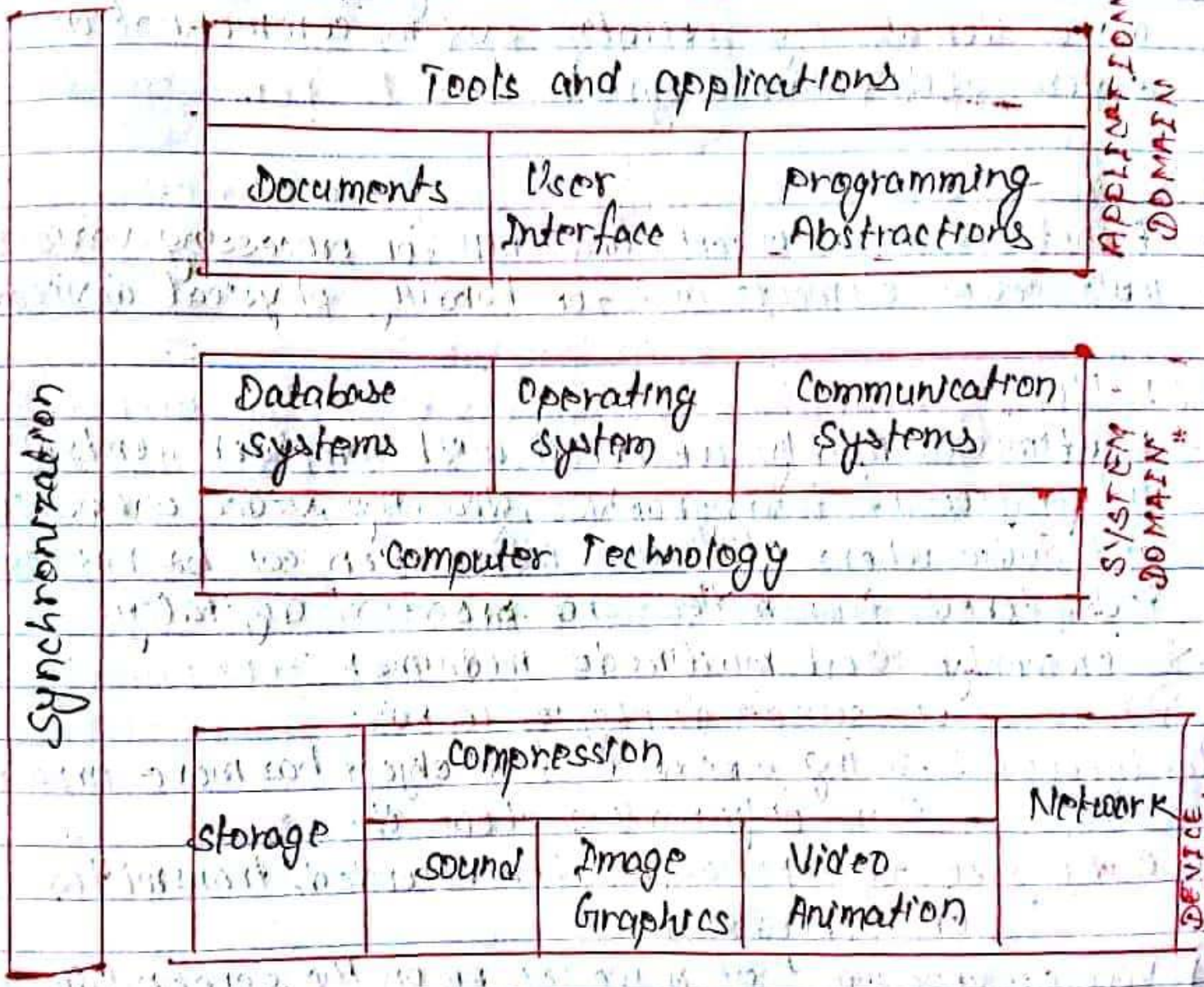
1.1 Global Structure of Multimedia:



Application domain:

- it provides functions to the user to develop and present multimedia project
- it includes software tools, and multimedia projects development methodology.

System domain :

→ it includes all supports for using the functions of the device domain e.g. operating system, communication system and database system.

Device domain :

→ it includes basic concepts and skill for processing various multimedia elements and for handling physical device.

1.2 Medium :

→ Multimedia mainly concerned with computer controlled integration of text, graphics, drawing, video, animation and audio where all these information can be represented, stored, transmitted and processed digitally.

→ commonly used multimedia mediums :

(i) Text :- on screen display of words.

(ii) Graphics :- seeing a picture of an object has more impact than only reading about it.

(iii) Audio :- sound especially when recorded, transmitted or reproduced.

(iv) Video :- anything that we see on the screen (digital movie)

(v) Animation :- time sequence of a series of graphic images together give the appearance of continous movement.

1.3 Multimedia System and properties:

→ Multimedia is define as integration of animation, audio, graphics, text and full-motion video through computer hardware and software.

→ Multimedia Application is an application which uses a collection of multiple media sources e.g. text, graphics, images, sound/audio, animation.

→ Hypertext is a text which contains links to other texts. The term was invented by Ted Nelson around 1965.

→ Hypermedia is not constrained to be text-based. It can included other media e.g graphics, images and especially the continuous media - sound and video.

Example : WWW
: powerpoint
: Adobe Acrobat

→ Multimedia system is a system capable of processing multimedia data and applications. It is characterised by the processing, storage, generation, manipulation and rendition of multimedia information.

Characteristics of a Multimedia Systems:

(i) It must be computer controlled
(ii) It should be integrated
(iii) The information they handle must be represented digitally.
(iv) The interface to the final presentation of media is usually interactive.

Challenges for Multimedia Systems:

(i) Supporting multimedia applications over a computer network renders the application distributed. This will involve many special computing techniques.

(ii) Temporal relationships between data
→ Render different data at same time continuously.
→ sequencing within the media (playing frames in correct order/time frame in video).
→ synchronisation (inter media scheduling)

Key Issue for Multimedia Systems:

(i) How to represent and store temporal information.
(ii) How to strictly maintain the temporal relationships on play back/retrieval.
(iii) Data has to represented digitally.

Applications:
(i) World Wide Web
(ii) Hypermedia courseware
(iii) Vide conferencing
(iv) Video-on-demand
(v) Interactive TV
(vi) Groupware
(vii) Home shopping
(viii) Games
(ix) Virtual reality

Development Process for Multimedia Application:
→ Developing a multimedia application follows the seven stages as same as software development process:

(i) Analysis :- looking at who will use the multimedia applicat- on, how and where.

(ii) Design :- what is required on screen is designed, & the order in which they will be linked together.

(iii) Implementation : multimedia or web page authoring software would be used to implement the design into a working application.

(iv) Testing :- makes sure all the multimedia functions in the project are working properly.

(v) Documentation :- considering the use of a help page inside your multimedia application.

(vi) Evaluation :- the finished project is checked to make sure it meets all design criteria.

(vii) Maintenance :- ensuring there are no errors (bugs), changing the ~~best~~ designs to meet the client need if required and changing to meet new hardware and software.

2.1 Concepts of Sound System

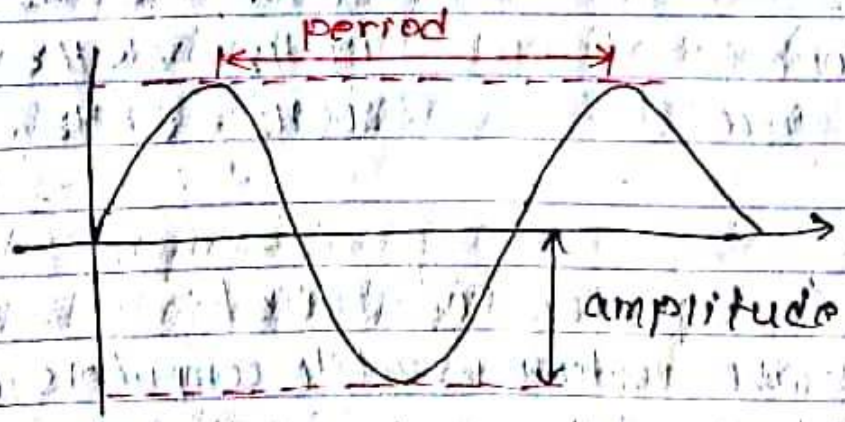
Nature of Sound:

→ Sound is a physical phenomenon produced by the vibration of matter and transmitted as waves.

→ It involves the three systems:

(i) the source which emits sound.
(ii) the medium through which the sound propagates
(iii) the detector which receives and interprets the sound.

→ sound wave can be characterised by following attributes: period, Frequency, Amplitude, Bandwidth, Pitch, Loudness, Dynamic.



→ Period is the interval at which a periodic signal repeats regular.

→ Pitch is a perception of sound by human beings.

→ Frequency measures a physical property of a wave.

$f = \frac{1}{P} = \frac{1}{\text{period}}$ = Herts(Hz) OR KiloHertz(kHz)

- According to Nyquist sampling theorem, in order to capture all audible frequency components of sound i.e. upto 20 KHz, we need to set the sampling to at least twice of this.
- Another aspect we need to consider is the resolution i.e. the number of bits used to represent a sample. Often 16 bits are used for each sample in high quality sound. This gives the SNR of 96dB.

Quality versus File size (Numerical)

→ The size of a digital recording depends on the sampling rate, resolution and number of channels.

$$S = R \times (b/8) \times C \times D$$

where;

S = file size (bytes)
R = sampling rate (samples per second)
b = resolution (bits)
C = channels (1 - mono, 2 - stereo)
D = recording duration (seconds)

→ Amplitude is the measure of sound levels.

Infra sound	0 - 20 Hz
Human hearing range	20 - 20 KHz
Ultrasound	20KHz - 1 GHz
Hypersound	1GHz - 10 THz

→ Bandwidth is the range of frequencies a device can produce.

FM radio	50Hz - 15KHz
AM radio	80Hz - 5KHz
CD player	20Hz - 20KHz
Children's voice	20Hz - 20KHz
Older voice	50 Hz - 10KHz
Male voice	120 Hz - 7KHz
Female voice	200Hz - 8KHz

Computer Representation of Sound

→ Sound waves are continuous while computers are good at handling discrete numbers.

→ In order to store a sound wave in a computer, samples of the wave are taken.

→ Each sample is represented by a number the 'code', this process is known as digitisation.

→ Method of digitising sound is known as pulse code modulation (PCM).

Numerical

(1) If we record 10 seconds of stereo music at 44.1 KHZ, 16 bits, the size will be?

Solution;

D = 10 seconds

C = 2 (because of stereo music)

R (sampling rate) = 44.1 KHZ
= 44.1 × 1000 HZ
= 44100

b (resolution) = 16 bits

$S = R \times (b/8) \times C \times D$

$= 44100 \times (16/8) \times 2 \times 10$

= 1764000 bytes

= 1722.656 Kbytes

= 1.682 Mbytes

Note: CD-quality Recoding

sampling rate = 44.1 KHZ

Resolution = 16 bit

stereo

(2) A multimedia presentation has 30 mins of CD quality in digital audio in web file. What is the storage of this file.

Solution;

D (recording duration) = 30 min

= 30 x 60 sec

= 1800 sec

In question, CD quality in digital audio is given. So,

R (sampling rate) = 44.1 KHz

b (resolution) = 16 bits

C (channel) = 2 (because of stereo)

S = R x (b/8) x C x D

= (44.1 x 1000) x (16/8) x 2 x 1800

= 317520000 bytes

= 310078.125 Kbytes

= 302.8106 Mbytes

Audio File Formats:

-> The most commonly used digital sound format are wave files (.wav) and MPEG layer-3 files (.mp3).

-> The way the audio is compressed and stored is call the codec which determines how small the file size is.

-> Some file types always use a particular codec.

Example:

:- ".wav" file can be encoded with PCM (Pulse Code Modulation) codec.

:- ".mp3" file always use the "MPEG layer-3" codec.

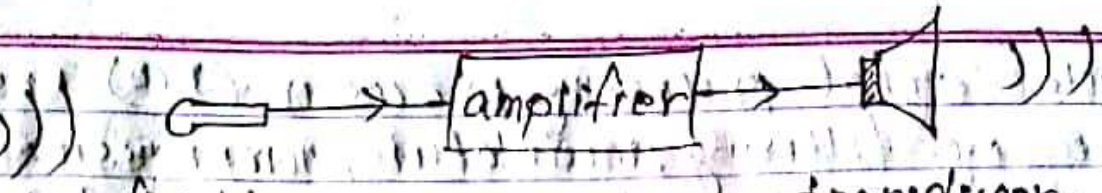
→ Some file types just contain the audio. But other file types can contain additional header information which can contain other information about the file.
Example: .dict files have information about the sender, priority, notes and other data in the file itself.

Audio Hardware:

→ Working with audio means working with sound system.
→ However all electronic audio systems are based around on very simple concept :-
"Take sound waves, convert them into a electric current and manipulate them as desired, then convert them back into sound waves"

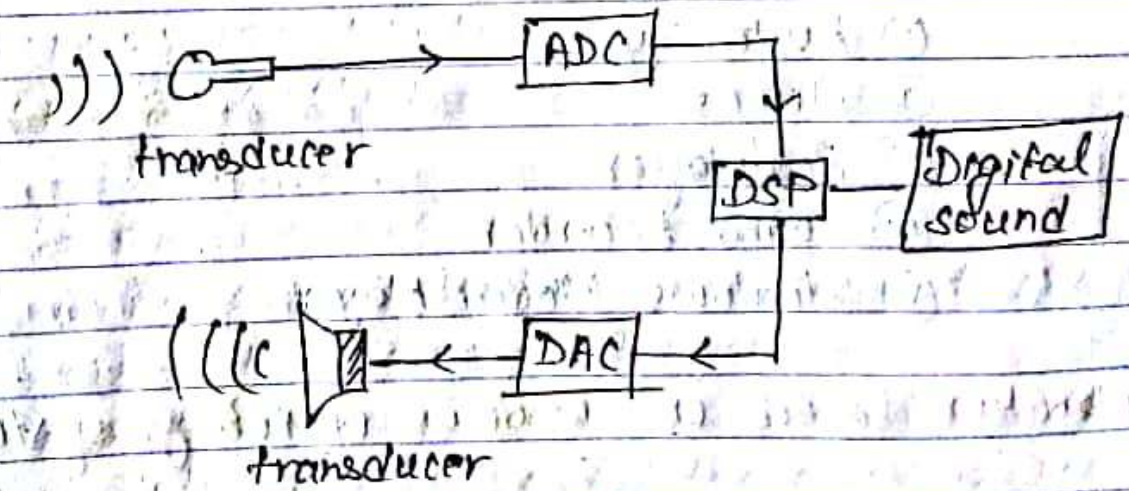
→ A very simple sound system is shown in the diagram below. It is made up of two types of component:
(i) Transducer :- It is a device which converts energy from one form into another. The two types of transducers we will deal with microphones (which convert acoustical energy into electrical energy) and speakers (which convert electrical energy into acoustical energy).

(ii) Amplifier : It is device which takes a signal and increases it power.



→ The process begins with a sound source (such as human voice) which creates waves of sound (acoustical energy)
→ These waves are detected by transducer (microphone), which converts them to electrical energy
→ The electrical signal from microphone is very weak so amplifier increase the amplitude.
→ The loudspeakers converts the electrical signal back into sound waves, which are heared by human ears.

The next diagram shows a slightly more elaborate system



→ Transducer (microphone) is device which allow the manipulation of signal (human voice) into ~~soun~~ acoustical energy.
→ An analog to digital converter (ADC) converts the analog sound ~~sig~~ signal into digital samples.

→ A digital signal processing processor (DSP) processthe sample e.g. filtering, modulation, compression & so on.
→ A digital signal sound is a signal which help to storage data in required format for late reproduction.
⇒ An digital to analog converter (DAC) converts the digital samples into sound signal.

Audio Software:

→ Audio software is any software that allows us to create, listen to or manipulate sound files.

Example of audio software:

(i) Audacity
(ii) iTunes
(iii) Realplayer
(iv) Sound Recorder
(v) Windows Media Player

Explanation based on windows operating system:

Operation of audio software:
(i) control device audio system:
→ user easily control device hardware.
Eg:- can set the audio volume.
:- can choose which audio device you want to use (speaker, headphone)

(ii) Mixer
- ⇒ it can combine sound from different sources.
- ⇒ it can easily adjust playback volume and recording volume of sound sources.

(iii) Recording
- ⇒ We can record easily with Sound Recorder in windows.

(iv) Editing
- ⇒ Windows Sound Recorder has a limiting editing function such as changing volume & speed, deleting part of the sound.

Computer Music - MIDI

⇒ MIDI (Musical Instrument Digital ~~Signature~~ Interface) is a technical standard that describes a communications protocol, digital interface and electrical connectors that connect a wide variety of electronic musical instruments, computer and related music and audio device.

⇒ It is a communication standard developed in the early 1980s for electronic instruments and computers.

⇒ It specifies the hardware connection between equipments as well as the format in which the data are transfered between equipments.

⇒ MIDI devices include electronic music synthesisers, modules.

MIDI Hardware :

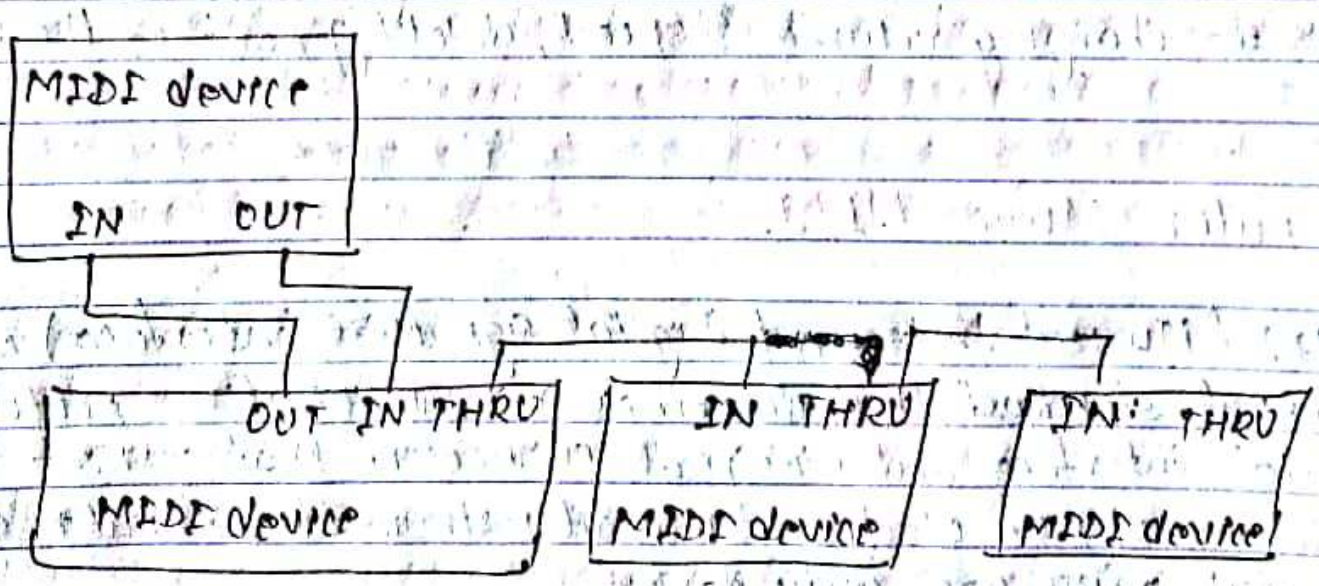
→ An electronic musical instrument or a computer which has MIDI interface should be has one or more MIDI port.

→ The MIDI ports on musical instruments are usually labelled with

IN → for receiving MIDI data

OUT → for outputting MIDI data that are generated by the instrument.

THRU → for passing MIDI data to the next instrument



MIDI versus Digital Sound Audio

Digital Audio	MIDI
(1) It refers to the reproduction and transmission of sound stored in a digital format.	(1) It is a software for recording musical information in a digital format.
(2) Digital representation of physical sound waves.	(2) Abstract representation of musical sounds and sound effects.
(3) File size is large if without compression.	(3) MIDI files are much more compact.
(4) Quality is proportional to file size.	(4) File size is independent to the quality.
(5) Play back quality less dependant on the sound sources.	(5) Much better sound if the sound sources is of high quality.

2.2 Music and speech

→ Music is a vocal or instrumental sounds (or both) combined in such a way as to produce beauty of form, harmony and expression of emotion.

→ Speech is the expression of or the ability to express thoughts and feelings by articulate sound.

Music Vs Noise

(1) Music has a pleasing effect on mind and ears. Noise, on other hand appears to be pretty irritating.

(2) Music usually has a high frequency & also exhibits a recognizable pattern of changes in amplitude as well as wavelength but Noise exhibits lower frequency, irregular wavelengths and also produces sudden changes in wavelength and amplitudes.

(3) Music is actually a combination of harmonics and frequencies but Noise has no such properties.

2.3 Speech Generation

→ Speech Generation is the computer-generated simulation of human speech. (artificial)

→ It is used to translate written information into aural information.

→ It is more convenient, especially for mobile application such as voice-enabled e-mail and to provide assist to vision-impaired person.

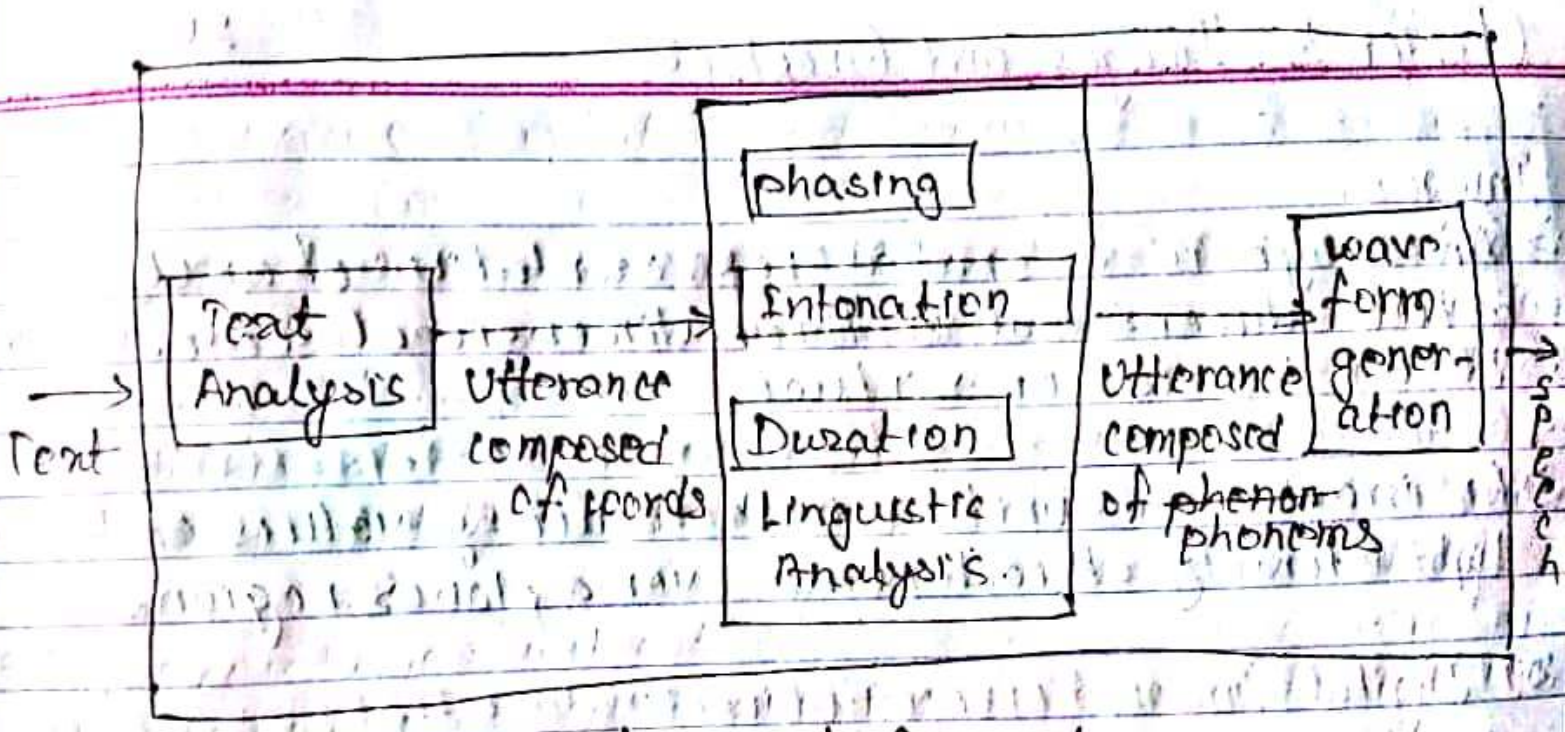


Fig: Process of speech Generation

From this portion this note is best

Chapter 3 Images and Graphics

Images:

→ An image is a spatial representation of an object, a two-dimensional or three-dimensional scene.
→ It can be real or virtual.
→ An image is a function with resulting values of the light intensity at each point over a planar region.

3.1 Digital Image Representation

→ A digital image is represented by matrix of numerical values each representing a quantized intensity value. When I is two-dimensional matrix, then I(r,c) is the intensity value at the position corresponding to row(r) and column(c) of the matrix.

→ The point at which an image is sampled are known as picture elements, commonly abbreviated as pixels.
→ The pixel values of intensity images are called gray scale levels.

→ If there are just two intensity values for example black and white, they are represented by the numbers 0 & 1; such images are called binary-valued images.
→ When 8 bit integers are used to store each pixel value, the gray levels range from 0(black) to 255 (white).

2.2 Image and graphics format

Image Format:

→ There are different kinds of image formats in the literature. We shall consider the image format that comes out of an image frame grabber.

(i) Captured Image Format
(ii) Stored Image Format

Captured Image Format

→ The image format is specified by two main parameters: spatial resolution, which is specified as pixels x pixels and color encoding, which is specified by bits per pixel. Both parameter values depend on hardware and software for input/output images.

Stored Image Format:

→ When we store an image, we are storing a two-dimensional array of values, in which each value represents the data associated with pixel in the image.

→ For bitmap, value is a binary digit.

→ For color image, three numbers representing the intensities of the red, green and blue components of the color at ~~that~~ pixel.

→ Some current image file formats for storing images are
GIF (Graphical Interchange Format)
X11 Bitmap, IRIS, JPEG

Graphics Format:

⇒ Graphics image formats are specified through graphics primitives and their attributes.

⇒ Graphics primitives and their attributes represent a higher level of an image representation i.e. either bitmap or pixmap.

⇒ A bitmap is an array of pixel values that map one by one to pixels on the screen; the pixel information is stored in 1 bit, so we get a binary image.

⇒ A pixmap is a more general term describing a multiple-bit-per-pixel image.

⇒ Bitmap formats and Vector formats are some of example of graphics format

Bitmap Vs Vector graphic

Bitmap	Vector
(1) A bitmap contains an exact pixel-by-pixel value of image.	(1) A vector graphic contains mathematical description of objects.
(2) A bitmap file is fixed in resolution.	(2) A vector graphic is resolution independent.
(3) The file size of bitmap is completely determined by image resolution and its depth.	(3) The file size of vector graphic depends on the number of graphic elements it contains.
(4) A bitmap image is easier to render.	(4) displaying a vector graphic usually involves a large amount of processing.

3.3 Image Synthesis, analysis and Transmission

Image Synthesis

→ Image synthesis is an integral part of all computer user interfaces and is indispensable for visualizing 2D, 3D and higher-dimensional objects.

→ The kinds of images that are typically synthesized include:

(i) Test patterns
(ii) Image Noise
(iii) Computer Graphics

→ Synthetic images are often used to verify the correctness of operators by applying them to known images.

Image Analysis:

⇒ Image analysis is the extraction of meaningful information from images, mainly from digital images by means of digital image processing techniques.

⇒ Image analysis techniques include computation of perceived brightness and color, partial or complete recovery of three-dimensional data in the scene, location of discontinuities corresponding to objects in the scene & characterization of the properties of uniform regions in the images.

⇒ Some Image analysis techniques are:

(i) Image segmentation
(ii) motion detection
(iii) 3D pose Estimation
(iv) Optical flow

Image Transmission

→ Image transmission takes into account transmission of digital images through computer networks.

→ There are several requirements on the networks when images are transmitted:

(i) The network must accommodate bursty data transport.
(ii) Image transmission requires reliable transport.
(iii) Time dependence is not a dominant characteristic of image in contrast to audio/video transmission.

→ Image size depends on the image representation format used for transmission. They are several possibilities:

(I) Raw image data transmission:

→ In this case, image is generated through a video digitizer and transmitted in its digital format. The size can be computed in the following manner

SIZE: spatial resolution × pixel quantization.

(II) Compressed image data transmission:

→ In this case, image is generated through a video digitizer & compressed before transmission.

→ The reduction of image size depends on the compression method and compression rate.

(III) Symbolic image data transmission:

→ In this case, image is represented through symbolic data

representation as image primitives, attributes & other control information.

→ Image size is equal to the structure size, which carries the transmitted symbolic information of the image.

Chapter 4 Video and Animation

4.1 Video Signal Representation

→ In conventional black and white TV sets, the video signal is displayed using a CRT. An electron beam causes corresponding pattern information, such as intensity in a viewed scene.

→ Video signal representation includes three aspects

(i) the visual representation
(ii) transmission
(iii) digitalization

Visual Representation :

→ A central objective is to offer the viewer a sense of presence in the scene and of participation in the events portrayed (चित्रण). To meet this objective, important measures are:

(i) vertical detail & viewing distance
(ii) Horizontal Detail & picture width
(iii) Total detail content of the image
(iv) Perception of depth
(v) Luminance & chrominance
(vi) Temporal Aspect of Illumination
(vii) Continuity of Motion
(viii) Flicker
(ix) Temporal Aspect of Video Bandwidth

4.2 Computer Video Format:

→ computer video format depends on the input and output devices for the motion video medium.

→ output of the digitalized motion video depends the display devices. The most often used display is raster display.

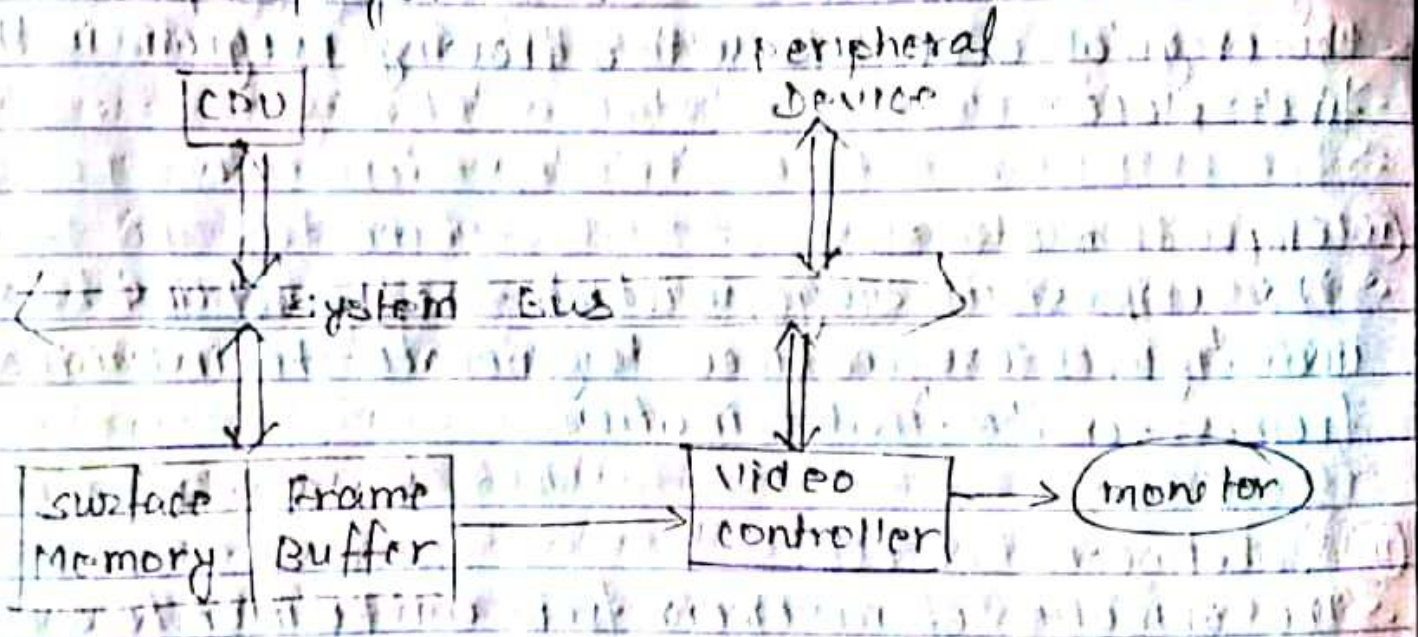


Fig: A common raster display system architecture

4.3 Computer-Based Animation

→ A computer based animation is an animation performed by a computer using graphical tools to provide visual effects.

→ Visual effects include time-varying positions (motion dynamics), shape, color, transparency, structure and texture of an object (update dynamics) and changes in lighting, orientation & focus.

Transmission:

→ Video signals are transmitted to receivers through a single transmission channel.

→ For transmission purpose, a video signal consists of one luminance and two chrominance signals.

→ In NTSC and PAL systems, single channel transmission is achieved by specifying the chrominance subcarrier to be an odd multiple of one-half of the line scanning frequency in order to prevent from cross-color and cross-luminance.

→ Notch filter tuned to the subcarrier's frequency to remove chrominance from luminance.

Digitalization:

→ Before a picture or motion video can be processed by a computer or transmitted over a computer speech network, it needs to be converted from analog to digital representation.

→ Digitalization consists of sampling the gray (color) level in the picture at M×N array of points.

→ For digital process, gray level must be quantized.

→ The result of sampling and quantizing is a digital image (picture).

→ Finally, digital + sequence of digital images per second that approximates analog motion video create digital motion video.

Basic Concept:

(i) Input Process:

→ Before the computer can be used, drawings must be digitized.

→ Digitized can be done through optical scanning, tracing the drawings with a data tablet or producing the original drawings with a drawing program in the first place.

(ii) Composition stage:

→ The composition stage, in which foreground and background figures are combined to generate the individual frames for the final animation.

(iii) Inbetween Process:

→ The animation of movement from one position to another needs a composition of frames with intermediate positions inbetween the key frames, this is called the inbetween process.

→ The process of inbetween is performed through interpolation.

→ The system gets only the starting and ending positions. The easiest interpolation in such situation is linear interpolation.

(a) key frames (b) linear interpolation

(iii) Changing colors:

→ In changing colors, computer based animation uses CLUT. (lut) in a frame buffer and the process of double buffering.

→ The simplest method is to cycle the colors in the lut, thus changing the color of the various pieces of the image.

→ Using lut animation is faster than sending an entire new pixmap to the frame buffer for each frame.

4.4 Animation Language

→ There are many different languages for describing animation and new ones are constantly being developed. They fall into three categories:

(i) Linear-list Notations:

→ In this, each event in the animation is described by a starting and ending frame no number and an action that is to take place (event).

→ The actions typically take parameters, so a statement such as

42, 53, B, ROTATE "PALM", 1, 30

→ This statement means " between frames 42 and 53,

relate the object called PRISM about axis J by 90 degrees, determining the amount of rotation at each frame from table E"

(ii) General-purpose Languages:

→ In this, values of variable in the language can be used as parameters to the routines, which perform the animation.
→ ASAS is an example of such a language.
→ The primitive entities include vectors, colors, polygons, splids, groups, points of view, subworlds and lights.
→ ASAS also includes a wide range of geometric transformations that operate on objects.

(grasp my-cube); The cube becomes the current object

(rio 0.05); spin it clockwise by a small amount

(grasp camera); Make the camera the current object

(right panning-speed); Move it to the right.

(iii) Graphical Language:

→ Graphical animation language describe animation in a more visual way.
→ This language are used for expressing, editing and comprehending the simultaneous changes taking place in an animation.

=> Instead of writing a code for descriptions of actions, the animator provides a picture of the action.

4. Method of Controlling Animation

=> Controlling animation is independent of the language used for describing it.
=> Method of controlling animation are:

(i) Full Explicit Control:

=> In this, animator provides a description of everything that occurs in the animation, either by specifying simple changes such as scaling, translation, and rotation or by providing key frames information and interpolation methods to use between key frames.

(ii) Procedural Control:

=> Procedural control is based on communication between various objects to determine their properties.
=> Procedural control is a significant part of several other control mechanisms.

(iii) Constraint-based System:

=> Moving object with which they are in contact. Such motion is known as compound motion. Compound motion may not be linear at all. Such motion can be modeled by constraints.

(iv) Tracking Live Action

⇒ Trajectories of objects in the course of an animation can also be generated by tracking live action.

⇒ Another live-action technique is to attach some sort of reflector to key points on a person's body. By tracking the positions of the indicators, one can get locations for corresponding key points in an animated model.

4.6. Display of Animation:

⇒ To display animations with raster systems, animated objects must be scan-converted into their pixmaps in the frame buffer.

⇒ To show a rotating object, we can scan-convert into the pixmap successive views from slightly different locations, one after another.

⇒ Such scan-conversion must be done at least 10 times per second to give a reasonably smooth effect; hence a new image must be created in no more than 100 milliseconds.

⇒ From these 100 milliseconds, scan-converting should take only a small portion of time.

4.7 Transmission of Animation

-> Animated objects may be represented symbolically using graphically objects or scan-converted pixmap images.

-> Transmission of animation over computer networks may be performed using one of two approaches:

(i) The symbolic representation (eg: circle) of animation object (eg ball) is transmitted together with the operation command (eg roll the ball) performed on the object and the receiver side the animation is displayed as described. In this case, transmission time is short but the display time at the receiver takes longer because scan-converting operation has to be performed at the receiver side.

(ii) The pixmap representation of the animated objects is transmitted and displayed on the receiver side. In this case transmission time is longer in comparison to the previous approach but display time is shortest because scan-conversion of the animated objects is avoided at the receiver side.

Chapter 5 Data Compression

5.1 Storage Space:

→ Uncompressed graphics, audio and video data require considerable storage capacity.

→ Data transfer of uncompressed video data over digital networks requires very high bandwidth to be provided for a single point to point communication.

→ To provide feasible and cost effective solutions, most multimedia system handle compressed digital video and audio data streams.

5.2 Coding Requirements:

5.3 Source, Entropy and Hybrid Coding

Entropy encoding	Run-length coding Huffman coding Arithmetic coding	
source coding	prediction	DPCM DM
	Transformation	FFT DCT
	layered coding	Bit position subsampling subband coding
	vector Quantization	
Hybrid coding	JPEG	
	MPEG	
	H.261	

Note: Please read "Multimedia : Computing, Communication and Application" by Ralf Steinmetz and Klara Nahrstedt.

Question bank Solution:

Chapter 8: Multimedia Application:

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(1) Application of multimedia in video conference system:

→ Video conference systems allow the user to achieve most of the efficiency and productivity of traditional meetings with one main difference: the user can stay at his/her desk as can the remote conference participants.

→ A video conferencing system enables people to work together across geographically distant locations without the need to meet at one site.

→ They communicate among each other in multi-party or face-to-face mode using motion video, audio and textual information in each direction.

Examples:

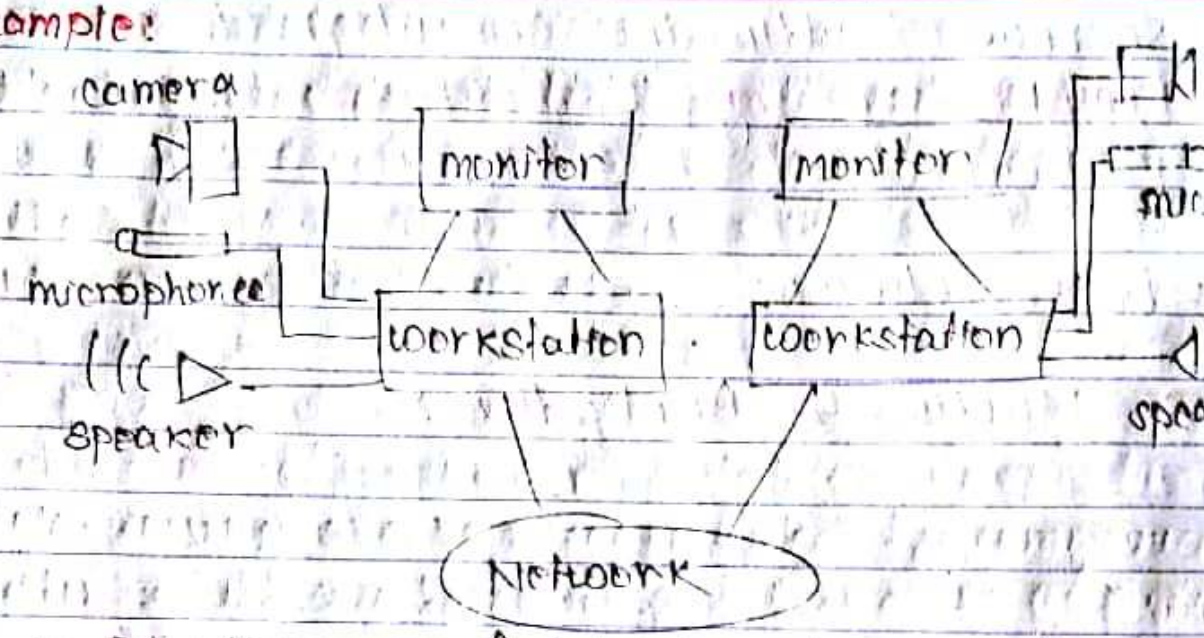

Fig: Video conferencing system

Above diagramatic representation of video conferencing system is an office environment, where the video is displayed on a PC so users can easily communicate with other groups located at different geographical places at any time. Desktop video conferencing systems often include a dedicated shared white-board application (i.e. drawing and writing software support for multiple users). Application sharing denotes techniques which replicate the user interface of the particular software (eg. user's favorite text processor) so that the software can be used simultaneously by all participants of a conference.

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(2) Application of multimedia in media entertainment:

→ Virtual Reality entertainment (VR), Location Based Entertainment (LBE), motion-based simulators are some applications that use multimedia for entertainment and bring a different and more involved entertainment experience.

Based on virtual Reality:

→ Computer-based VR systems are 3-D, interactive (as opposed to passive) and use one or more devices in an attempt to provide the user with a sense of presence be it visual, auditory & haptic display.

→ The modern computer game is an audiovisual engine capable based on interactivity between the user and the computer. With respect to the environment, games can be played in an interactive environment with advanced technology components such as VR groupware.

Based on Interactive Audio

→ The audio server will store music libraries and the listeners will be able to retrieve their requested song from such a library. Example: Google play Music, Soundcloud

Based on Entertainment and fine arts

→ Multimedia especially develop special effects in movies & animations as demand of user's needs.

Based on Interactive Video:
→ Cable companies distributed a customized program to each viewer & users individual and instantaneous control of the storage medium in terms of start, fast-forward, pause and record actions.

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③ Application of multimedia in tele-services
→ Tele-services are services provided by communication system which are based on and make use of audio and video data.

Based on conversational service:
→ A conversational service supports conversation between remotely located end users. In this service bi-directional delivery is done in synchronous mode.
Example: Video conferencing

Based on Messaging service:
→ A messaging service provides an exchange of messages between a sender and receiver where the end users are human users & exchange of messages in both directions is done asynchronously.
Example: Mailing system

Based on Retrieval ~~syst~~ service:
→ A retrieval service provides an exchange of message

between a sender and receiver, where sender called the client (human user) and receiver called server (computer with database). The client requests information from the server, where the information is stored; the server retrieves the information and sends it back.

Example: Google cloud

Based on Tele-action service

→ Tele-action means to act a distance. Such actions include reading or writing some information to a remote location or possibly both.

Example: Banking system

Based on Distribution Service

→ Distribution services are services for the distribution of information to different remote sites. They are one-copy communication from broadcasting source to the remote destinations.

Example: TV broadcasting.

2071 Bhadra

④ Applications of multimedia in education:

→ Books and newspaper:

Based on text:

→ Books and Newspapers (bounch of text) can be interactive multimedia documents which may be electronically distributed to the home/user's declearied address which saves time and money for both parties.

Based on Graphics:
→ Graphics are two-dimensional figure or illustration. Using graphics in education will increase the student understanding level & enhance their memory skills because pictures are easy to remember.

Based on Audio:
→ Audio comfort students by conducting live online discussion via audio tools and platform.
→ Learning by audio also can help disable people such as blind people.

Based on Video:
→ Video can provide visual simulation for students so that they can have a better understanding in learning.
→ Video in surgical training is helpful to student for better understanding which they did not able by reading.

Based on Animation:
→ Animation improve student's creativity while bringing fun in learning.
Example: Student may not understanding flow of blood over the heart by just lecture of teacher. But students have clear concept they learn with animated clips.

Chapter 7 Abstractions for programming

7.1. Abstractions Levels

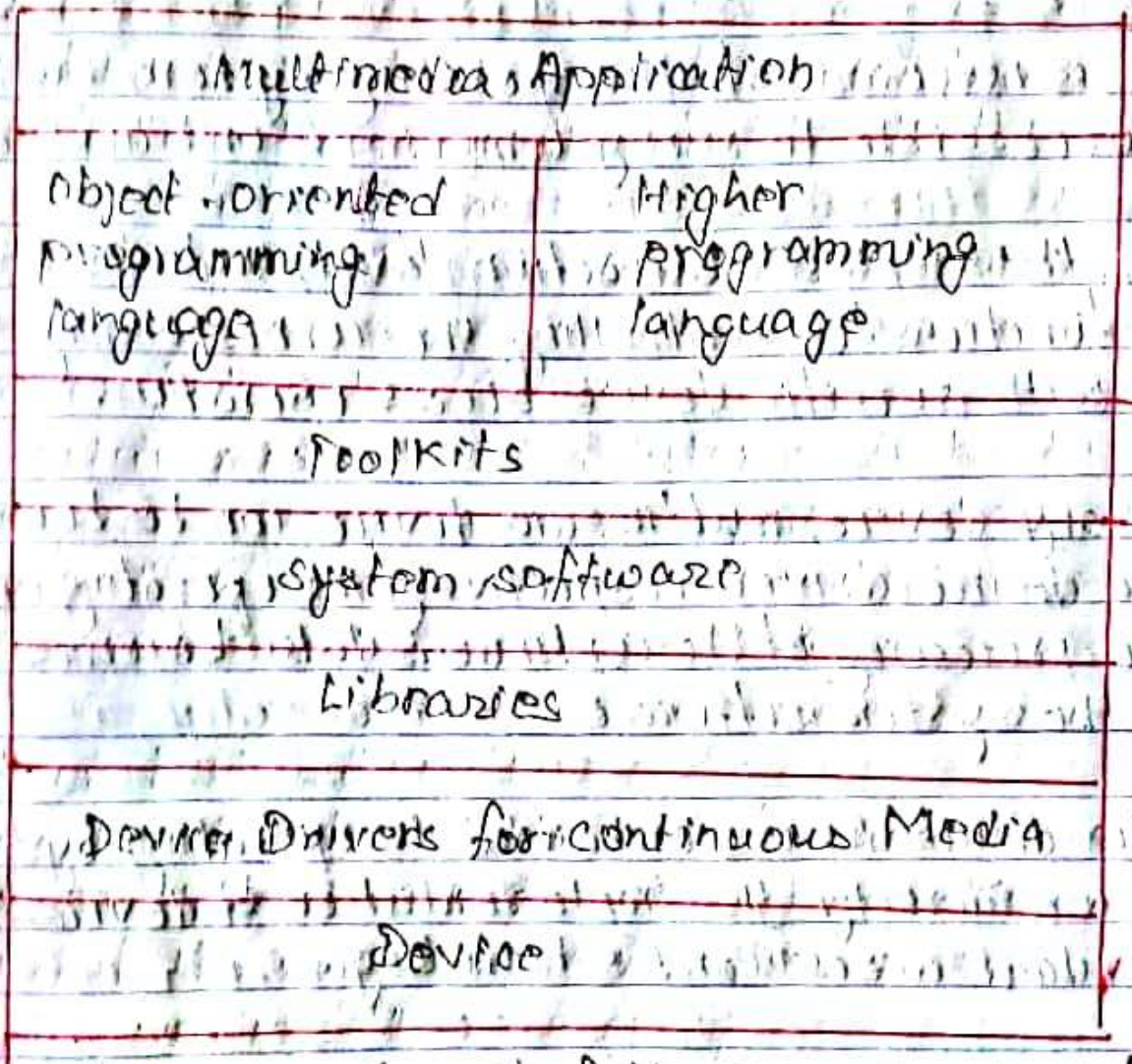

Fig: Abstraction levels of the programming of multimedia systems

→ Abstraction levels in programming define different approaches with a varying degree of detail for representing, accessing and manipulating data.

A multimedia application may access each level

→ A device for processing

→ A device is not part of the operating system but is directly accessible to every component and application

→ A library, the simplest abstraction level, includes the necessary functions for controlling the corresponding hardware with specific device access operation.

→ As with any device, multimedia device can be bound through a device driver respectively the operating system. Here, the processing of the continuous data becomes part of the system software.

→ Multimedia device drivers embedded in operating systems simplify considerably the implementation of device-specific embedded access and scheduling.

→ Higher procedural programming languages most often used to implement commercial multimedia application. The code generated from the compiler can be processed through libraries as well as through a system interface for continous data.

→ Object oriented environment provides the application with a class hierarchy for the manipulation of multimedia. The generated or interpreted code can be processed f-

controlled through libraries and system interface for continuous media.

7.2 Libraries

→ The processing of continuous media is based on set of functions which are embedded into libraries & libraries are provided together with the corresponding hardware.

→ The device driver or library controls all available functions, also supports each device.

→ Some libraries considered as extensions of the graphical user interface whereas other libraries consist of control instruction passed as control blocks to corresponding driver.

Example:
```
abc.channel = APPI_CHNA
abc.mode = APPI_PLAY
aud_init (&abc)
/* abc is the
acb.channel = APPI_CHNA
acb.mode = APPI_PLAY
.....
aud_init (&acb)
/* acd is the audio control block */
```

7.4 Toolkits:

-> A simpler approach in a programming environment than the system software interface for control of the audio and video data processing can be taken by using toolkits.

-> These toolkits are used to
:- Abstract from the actual physical layer.
:- Allow a uniform interface for communication with all different devices of continuous media.
:- Introduce the client-server paradigm.

-> Toolkits can be embedded into programming languages or object-oriented environments.

7.5 Higher Programming Languages:

-> It can rely on library functions when continuous media programming is integrated.

-> As an alternative, it is possible to access abstractions such as constraints and event handlers in the operating system.

-> Integrated programming of applications with continuous media inside higher programming languages leads to simpler and clearer programming.

→ libraries are very useful at the operating system level, but there is no agreement over which functions are best for different drivers.

7.8 System software:

→ Instead of implementing access to multimedia devices through individual libraries, the device access can become part of the operating system.

→ ~~Data~~ Logical Data as Time Capsules:

→ Each Logical Data Unit (LDU) carries in its time capsule, in addition to its data type and actual value, its valid life span.

→ The presentation life span of data unit (e.g. a video frame) can change for VCR (Video Cassette Recorder) functions like fast forward, slow forward or fast rewind by
:- changing the presentation life span of LDU
:- skipping of LDU or repetition of LDUs.

Data as streams:

→ a stream denotes the continuous flow of audio and video data between a source and a sink.

→ prior to the flow the stream is established equivalent to the setup of a connection in a networked environment.

7.6 Object-Oriented approaches:

→ Object oriented approaches main function is to treat its values in certain hierarchy.

→ Important properties of object-oriented systems are:

:- Inheritance

:- Polymorphism

Designing :

→ Design is a creative activity which includes:
- :- best knowledge in related field with basic computer skills.
- :- be talent in graphics arts, video and music

→ The main emphasis in the design of multimedia user interface is multimedia presentation so contents selection is the ~~key~~ key to convey the information to the user.

Developing and Producing

→ production is the phase when multimedia project is actually rendered. After ~~that~~ production, project plan (storyboard) has be filled with all details.

→ The task to be performed in this phase are:
- :- Acquiring all media elements
- :- composing the elements according to the storyboard

Testing and debugging :

→ like all other software, testing and debugging is an important and time-consuming phase.

→ Alpha testing is an internal activity which is done by in-house team members.

→ Beta testing involves a wider range of testers which

(2) The different stages in multimedia application development are:
(i) Planning and costing
(ii) Designing
(iii) Developing and producing
(iv) Testing and debugging
(v) Delivering

Planning and costing:
→ The main concerns in this phase are:
:→ to capture the ideas and requirements of you or your clients.
:→ to identify the potential audience and users of the application.
:→ to find out the benefit that will gain from developing the application.
:→ to evaluate the feasibility and costs of the entire project, including all tasks of production, testing and delivery.

→ "paper napkin" approach is used at this stage.
→ The most important consideration in this phase are
:- hardware
:- software
:- contents
:- skills

is done by representative of real users (those who didn't involved in production of the project)

Delivering
→ In this phase, we have to plan how to deliver the product very early to customer.
→ Nowadays storage devices (pendrive) & internet are two most popular means of delivering multimedia applications.
→ For better experience to user, production team members need to plan/instruct how to install & use that application.

(2)→ The objective of image compression is to reduce irrelevant and redundant image data in order to be able to store, or transmit data in an efficient form.

→ Types of image compression
(i) Lossless
(ii) Lossy

Lossless image compression is a compression algorithm that allows the original image to be perfectly reconstructed from the original data.

Lossy image compression is a compression algorithm where a certain amount of information is discarded which means

that some data are lost and hence the image cannot be decompressed with 100% originality.

JPEG

→ JPEG is a commonly used method of lossy compression for digital images.

→ JPEG Compression steps:

Step 1 Transformation:

→ Color images are transformed from RGB into a luminance / chrominance image.

Step 2 Down Sampling:

→ The down sampling is done for colored component & not for luminance component.

→ Down sampling is done either at a ratio 2:1 horizontally and 2:1 vertically.

Step 3 Organizing in Groups:

→ The pixels of each color component are organized in groups of 8×8 pixels called "data units" if number of rows or column is not multiple of 8, the bottom row and rightmost columns are duplicate.

Step 4 Discrete Cosine Transform:

→ DCT applied to each data unit to create 8×8 map of transformed components.

→ DCT involves some loss of information due to the limited precision of computer arithmetic.

Step 5 Quantization:

→ Each of the 64 transformed components in the data unit is divided by a separate number called its Quantization Coefficient (QC) and then rounded to an integer.

→ This is where information is lost irretrievably. Large QC cause more loss.

Standard formula: $\hat{F}(u,v) = \text{round}\left(\frac{F(u,v)}{Q(u,v)}\right)$

Step 6 Encoding:

→ The 64 quantized transformed coefficients of each data unit are encoded using a combination of Run length Encoding and Huffman coding.

Step 7 Adding Header:

→ The last step adds header and all the JPEG parameters used and output the result.

MPEG Compression Steps:

→MPEG-4 is an inclusive superset of mpeg-1 and mpeg-2 standards. This means the core compression algorithm remains the same except the fact that it has got so many additional features like re-scalability and user interactivity.

→The 5 basic steps can be described in detail below:

step1 Reduction of resolution:

→Color images are transformed from RGB to YUV in ratio of YUV (4:2:0) OR YUV (4:2:2) of RGB (~~xx~~ 4:4:4)

step 2 Motion Compression

→ Algorithm calculate motion vector which describes the transformation between objects.

→MPEG-1 and MPEG2 use block based or frame based compensation where as MPEG-4 uses video object plane (VOP) coding.

step3 Discrete Cosine Transform

→ DCT converts still VOP object blocks into their equivalent frequency domain.

→Each 8×8 or 16×16 VOP block is represented in its frequency domain with the given formula:

$$F(u,v) = \frac{1}{4} C(u) C(v) \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} f(x,y) \cdot \cos\frac{(2x+1)u\pi}{2N} \cdot \cos\frac{(2y+1)v\pi}{2N}$$

$C(u), C(v) = 1/\sqrt{2}$ for $u, v = 0$

$C(u), C(v) = 1$ else

N = block size

Step 4 Quantization :

-> DCT terms are divided by a quantization matrix (Q)

$$F_Q = F(u,v) \text{ DIV } Q(u,v)$$

$$= \frac{F(u,v)}{Q(u,v)}$$

Step 5 Entropy Encoding :

-> For entropy encoding variety of techniques used for MPEG-4 which are :

:- context adaptive binary arithmetic coding

:- Context adaptive variable length coding.

-> The entropy coding converts a vector X made up of integers into binary set Y.

(4)

Color Model	Application area
RGB	computer graphics Image processing Image Analysis Image Storage
CMY(K)	printing
HSV, HSL	Human visual perception Computer graphics processing Computer vision Image Design Video editor
YIQ	TV broadcasting Video system

~~RGB~~

(5) Lossy data compression is sometimes preferred over lossless due to significantly reduced file size

(6) Design guidelines for the multimedia user interface design:

(i) User familarity:
→ The interface should use terms and concepts which are drawn from the experience of the people who will make most use of the system.

(ii) Consistency:
→ The interface should be consistent in that wherever possible, comparable operations should be activated in the same.

(iii) Minimal surprise:
→ If a command operates in a known way, the user should be able to predict the operation of comparable commands.

(iv) Recoverability:
→ The interface should include mechanisms to allow users to recover from errors.

(v) User guidance:
→ The interface should provide meaningful feedback when errors occurs and provide context-sensitive user help facilities.

(viii) User diversity :
→ The interface should provide appropriate interaction facilities for different types of system user.

Paper I

Component of Multimedia System

-> Hardware and software required for a multimedia system

(i) Capture devices
-> video camera, video recorder, audio microphone, keyboard, mice, graphics tablets

(ii) Storage devices
-> Hard disks, CD-ROMs, DUD-ROM

(iii) Communication Network
-> Local Networks, Intranets, Internet, ~~Multimedia~~

(iv) Computer System
-> MPEG / VIDEO / DSP Hardware

(v) Display Device
-> CD. quality speakers, SVGA, colour printers

Multimedia Computing

-> Multimedia systems involve some basic enabling techniques:
(i) Multimedia data representation and compression.
(ii) Multimedia data processing and analysis.
(iii) Transmitting multimedia data through communication network.
(iv) Multimedia database, indexing and retrieval

(iv) Home
→ Teleshopping
→ satellite TV
→ SMS services (chats, voting, reality TV)

(v) Public Place
→ Smart Cards, Security

Current Multimedia Project
→ Many exciting research projects are currently underway. Here are few of them:

(i) Camera based object tracking technology
→ tracking of the control objects provides use control of the process.

(ii) 3D motion capture
→ used for multiple actor capture so that multiple a real actors in a virtual studio can be used to automatically produce realistic animated models with natural movement.

(iii) 3D capture technology
→ allow synthesis of highly realistic facial animation from speech

(iv) Specific multimedia applications
→ aimed at handicapped persons with low vision capability

Challenges of Multimedia Computing

→ Continuous media types such as video need a lot of space to store and very large bandwidth to transmit.
→ They also have tight timing constraints.
→ Automatically analyzing, indexing and organizing information in audio, image and video is much harder than from text.
→ Multimedia involves many different research areas and needs more complex and more efficient algorithms & hardware platforms.

Importance of Multimedia

(i) Business

→ Sales / Marketing Presentation
→ Trade show production
→ Staff Training Application

(ii) Education

→ Simulations
→ E-learning / Distance Learning
→ Information Searching

(iii) Entertainment

→ Games
→ Movies
→ Video on Demand (online)

(v) Electronic Housecall System

→ an initative for providing interactive health monitoring services to patronts in their homes.

Medium

→ Medium means for distribution and presentation of information.

→ Example of medium are text, graphics, speech, music.

→ Medium classify according to

(i) Perception
(ii) Representation
(iii) Presentation
(iv) Storage
(v) Transmission
(v) Information exchange

Perception Medium

→ It helps humans to sense their environment by seeing or hearing.

→ Main question of this Medium is "How do humans perceive information in a computer environment?"

→ For the perception of information through seeing, the visual media such as text, image and video are used.

→ For the perception of information through hearing, auditory media such as media, noise and speech are relevant.

Representation Medium

-> Representation media are characterized by internal computer representations of information.
-> Main question of this medium is "How is the computer information coded?"
-> Various format are used to represent media information in a computer.
-> For example:
:- Text character is coded in ASCII code.
:- Graphics are coding according to CAPTAIN videotext standard.
:- Audio stream can be represented using simple PCM (Pulse Coding Method) with a linear quantization of 16 bits per sample.

Presentation Medium

-> It refer to tools and devices for the input and output of information.
-> Main question of this medium is "Through which medium is information delivered by the computer, or introduced into the computer?"
-> The media example are screen, paper & speaker used to deliver the information by the computer; keyboard, mouse, camera and microphone are the input media.

Storage Medium

→ It refer to a data carrier which enables storage of information.
→ Main question for this medium is "Where will the information be stored?"
→ Floody disk, hard disk and CD-ROM are examples of storage media.

Transmission Medium

→ It characterizes different information carriers, that enable continous data transmission.
→ Main question for this medium is "Over what will the information be transmitted?"
→ Example of this medium are wire and cable transmission such as coaxial cable and fiber optics.

Information Exchange Medium

→ It includes all information carriers for transmission i.e. all storage and transmission media.
→ Main question of this medium is "Which information carrier will be used for information exchange between different places?"
→ Example of this medium is direct network transmission and using mailing system.

Chapter 2

Audio File Formats

The most commonly used digital sound format in Windows system is .wav files.

→ Sound is stored in .wav as digital samples known as Pulse Code Modulation (PCM)

→ Each .wav file has a header containg information of the file.
- type of format (e.g. PCM)
- size of the data
- number of channel
- samples per second
- bytes per sample

→ There is usually no compression in .wav files.

Streaming audio

→ Streaming audio is the practice of delivering real-time audio through a network connection.

→ Instead of having full download, we are able to listen as it arrives at our computer.

→ As the audio is playing, more data is constantly arriving.

Audio File Formats

→ An audio file's format determines what files a PC can open and play, & how much space the file occupies on a disk.
→ File formats include:
  (i) MP3
  (ii) WAV
  (iii) MIDI

MP3 Format

→ MP3 is a ~~form~~ standard format for music files sent over the Internet.
→ Use one of three MPEG standards for audio compression.
→ Can compress an audio file to about one-twelfth of the space it occupies on a CD with no significant loss of sound quality.

WAV Format

→ WAV is a standard for sound files on Windows & Macintosh PCs.
→ Do not compress audio as much as MP3s.
→ Are generally used for sound effects & other small files.

[MIDI] Format

-> [MIDI] is a method and format for recording music from synthesizers and other electronic instruments.

-> [MIDI]s :

:- Are created with a computer that has a sequencer
:- Do not contain actual musical notes.
:- Do not contain sound waves or use sampling.
:- Are small & load quickly on a web site.