MULTIMEDIA SYSTEM-7MCE3E3

UNIT-I

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1.1 MULTIMEDIA DEFINITION

Introduction

- *Multimedia* means that computer information can be represented through audio, video, and animation in addition to traditional media (i.e., text, graphics, drawings, images).
- ***Multimedia*** is the field concerned with the computer-controlled integration of text, graphics, drawings, still and moving images (Video), animation, audio, and any other media where every type of information can be represented, stored, transmitted and processed digitally.
- The Computer, communication and broadcasting fields widely used Multimedia

What is Multimedia:

- A ***Multimedia*** is an Application which uses a collection of multiple media sources e.g. text, graphics, images, sound/audio, animation and video.

1.2 MULTIMEDIA HARDWARE

- Most of the computers now-a-days equipped with the hardware components required to develop/view multimedia applications.
- Multimedia related hardware includes video and audio equipment required at multimedia production and presentation. These equipment's can be divided into
    a) Image and video capturing equipment
    b) Image and video storage equipment
    c) Image and Video output equipment
    d) Audio equipment

a) **Image and video capturing equipment's:** Still camera, video camera, scanners and video recorders

- **Still Camera/Digital Camera** - Digital camera is an input device to input images that is then stored in digital form.

- **Digital Video Camera** - Digital Video camera is an input device to input images/video that is then stored in digital form. The normal consumer cameras use single image sensor chip ,whose output has to be multiplexed to produce three colors red, green, blue. The three sensor camera has a separate chip for each color . The three sensor camera is used there are various stages of generation of the video and audio signals (in fig)

  The RGB output produces more than 400 lines per frame. The RGB system produce three output signals: S-video, Composite video and RF output.

  - **S-video**-high quality,used at Y/C stage,it combines luminance and chrominance of color, resolution 400 lines per frame.
  - **composite video**–a single signal contains the complete picture information,while the audio is represented by a separate signal.resolution 200 lines per frame.
  - **RF output-** lowest quality ,not used for multimedia, combines both audio and video signals.

- **Scanner** - Scanner is an input device, which works more like a photocopy machine. It is used when some information is available on a paper and it is to be transferred to the hard disc of the computer for further manipulation. Scanner captures images from the source which are then converted into the digital form that can be stored on the disc. These images can be edited before they are printed.
- **Video Tape/Cassette Recorders** (VTR ,VCR) is a tape recorder designed to record and play back video and audio material on magnetic tape. They were used in television studios, serving as a replacement for motion picture film stock and making recording for television applications cheaper and quicker. the machines which play them are called video cassette recorders. Formet of video BETA,VHS, VIDEO, PAL, SECAM, NTSC.

b)Image, audio and video storage equipment: Storage Devices, laser discs, video tapes, optical discs

- **Memory and Storage Devices** - we need memory for storing various files, audio and video clips, edited images.
  - **Primary Memory-** Primary memory holds only those data and instructions on which computer is currently working. It has limited capacity and data gets lost when power is switched off. The data and instructions required to be processed earlier reside in main memory. It is divided into two subcategories RAM and ROM
- **Flash Memory-** Cache memory is a very high speed semiconductor memory, which can speed up CPU. It acts as a buffer between the CPU and main memory. It is used to hold those parts of data and program which are most frequently used by CPU.
- **Secondary Memory:** This type of memory is also known as external memory or non-volatile. It is slower than main memory. These are used for storing Data/Information permanently. CPU directly does not access these memories; instead they are accessed via input-output routines. Contents of secondary memories are first transferred to main

memory and then CPU can access it. For example, laser discs, video tapes, optical discs(CD-ROM, DVD), etc.

- **Laser Discs,**LaserDisc (LD) is a home video format and the first commercial optical disc storage medium,

- **Optical Discs** An optical disc is an electronic data storage medium that can be written to and read from using a low-powered laser beam. Originally developed in the late 1960s, the first optical disc, created by James T. Russell, stored data as micron-wide dots of light and dark.

  CD-ROM Standards:CD-I(CD Interactive), CD DA(CD Digital Audio),CD-ROM XA(CD-ROM Extended Architecture),CD-MO(magneto Optic),CD-WO(CD Write Once),CD-R(CD-Recordable),CD-Bridge, photo CD, video CD.

c) Image and Video Output Equipment: Interactive display devices, projectors, printers

- **TV,Monitors** - Monitor commonly called as Visual Display Unit (VDU) is the main output device. There are two kinds of viewing screen used for monitors:

  - **Cathode-Ray Tube (CRT) Monitor**- In the CRT, display is made up of small picture elements called pixels for short.The screen can be divided into a series of character boxes

  - **Flat-Panel Display Monitor**- The flat-panel display refers to a class of video devices that have reduced volume, weight and power requirement compared to the CRT. You can hang them on walls or wear them on your wrists. Current uses for flat-panel displays include calculators, video games, monitors, laptop computer, graphics display. The flat-panel displays are divided into two categories:

    - ✓ **Emissive Displays**- The emissive displays are devices that convert electrical energy into light. Examples are plasma panel and LED (Light-Emitting Diodes).

    - ✓ **Non-Emissive Displays**- The Non-emissive displays use optical effects to convert sunlight or light from some other source into graphics patterns. Example is LCD (Liquid-Crystal Device)

- **Screen Image Projector** - Screen image projector or simply projector is an output device used to project information from a computer on a large screen so that a group of people can see it simultaneously. A presenter first makes a PowerPoint presentation on the computer. Now a screen image projector is plugged to a computer system and presenter can make a presentation to a group of people by projecting the information on a large screen. Projector makes the presentation more understandable

- **Printers** - Printer is the most important output device, which is used to print information on paper.

  - **Dot Matrix Printer**- In the market, one of the most popular printers is Dot Matrix Printer because of their ease of printing features and economical price. Each character printed is in form of pattern of Dot's and head consists of a Matrix

of Pins of size (5*7, 7*9, 9*7 or 9*9) which comes out to form a character that is why it is called Dot Matrix Printer.

- **Daisy Wheel**- Head is lying on a wheel and Pins corresponding to characters are like petals of Daisy (flower name) that is why it is called Daisy Wheel Printer. These printers are generally used for word-processing in offices which require a few letters to be send here and there with very nice quality representation.
- **Line Printers**- Line printers are printers, which print one line at a time.
- **Laser Printers**- These are non-impact page printers. They use laser lights to produce the dots needed to form the characters to be printed on a page.
- **Inkjet Printers**- Inkjet printers are non-impact character printers based on a relatively new technology. They print characters by spraying small drops of ink onto paper. Inkjet printers produce high quality output with presentable features. They make less noise because no hammering is done and these have many styles of printing modes available. Colour printing is also possible. Some models of Inkjet printers can produce multiple copies of printing also.

d)Audio equipment : Microphone, Audio Tape Recorder, Head Phone, Speakers

- **Microphone**- Microphone is an input device to input sound that is then stored in digital form. The microphone is used for various applications like adding sound to a multimedia presentation or for mixing music
- **Headphones** (or head-phones in the early days of telephony and radio) traditionally refer to a pair of small loudspeaker drivers worn on or around the head over a user's ears. They are electroacoustic transducers, which convert an electrical signal to a corresponding sound.
- **Speaker and Sound Card** - Speaker is an output device to produce sound which is stored in digital form. The speaker is used for various applications like adding sound to a multimedia presentation or for movies displays etc. Computers need both a sound card and speakers to hear audio, such as music, speech and sound effects. Most motherboards provide an on-board sound card. This built-in-sound card is fine for the most purposes. The basic functions of a sound card are that it converts digital sound signals to analog for speakers making it louder or softer.

1.3 MULTIMEDIA SOFTWARE

Multimedia software tells the hardware to display the color blue, play the sound of cymbals crashing etc. To produce these media elements(movies, sound, text, animation, graphics etc.) there are various software available in the market such as Paint Brush, Photo Finish, Animator, Photo Shop, 3D Studio, Corel Draw, Sound Blaster, IMAGINET, Apple Hyper Card, Photo Magic, Picture Publisher.

a) Multimedia Software Categories

- **Device Driver Software**- These software's are used to install and configure the multimedia peripherals.
  - **Media Players**- Media players are applications that can play one or more kind of multimedia file format.

- **Media Conversion Tools**- These tools are used for encoding / decoding multimedia contexts and for converting one file format to another.
- **Multimedia Editing Tools**- These tools are used for creating and editing digital multimedia data.
- **Multimedia Authoring Tools**- These tools are used for combing different kinds of media formats and deliver them as multimedia contents.

- **Graphic and Image Editing Software**
  Some of us may already be familiar with a certain image editing software if we have edited our own digital photo albums before. With graphics software programs we now can manipulate our digital images through resizing, cropping, enhancing, or transforming them. Examples of the more popular commercial ones are Adobe Photoshop, Paint Shop Pro, Visualizer, Photo Studio, and Corel Photo-Paint. Adobe Photoshop is claimed by Adobe Systems as the industry standard for graphics professionals.

The following list indicates what image editing tools such as Photoshop can do:

(a) Merge images;

(b) Alter image size;

(c) Crop image;

(d) Adjust colors;

(e) Remove unwanted elements;

(f) Orientate image (change direction);

(g) Sharpen and soften image;

(h) Contrast change and brighten image; dan

(i) Add text onto image.

b)Audio and Sound Editing Software

In the 90s the only popular audio wave file editor was the Sound Designer. Today, the most popular audio editing programs are Sony Sound Forge, Audacity and Adobe Audition. Sony Sound Forge (known formerly as Sonic Foundry Sound Forge) is a digital audio editing software for the professional as well as amateur or nonTOPIC professional user. Sound Forge lets us create a stunning audio clip with various sound effects such as fading, echo, etc. from raw audio files.

c)Video Editing Software

- Digital video brings the power to our multimedia presentation or project. With video editing software, we can create our own original and unique movies for our personal or business purposes. Examples of video editor software that we may choose from are Avid's Media Composer and Xpress Pro, Apple's Final Cut Pro and Adobe's Premiere.
- Creating a video is always a complex, expensive and time-consuming task.However with user friendly video editing software, we can become a semi-pro film producer. We can fully utilize the software re-arranging or modifying segments of our raw video to form another piece of video.

- To use a video editing tool such as Adobe Premier we first arrange our video clips (or „footages‰) on a timeline. Then we can apply the built-in special effects for our movie production. However we have to be careful because video editing involves dual tracks of audio and video. Therefore we need to make sure that the audio and video are synchronised.For the final package we can opt to distribute it using a CD-ROM or DVD. If we wish to distribute it online we can use streaming technology or the program QuickTime.

d)Animation Authoring software

As more and more Flash movies are created, delivered, and viewed by over millions of Internet users. We can use Flash to create simple animation, advertisements, or even online banners for our personal homepage or web log (blog). We can even embed or integrate flash video into our web pages.

Various Flash file formats include standalone Flash Player (in .SWF or .EXE format) or flash video (.FLV). Adobe Flash has the capability to create online content such as web applications, games and movies.

Recent development shows that TV animation production studios such as Warner Bros. and Cartoon Network have started to produce industry-standardanimation using Flash as well.

1.4 MULTIMEDIA NETWORKING

Multiple computers connected by communication channels for Information sharing and Resource sharing.

- ✓ **Multimedia networking applications**
- ✓ **Streaming stored audio and video**
- ✓ **Making the best out of best effort service**
- ✓ **Protocols for real-time interactive applications RTP,RTCP,SIP**
- ✓ **Providing multiple classes of service**
- ✓ **Providing QoS guarantees**

Multimedia networking applications

The multimedia networking applications are referred as continuous-media applications. The Challenges faced on the multimedia networking for real-time Delay, Quality of service. The new multimedia networking applications is how to get the high quality for the Communication over the Internet.

Classes of Multimedia Applications:

Streaming stored audio and video.

Stored media, the contents has been prerecorded and is stored at the server. So, a user may pause, rewind, or fast-forward the multimedia contents.

Streaming, a user starts playout a few seconds after it begins receiving the file from the server. So, a user plays out the audio/video from one location in the file

while it is receiving later parts of the file from the server. This technique is called streaming

Continuous playout, once playout begins, it should proceed based on the original timing of the recording.

Ex: VCR-like functionality:

Streaming live audio and video-Applications are similar to traditional radio and television. Ex: Internet radio talk show , live sporting event Streaming

Real time interactive audio and video.-Applications allow users using audio/video to communicate with each other in real time. Real-time interactive audio on the Internet is known as Internet phone.. Ex: IP telephony, video conference,

Problems-1. jitter - The variations of packet delays within the same packet stream is called packet jitter. 2. loss tolerant: The end-to-end delay

Streaming stored audio and video

Problem removal for overcoming the hurdles mentioned above. In this approach, small changes at the network and transport layers are required and scheduling/policing schemes are introduced at edges of the network. The idea is to introduce traffic classes, assign each datagram to one of the classes, and give data grams different levels of services based on their class.

Overview

In these applications, clients request audio/video data stored at servers. Upon client's request, servers send the data into a socket connection for transmission. Both TCP and UDP socket connections have been used in practice. Clients often request data through a Web browser. A separate helper application (called media Player, Real Player) is required for playing out the audio/video.

Access audio/video through Web server

- The stored audio/video files can be delivered by a Web server. To get the file, a client establishes a TCP connection with the server and sends an HTTP request for the object. On receiving the request, the Web server encapsulates the audio file in an HTTP response message and sends the message back to the TCP connection.
- It is more complicated for the video case because usually the sounds (audio) and images are stored in two different files. In this case, a client sends two HTTP requests over two separate TCP connections and the server sends two responses, one for sounds and the other for images, to the client in parallel. It is up to the client to synchronize the two streams. With a streaming server, audio/video _les can be transmitted over UDP which has much smaller end-to-end delay than TCP.

Real-Time Streaming Protocol (RTSP)

- RTSP is a protocol which allows a media player to control the transmission of a media stream. The control actions include pause/resume, repositioning of playback, fast-forward, and rewind. RTSP messages use a different port number from that used in the media stream and can be transmitted on UDP or TCP.

Making the best of the best-effort service

Removing jitter at the receiver for audio

Recovering from packet loss

Protocols for real-time interactive applications (RTP, RTCP,SIP)

RTP(Real Time Protocol)-RTP specifies packet structure for packets carrying audio, video data. The media data is encapsulated in RTP packets which are encapsulated in UDP segments.

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RTP Header

RTP packet header fields include

- ✓ payload type, 7 bits, used to indicate the type of encoding for audio and video;
- ✓ sequence number, 16 bits, incremented by one for each RTP packet sent;
- ✓ timestamp, 32 bits, used to give the sampling instant of the first byte in the RTP packet data;
- ✓ synchronization source identifier (SSRC), 32 bits, used to identify the source of the RTP stream;
- ✓ miscellaneous fields

RTP control protocol (RTCP)

- RTCP is a protocol that a networked multimedia application can use in conjunction with RTP.
- RTCP packets do not carry audio/video data but contain sender/receiver reports which include the statistics on the number of RTP packets sent, number of packets lost, and interarrival jitters.
- RTCP packets are sent periodically. There are two types of RTCP packets.

The RTCP packets used by receiver include

- ✓ the SSRC of the RTP stream for which the reception report is generated;
- ✓ the fraction of the packets lost within the RTP stream;
- ✓ the last sequence number received in the stream of RTP packets; and
- ✓ the interarrival jitter.

The RTCP packets used by sender include

- ✓ the SSRC of the RTP stream;
- ✓ the timestamp and real time of the most recently generated RTP packet in the stream;
- ✓ the number of packets sent in the stream; and
- ✓ the number of bytes sent in the stream.

Session initiation protocol (SIP)

SIP provides mechanisms for the following.

- ✓ It establishes calls between a caller and a callee over an IP network. It allows the caller to notify the callee that it wants to start a call. It allows the participants to agree on media encodings and to end a call.
- ✓ It allows the caller to determine the current IP address of the callee. Users may have multiple or dynamic IP addresses.
- ✓ For call management like adding new media streams, changing the encoding, inviting new participants, call transfer, and call holding.

H.323

- H.323 is popular standard for real-time audio and video conferencing among end systems in theInternet.

The standard includes the following:

- A specification for how endpoints negotiates common audio/video encodings.
- H.323 mandates RTP for audio and video data encapsulation and transmission over the network.
- A specification for how endpoints communicates with their respective gatekeepers (a device similar to and SIP registrar).
- A specification for how Internet phones communicate through a gateway with ordinary phones in the public circuit-switched telephone networks.

Providing multiple classes of service

- The central idea for those technologies is to add new architectural components to the Internet to change its best effort nature. Those technologies have been under active discussion in the Internet Engineering Task Force (IETF) working groups for Diffserv, Intserv, and RSVP.

Integrated service and differentiated service

- The principles and mechanisms discussed above are used in two architectures, integrated service (Intserv) and differentiated service (Diffserv), proposed to providing QoS in the Internet. Intserv is a framework developed within the IETF to provide individualized QoS guarantees to individual application sessions. Diffserv provides the ability to handle different classes of traffics in different ways within the Internet.

Providing QoS guarantees

Scheduling and policing mechanisms are used to provide QoS guarantees. Resource reservation protocol (RSVP)- is used by application sessions to reserve resources in the Internet.

1.5 MULTIMEDIA APPLICATION

Multimedia applications can be subdivided into different categories, each making particular demands for support on the operating system or runtime environment. suggests three application categories:

- *Information Systems.* The main purpose of such systems is to provide information for one or several users. The requested information is typically stored in databases or media archives. Examples are electronic publishing, online galleries or weather information systems.
- *Remote Representation.* By means of a remote representation system a user can take part in or monitor events at a remote location. Important examples are distance conferencing or lecturing, virtual reality, or remote robotic agents.
- *Entertainment.* This major application area of multimedia technology is strongly oriented towards audio and video data.
  Example entertainment applications are digital television, video on demand, distributed games or interactive television.

User interaction possibilities are a more technical classification are in to two

Interactive Services. Interactive services permit the user to select the transmitted information. These services can be be further subdivided into:

- *Conversational Services.* Services with real-time demands and no relevant buffering, like video conferencing or video surveillance.
- *Messaging Services.* Services with temporary storing, like multimedia mail.
- *Retrieval Services.* Information services interactively presenting previously stored information from a database or media collection, for example tele shopping or hospital information systems.

- *Distribution Services.* Distribution services transmit information from a central source to a potentially unknown set of receivers. There are two subcategories that differ in the control possibilities granted the users:

- *Services without User Control*. Services characterised by having one central sender that broadcasts information to all participating users, for example digital television broadcasting.
- *Services with User Control*. Services allowing the user to choose from the distributed information.

1.6.MULTIMEDIA ENVIRONMENT

Multimedia Development Environment

- Computer-delivered electronic system that allows the user to control, combine, and manipulate different types of media, such as text, sound, video, computer graphics, and animation.Multimedia can be recorded and played, displayed, interacted with or accessed by information content processing devices, such as computerized and electronic devices.

- Interactive multimedia systems under commercial development include cable television services with computer interfaces that enable viewers to interact with TV programs; high-speed interactive audiovisual communications systems, including video game consoles, that rely on digital data from fibre-optic lines or digitized wireless transmission; and virtual reality systems that create small-scale artificial sensory environments. Multimedia design includes a combination of content delivered in a variety of different forms. Examples of the application of state-of-the-art multimedia content include:

- **Live Presentations** (speeches, webinars, lectures)
- **Game Shows** (corporate, studio, workshops)
- **Prototyping** (digital, interactive)
- **Application/App Development** (PC, Mac, iOS, Android)
- **Interactive Animations** (story-telling, persuasive graphic design)
- **Simulations** (environments, 2D and 3D, research, data visualization)
- **eLearning Programs** (online and blended training)
- **Product Configurators** (customizable product options and upgrades)
- **Customized** Touch-Screen **Kiosks**

1.Interactive multimedia systems

Interactive multimedia development involves the process of organizing content into creative interactions for presentation in a variety of content forms on various delivery platforms. Often involving animation and object interactions, a multimedia designer will create dynamic content delivered as unique experiences on computers, tablets, televisions, and smart phones. A seasoned multimedia designer can also effectively control multimedia as part of a live performance.

Advantages of Interactive Multimedia

- **communication of ideas takes less time**, is enjoyed more, and audience retention is increased

- **flexible content can be leveraged** at work, at a learning center, at home, while travelling, or as enhancements to management development programs

- **modular design provides audience-directed navigation**, resulting in improved engagement

- **true-to-life situations advance hands-on participation**, furthering audience comprehension (e.g., "decision-tree" simulations, video demonstrations, or simple animations)

- **multimedia presentations empower presenters** to consistently share the same concepts and ideas by standardizing presentations across multiple audiences and delivery platforms

- **audiences can consume content as needed**, and at their own pace

Tools for Development multimedia

- Good authoring tools provide a multimedia designer with robust environments for creating rich, interactive games, product demonstrations, prototypes, simulations, and eLearning courses for the web, desktops, mobile devices, DVDs, CDs, kiosks, and other multimedia development efforts. Traditional multimedia developer environments include the Microsoft Windows and Apple Macintosh platforms, with most software tools available cross-platform.

- Displayed in either **linear** or **non-linear** formats, the work of a multimedia designer can combine a wide variety of content, including bitmap images, vector artwork, audio, video, animation, native 3D, and text/hypertext. The presenter, audience responses, or the studio crew control how and when these content elements appear, where they move, how they trigger sound (or other events), and the interactions they have with each other, the presenter, the audience, and your data.

Linear navigation guides audiences through content from start to finish without deviation, often without any navigational controls at all. Examples of **linear multimedia** can be seen in trade show booths, on video walls, or in video presentations.

Non-linear navigation uses interactivity and audience decisioning to advance progress, for example, controlling the pace and path of a live presentation, interactions within a video game, or self-paced computer-based training. Links on web pages are another example of simple non-linear navigation.

Here are some **basic tools** for developers to create interactive development:

- **World Wide Web** (browser-based playback) - HTML 5, CSS, Flash, Dreamweaver

- **Programming Applications** (native playback) - Director, LiveCode

- **Artwork Development** - Photoshop, Illustrator

- **Animation Development** (2D and 3D) - After Effects, Maya

- **Audio Editing** - Sound Forge, Audition

- **Video Editing** - Final Cut Pro, Premiere Pro

- **Compression** - Adobe Media Encoder, Sorenson Squeeze

presentation*Delivery*

Multimedia presentations can be delivered **live**, **pre-recorded**, or a combination of both. Needing no presenter, **developer authored multimedia** delivers interactivity directly to the audience through a pre-designed **graphic user interface** (GUI). Live multimedia productions require developers to creatively weave interactivity and animation with **presenter** interaction to create even more impactful and memorable presentations. **Streaming multimedia** presentations may also be delivered by developers as **live** or **on-demand**. Consider the following methods of delivery:

- **performed on stage** in front of a live audience
- **projected or displayed** on video walls
- **presented in kiosks** or other touch-screen devices
- **streamed in real-time** over the Internet
- **delivered as applications** on CD/DVD/Flash drive
- **downloaded** and played on a local device

High-speed interactive audiovisual communications systems

Quality digital multimedia is designed to enhance the audience's experience, making it faster and easier to communicate intelligence. To further embellish content and deliver rich, interactive experiences, designers integrate creative media with advanced content types, including 3D renderings, real-world dynamic motion, and sophisticated interactivity between 2D and 3D elements. Enhanced levels of interactivity are achieved when developers creatively combine multiple types of media content.

Live multimedia games, prototypes, and simulations can be designed with triggers for navigation and special effects, or tied to an offline computer (or other external controller). This integration provides director/producer controls for queuing and forwarding the media throughout the presentation.

More sophisticated multimedia is increasingly becoming object-oriented and data-driven, enabling collaboration directly with the audience. For example, designers can create photo galleries providing audience-selected and uploaded images and titles, or simulations whose navigation, illustrations, animations or videos are modifiable, allow the multimedia "experience" to be customized without any reprogramming. In addition to seeing and hearing content, "haptic" technology enables virtual objects to be felt by the audience in the form of small vibrations or movement. Other emerging technologies developers can leverage involve taste and smell and may further enhance future multimedia experiences.

1.7MUTIMEDIA COMPUTER COMPONENTS,

Components of Multimedia

Multimedia has five major components like text, images, audio, video,graphics and animation. They are explained in detail below:

1)Text:

Text is the most common medium of representing the information. In multimedia, text is mostly use for titles, headlines,menu etc. The most commonly used software for viewing text files are *Microsoft Word, Notepad, Word pad etc.* the extension text files are DOC, TXT etc.

Static Text

Static text, the text or the words will remain static as a heading or in a line, or in a paragraph. The words are given along with the images to explain about the images. In static text the words will either give information or support an image or an video.

Hypertext

A hypertext is a system which consists of nodes, the text and the links between the nodes, which defines the paths the user need to follow for the text access in non-sequential ways. The author of the working system created this structure. The user is permitted to define their own paths in more sophisticated hypertext systems.

The user is provided with the flexibility and choice to navigate in hypertext. In a multimedia product Text is used to convey the information and must be placed at appropriate position in order to obtain the well -formatted sentences and paragraphs. The readability of the text depends on the spacing and punctuation. The message communication is more appropriate with improved Fonts and styles.

2. Image

Images acts as an vital component in multimedia. These images are generated by the computer in two ways, as bitmap or raster images and as vector images.

Raster or Bitmap Images

The common and comprehensive form of storing images in a computer is raster or bitmap image. Bitmap is a simple matrix of the tiny dots called pixel that forms a raster or bitmap image. Each pixel consists of two or more colors. Based on how much data, in bits is used to determine the number of colors, the color depth is determined. Eg. one bit is two colors, four bits means sixteen colors, eight bits indicates 256 colors, and so on.

Vector Images

Drawing elements or objects such as lines, rectangles, circles and so on to create an images are based on Vector images. The advantage of vector image is relatively small amount of data is required to represent the image and thereby only less memory is needed to store. Compression techniques are used to reduce the file size of images that is useful for storing large number of images and speeding transmission for networked application. various Compression formats used for this purpose are GIF, TIFF and JPEG.

3)Audio:

Audio is a meaningful speech in any language .Audio is an important components of multimedia because this component increase the understandability and improves the clarity of the concept. audio includes speech, music etc. The commonly used software for playing audio files are:*Quick Time, Real player , Windows Media Player.*Decibels is the measurement of volume, the pressure level of sound.

Musical Instrument Digital Identifier (MIDI)

Musical Instrument Digital Identifier (MIDI) is a standard communication tool developed for computers and electronic instruments. This tool is flexible and easy for composing the projects in multimedia. Tools for synthesizing the sound and software for sequencing are necessary for MIDI.

Digital Audio

- Sampled sound is a Digitized sound. A sample of sound is taken and stored every nth fraction of a second as digital information in bits and bytes. The quality of this recording depends on the sampling rate.
- Sampling rate is defined as how often the samples are taken and how many numbers are used to represent the value of each sample (bit depth, resolution and sample size). The finer the quality of the captured sound and the resolution is achieved while played back, when more often the sample is taken and the more data is stored about that sample.

4. Video

Video means moving pictures with sound. It is the best way to communicate with each other. In multimedia it is used to makes the information more presentable and it saves a large amount of time. The commonly used software for viewing videos are:*Quick Time , Window Media Player , Real Player.*Video is defined as the display of recorded event, scene etc. The powerful way to convey information in multimedia applications are embedding of video. The video can be categorized in two types as Analog video and Digital video.

Analog Video

In Analog video, the video data's are stored in any non-computer media like video tape, laserdisc, film etc. It is divided further in two types as Composite and Component Analogue Video. Composite Analog Video has all the video components like brightness, color, and synchronization combined into one signal. Due to the combining of the video components, the quality of the composite video resulted in color blending, low clarity and high generational loss. This recording format was used for customer analog video recording tape formats such as Betamax and VHS.

Digital video

Digital video is an electronic representation of moving visual images in the form of encoded digital data. Digital video formats are H.264 and MPEG-4.

5.)Graphics: Every multimedia presentation is based on graphics. The used of graphics in multimedia makes the concept more effective and presentable. the commonly used software for viewing graphics are *windows Picture, Internet Explorer etc.* The commonly used graphics editing software is Adobe Photoshop through which graphics can be edited easily and can be make effective and attractive

6)Animation:

- In computer animation is used to make changes to the images so that the sequence of the images appears to be moving pictures. An animated sequence shows a number of frames per second to produce an effect of motion in the user's eye.

- Using numerical transformations, the movement of that image along its paths is calculated for their defining coordinates. The least frame rate of at least 16 frames per second gives the impression of smoothness and for natural looking it should be at least 25 frames per second. Animations may be in two or three dimensional.

- The two dimensional animation, bring an image alive, that occur on the flat X and Y axis of the screen. while in three dimensional animation it occurs along the three axis X, Y and Z. Animation tools are very powerful and effective. Some of the commonly used software for viewing animation are: *Internet Explorer, Windows Pictures ,Fax Viewer*

The two basic types of animations are Path animation and Frame animation.

Path Animation

Path animation involves moving an object on a screen that has a constant background e.g. a cartoon character may move across the screen regardless of any change in the background or the character.

Frame Animation

In frame animations, multiple objects are allowed to travel simultaneously and the background or the objects also changes.

1.8 MULTIMEDIA STANDARDS

Multimedia data standards

Standardization bodies continue to work on media standards in order to provide a common approach to enable interoperability, better quality and efficiency under specific constraints. The MM standards, the major part of which can be grouped as follows:

- Video: in this category we can remember the MPEG-1, MPEG-2, MPEG-4, QuickTime, Sony DV, AVI, ASF, Real-Media, …
- Audio : among the most known standards we can remember Raw PCM, WAV, MPEG-1, MP3, GSM, G.723, ADPCM
- Image: the most diffuse image standards are JPEG, TIFF, BMP, GIF
- MM Presentations: among these standard types we can cite SMIL and MHEG

Video standards

MPEG family

the International Standards Organization (ISO) formed the Motion Picture Experts Group (MPEG) developing good quality audio and video.MPEG-1 In development for years, MPEG-1 became an official standard for encoding audio and video in 1993.

It can be described as the simplest of the MPEG standards, it describes a way to encode audio and video data streams, along with a way to decode them. The default size for an MPEG1 video is 352x240 at 30fps for NTSC (352x288 at 25fps for PAL sources). These were designed to give the correct 4:3 aspect ratio when displayed on the rectangular pixels of TV screens.

MPEG-2

The MPEG-2 standard builds upon MPEG-1 to extend it to handle the highest-quality video applications. It is a common standard for digital video transmission at all parts of the distribution chain. Broadcast distribution equipment, digital cable head-ends, video DVDs, and satellite television all employ MPEG-2.

MPEG-4 : Internet Streaming and Synchronized Multimedia Where MPEG-4 was designed to scale down to dial-up internet bandwidths and to tiny devices like cell phones and PDAs; as well as still remain viable for high quality desktop streaming up to 1Mbps. But MPEG-4 is much more than just an audio and video compression/decompression scheme. It's a container for all kinds of media objects (images, text, video, animation, interactive elements like buttons and image maps, etc) and a way to choreograph them into a synchronized, interactive presentation.

AVI

A format developed by Microsoft Corporation for storing video and audio information is AVI format (Audio Video Interleave). It is limited to 320 x 240 resolution and 30 frames per second, neither of which is adequate for full-screen, full-motion video.

However, AVI video does not require any special hardware, making it the lowest common denominator for MM applications. Many MM producers use this format because it allows them to sell their products to the largest base of users.

Quicktime

A competing video format is QuickTime, which is a video and animation system developed by Apple Computer. QuickTime is built into the Macintosh operating system and is used by most Mac applications that include video or animation. PCs can also run files in QuickTime format, but they require a special QuickTime driver. In February 1998, the ISO standards body gave Quicktime a boost by deciding to use it as the basis for the new MPEG-4 standard.

Audio standards

MP3 is not MPEG3

It's the magical ability to squeeze the 1.4 Mbps audio stream from a standard audio CD down to a sweet-sounding 128kbps that has made MP3 the de facto standard for digital music distribution. You can find MP3 support in every major media player on every computer platform, and dozens of consumer electronic devices can play MP3s. It's as close to a universal format for audio as you'll find.

MP3 is actually part of the MPEG1 standard. The audio portion of the MPEG1 spec contains three different compression schemes called layers. Of the three, Layer 3 provides the greatest audio quality and the greatest compression. At 8kbps, MP3 will sound like a phone call intelligible, but nothing you'd ever call high-fidelity. Good-quality music starts at about 96kbps, but generally you'll want 128 or 160kbps to get "CD quality" reproduction.

PCM

Short for Pulse Code Modulation, PCM is a sampling technique for digitising analogue signals, especially audio signals. PCM samples the signal 8000 times a second; each sample is represented by 8 bits for a total of 64 Kbps. Since it is a generic format, it can be read by most audio applications. Similar to the way a plain text file can be read by any word-processing program. PCM is used by Audio CDs and digital audio tapes (DATs). It is also a very common format for AIFF and WAV files.

ADPCM

Short for Adaptive Differential Pulse Code Modulation, ADPCM is a form of pulse code modulation (PCM) that produces a digital signal with a lower bit rate than standard PCM. It produces a lower bit rate by recording only the difference between samples and adjusting the coding scale dynamically to accommodate large and small differences.

It works by analysing a succession of samples and predicting the value of the next sample. It then stores the difference between the calculated value and the actual value. Some applications use ADPCM to digitise a voice signal so voice and data can be transmitted simultaneously over a digital facility normally used only for one or the other.

WAV (RIFF)

WAVE format, the Microsoft WAV sound file format, is derived from the RIFF (Resource Interchange File Format). The WAV files can be recorded at 11kHz, 22kHz, and 44kHz, in 8 or 16- bit mono and stereo formats.

A WAV file consists of three elements: a header, audio data, and a footer. The header is mandatory and contains the specifications for the file (information on interpreting the audio data) and optional material including copyright. The audio data are in the format specified by the header. The footer is optional and, if present, contains other annotation. Usually, the data in a WAV file take the form of PCM bit streams.

AIF (AIFF)

The Audio Interchange File Format (AIFF) was developed by Apple computer to store high-quality sampled sound and musical instrument information. AIF is a popular file format for transferring files between the Mac and the PC. This format supports 8-bit files only; mono up to 44.1 KHz, and stereo up to 22 KHz.

Image standards

JPEG : Joint Photographic Experts Group In general, what people usually mean when they use the term "JPEG" is the image compression standard they developed. JPEG was developed to compress still images, such as photographs, a single video frame, something scanned into the computer, and so on. You can run JPEG at any speed that the application requires.

For a still picture database, the algorithm doesn't have to be very fast. If you run JPEG fast enough, you can compress motion video -- which means that JPEG would have to run at 50 or 60 fields per second.

This is called motion JPEG or M-JPEG. You might want to do this if you were designing a video editing system. Now, M-JPEG running at 60 fields per second is not as efficient as MPEG-2 running at 60 fields per second because MPEG was designed to take advantage of certain aspects of motion video.

BMP

- A representation, consisting of rows and columns of dots, of a graphics image in computer memory. The value of each dot (whether it is filled in or not) is stored in one or more bits of data. For simple monochrome images, one bit is sufficient to represent each dot, but for colours and shades of grey, each dot requires more than one bit of data.
- The more bits used to represent a dot, the more colours and shades of grey that can be represented. The density of the dots, known as the resolution, determines how sharply the image is represented. This is often expressed in dots per inch (dpi) or simply by the number of rows and columns, such as 640 x 480.
- Bit-mapped graphics are often referred to as raster graphics. The other method for representing images is known as vector graphics or object-oriented graphics. With vector graphics, images are represented as mathematical formulas that define all the shapes in the image.
- Vector graphics are more flexible than bit-mapped graphics because they look the same even when you scale them to different sizes [http://www.webopedia.com].

GIF

- Short for Graphics Interchange Format, another of the graphics formats supported by the Web. Unlike JPG, the GIF format is a loss less compression technique and it supports only 256 colours.
- GIF is better than JPG for images with only a few distinct colours, such as line drawings, black and white images and small text that is only a few pixels high. With an animation editor, GIF images can be put together for animated images.
- The compression algorithm used in the GIF format is owned by Unisys, and companies that use the algorithm are supposed to license the use from Unisys [http://www.webopedia.com].
- 10 PNG Short for Portable Network Graphics, the third graphics standard supported by the Web (though not supported by all browsers). PNG was developed as a patent-free answer to the GIF format but is also an improvement on the GIF technique.
- An image in a loss less PNG file can be 5%-25% more compressed than a GIF file of the same image. PNG builds on the idea of transparency in GIF images and allows the control of the degree of transparency, known as opacity.
- Saving, restoring and re-saving a PNG image will not degrade its quality. PNG does not support animation like GIF does [http://www.webopedia.com].

TIFF

- Acronym for Tagged Image File Format, one of the most widely supported file formats for storing bit-mapped images on personal computers (both PCs and Macintosh computers). What made the TIFF so different was its tag-based file structure.
- Where the BMP is built on a fixed header with fixed fields followed by sequential data, the TIFF has a much more flexible structure. At the beginning of each TIFF is a simple 8-byte header that points to the position of the first Image File Directory (IFD) tag.
- This IFD can be of any length and contain any number of other tags enabling completely customised headers to be produced. The IFD also acts as a road map to where image data is stored in the file as the tagged nature of the format means that this needn't be stored sequentially. Finally the IFD can also point to another IFD as each TIFF can contain multiple sub files [http://www.webopedia.com].

TGA (Tagra)

This was the first popular format for high-resolution images. The name comes from the original Targa board, the first true-colour video board. Most video-capture boards support TGA, as do most high-end paint programs.

(g) PNG (Portable Network Graphics)

An extensible file format for the loss less, portable, well compressed storage of raster images. PNG provides a patent free replacement for GIF and can also replace many common uses of TIFF. PNG is designed to work well in online viewing applications, such as the worldwide web, so it is fully streamable with a progressive display option.

Multimedia presentation standards:

SMIL

- SMIL (pronounced smile) stands for Synchronized Multimedia Integration Language [20] It is a mark-up language, like HTML and is designed to be very easy to learn and deploy on Web sites.
- Recommended from the World Wide Web Consortium (W3C) it allows developers to create timebased multimedia documents on the web. Based on XML, it is able to mix many types of media, text, video, graphics, audio and vector based animation together and to synchronize them according to a timeline.

MHEG

- MHEG is an abbreviation for the Multimedia and Hypermedia Experts Group [19]. This is another group of specialists, eminent in their field which has been set up by ISO, the International Standards Organisation.

- This group had the task of creating a standard method of storage, exchange and display of MM presentations. In particular we can distinguish between MHEG-5 and MHEG-4. The first one allows us to manage MM applications across computer networks; for each MM object it doesn't defines a compression scheme, each object has an own compression standard, while the last one doesn't defines tools to create a multimedia structure but it is able to combine a multimedia information stream in time by integrating it with different components as text, video, images each compressed in a specific way according to the media which it represents.

- The aim of the standard MHEG-5 consists in defining an object-oriented model to codify the synchronization of the multimedia objects in a standard way. The synchronization regards not only the objects themselves (the activation of a musical piece together with the end of a video film) but also events generated by users (the press of such a bottom using mouse) and temporal events (as an example after one minute from the visualization of an image an audio comment will be activated).

(i) Text Formats

(a) RTF (Rich Text Format)

- RTF is a proprietary document file format with published specification developed by Microsoft Corporation in 1987 for Microsoft products and for cross-platform document interchange.

(b) Plain text

- Plain text files can be opened, read, and edited with most text editors. Examples include Notepad (Windows), edit (DOS), ed, emacs, vi, vim, Gedit or nano (Unix, Linux), SimpleText (Mac OS), or TextEdit (Mac OS X). Other computer programs are also capable of reading and importing plain text. Plain text is the original and ever popular method of conveying e-mail. HTML formatted e-mail messages often include an automatically-generated plain text copy as well, for compatibility reasons.

1.9 MULTIMEDIA PC

A multimedia computer system is a computer system, which has the capability to integrate two or more types of media (text, graphics, images, audio, and video) for the purpose of generation, storage, representation, manipulation and access of multimedia information. In generate, the data

size for multimedia information is much larger than textual information, because representation of graphics, animation, audio or video media in digital form requires much larger number of bits than that required for representation of plain text. Due to this, multimedia computer system requires:

- Faster CPU (for quicker processing of larger amount of data).
- Larger storage devices(for storing large data files).
- Larger main memory(for running programs with large data size).
- Good graphics terminal s(for displaying graphics, animation and video).
- Good graphics terminal s(for displaying graphics, animation and video).

Input/output devices (required to play any audio associated with a multimedia application program.)

- The **Multimedia Personal Computer(MPC)** was developed in 1990 and is any computer that is capable of running programs that combine video, animation, audio, and graphics.The **Multimedia PC** (**MPC**) was a recommended to adding and configuring a sound card, a video card, and a CD-ROM drive to a system.
- CD-ROM drives were just coming to market in 1990, and it was difficult to concisely communicate to a consumer all the hardware requirements for using "multimedia software", which mostly meant "displaying video synced with audio on a PC via a CD-ROM drive". The MPC standard was supposed to communicate this concisely, so a consumer buying hardware or software could simply look for the MPC logo and be assured of compatibility.
- Microsoft formed an organization called the Multimedia PC Marketing Council in 1991 to generate standards for multimedia computers. The council created several multimedia PC (MPC) standards, and it licenses its logo and trademark to manufacturers whose hardware and software conform to these guidelines.
- The MPC program had mixed results primarily because of the vast number of PCs sold under different brands, and once Windows became global on PCs, specifying minimum or recommended Windows versions and features was often clearer to consumers than the MPC nomenclature.
- The Multimedia PC Marketing Council formally transferred responsibility for its standards to the Multimedia PC Working Group of the Software Publishers Association (SPA). This group includes many of the same members as the original MPC Marketing Council. The group's first creation was a new MPC standard.
- The MPC Marketing Council originally developed two primary standards for multimedia: MPC Level 1 and MPC Level 2. Under the direction of the SPA, the first two standards have been replaced by a third, called MPC Level 3 (MPC 3), which SPA introduced in June 1995. (There are currently no plans for the publication of any additional MPC standards.) These standards define the minimum capabilities for a multimedia computer.
- Any PC with the required standards could be called an "MPC" by licensing the use of the logo from the SPA

There are three MPC standards MPC, MPC2, and MPC3.

MPC Level 1

The first MPC minimum standard, set in 1991, was:

- 16 MHz 386SX CPU
- 2 MB RAM
- 30 MB hard disk
- 256-color, 640×480 VGA video card
- 1× (single speed) CD-ROM drive using no more than 40% of CPU to read, with < 1 second seek time
- Sound card (Creative Sound Blaster recommended as closest available to standard at the time[1]) outputting 22 kHz, 8-bit sound; and inputting 11 kHz, 8-bit sound
- Windows 3.0 with Multimedia Extensions.

MPC Level 2

In 1993, an MPC Level 2 minimum standard was announced:

- 25 MHz 486SX CPU(Intel)
- 4 MB RAM
- 160 MB hard disk
- 16-bit color, 640×480 VGA video card
- 2× (double speed) CD-ROM drive using no more than 40% of CPU to read at 1x, with < 400 ms seek time
- Sound card outputting 44 kHz, 16-bit CD quality sound.
- Windows 3.0 with Multimedia Extensions, or Windows 3.1.

MPC Level 3

In 1996, MPC Level 3 was announced:

- 75 MHz Pentium CPU (Intel)
- 8 MB RAM
- 540 MB hard disk
- Video system that can show 352×240 at 30 frames per second, 16-bit color
- MPEG-1 hardware or software video playback
- 4× CD-ROM drive using no more than 40% of CPU to read, with < 250 ms seek time
- Sound card outputting 44 kHz, 16-bit CD quality sound
- Windows 3.11 or Windows 95

The following table presents these standards.

	MPC Level 1	**MPC Level 2**	**MPC Level 3**
Processor	16 MHz 386SX	25 MHz 486SX	75+ MHz
RAM	2 MB	4 MB	8 MB
Hard disk	30 MB	160 MB	540 MB

Floppy disk	1.44 MB 3.5-inch	1.44 MB 3.5-inch	1.44 MB 3.5-inch
CD-ROM	Single-speed	Double-speed	Quad-speed
Audio	8-bit	16-bit	16-bit
VGA video resolution	640 x 480; 16 colors	640 x 480; 64,000 colors	640 x 480; 64,000 colors
Other I/O	Serial; parallel; MIDI; game	Serial; parallel; MIDI; game	Serial; parallel; MIDI; game
Software	Microsoft Windows 3.1	Microsoft Windows 3.1	Microsoft Windows 3.1
Date introduced	May 1993	1994	June 1995

Video-Capture Software

- With the advent of multimedia computers and software, manipulating full-motion video was the next logical step. A modern high-speed multimedia computer has become standard equipment in the moviemaking industry. Today, even amateur filmmakers can use their computers to give home movies a touch of professionalism.
- Video-capture software provides an interface that allows users to import and export video formats in order to edit them with their computers. This software allows a user to view audio waveforms and video images, create files, capture single frame or full-motion video, and edit video clips and still frames for content and effects.
- File-editing functions such as zoom, undo, cut, paste, crop, and clear can be used to edit audio and visual files. Users can also set the compression controls to the type of format desired and determine the capture rates.
- The capture rate for full-motion video (equivalent to what you would find in TV or on the big screen) is 30 frames per second (fps), but some systems might not be able to reach this potential.
- Professional systems include very large, very fast hard disk drives for data buffering. A typical user of video-capture software might realize a frame-capture rate of only up to 15 fps without adding an arsenal of hardware to enhance the system.

UNIT II

TEXT

- ENGINEERING TEXT
- POSITIONING TEXT
- SIZING TEXT
- EDITING TEXT
- FONTS
- SHADOWING
- CLONING
- BUILDING

IMAGE AND GRAPHICS

- BACKDROPS AND HANGING PICTURES
- POSITIONING, CAPTURING AND CONVERTING GRAPHICS
- COMPRESSING BITMAPS
- CONTROLLING PALLETS
- TRIGGERING
- HYPERTEXT
- HYPER PICTURE
- BUTTONS
- EDITING LINKS
- TRIGGERING IN BACKDROPS
- ANALOG VIDEO
- DIGITAL VIDEO
- DIGITAL AUDIO
- MUSIC

- ANIMATION
- OPERATING SYSTEM SUPPORT FOR MULTIMEDIA
- CD FAMILY
- VARIOUS CD FORMATS
- CD-ROM FORMAT

TEXT

What is Text?

- Text is the graphic representation of speech. Unlike speech, however, text is silent, easily stored, and easily manipulated.
- Text in multimedia presentations makes it possible to convey large amounts of information using very little storage space.
- Computers customarily represent text using the ASCII (American Standard Code for Information Interchange) system.

FONTS

- The graphic representation of speech can take many forms.
- These forms are referred to as fonts or typefaces.
- Fonts can be characterized by their proportionality and their serif characteristics.

- Non-proportional fonts, also known as monospaced fonts, assign exactly the same amount of horizontal space to each character
- Monospaced fonts are ideal for creating tables of information where columns of characters must be aligned

EDITING TEXT

- The ability to change text by adding, deleting and rearranging letters, words, sentences and paragraphs.
- Text editing is the main operation users perform in word processors, which typically also handle graphics and other multimedia files.
- See text editor and word processing.

A text editor (like notepad) is useful for making quick changes and quick typing of the text and it a great tool to write out HTML code.

A word processor (like MS Word) has a plethora of options with which one can format

the text and can insert special symbols, colours, line spacing and a whole lot of other things that can't do with a normal text editor.

Fontographer (sometimes abbreviated FOG), is a software application used to create digital fonts, available for both Microsoft Windows and Apple Macintosh platforms.

It was originally developed by Altsys but is now owned by Font Lab Ltd.

Mapping Text:

Character mapping allows bullets, accented characters, and other curious characters that are part of the extended character set on one platform to appear correctly when text is moved to the other platform.

IMAGE AND GRAPHICS

BACKDROPS AND HANGING PICTURES

- Media backdrops give your press conferences, highly visible events, and photoshoots a professional look.
- Sports backdrops are perfect for pre or post-game press conferences or introducing a new player or coach to the public.
- Administration, coaches, and their athletes can interact with the media in front of crisply printed Sports Backdrops featuring team and school branding, sponsor logos, or both.
- Media backdrops from AMI Graphics are custom finished for your hanging needs whether you plan to secure it to an existing solid surface, like a wall, or use freestanding hardware.
- AMI Graphics offers multiple types of freestanding hardware options for your media backdrops –
- including pop up media backdrops that feature a lightweight, collapsible frame system that is designed for easy set-up and breakdown while keeping your custom graphics attached.

- ❖ Media backdrops are not limited to just sports or press conferences.
- ❖ Line special event entryways, create fun photo opportunities for your customers, or use as a backdrop for your tradeshow booth.

- ❖ Media backdrops can be a multipurpose signage solution.

POSITIONING, CAPTURING AND CONVERTING GRAPHICS:

- ❖ Pointing technique refers to look at the items already on the screen whereas the positioning technique refers to position the item on the screen to a new position, i.e., the old current position.
- ❖ The user indicates a position on the screen with an input device, and this position is used to insert a symbol.
- ❖ There are various pointing and positioning devices which are:

- **Light Pen**
- **Mouse**
- **Tablet**
- **Joystick**
- **Trackball and spaceball**

CAPTURING

- ❖ Image generation can be handled in a number of ways.
- ❖ Spreadsheets can be used to store data and generate graphs and charts. Line diagrams, flow charts and sophisticated graphics such as molecular models and chemical formulae.
- ❖ It can be generated using graphic design and drawing software programs. Photographs, transparencies and documents can be scanned or captured using a camera and image capture board.
- ❖ There are several ways of capturing images but all have one thing in common;
- ❖ the visual information needs to be converted into an electronic signal before it can be stored, edited and ultimately displayed.

- We perceive images by the light that reflects off or passes through an object. This light or optical signal is captured and converted to an electronic signal which can be stored. The electronic information or data can be stored as either an analogue or digital signal.

COMPRESSING BITMAPS

- Many *graphical user interfaces* use bitmaps in their built-in graphics subsystems;*[3]*
- for example, the *Microsoft Windows* and *OS/2* platforms' *GDI* subsystem, where the specific format used is the *Windows and OS/2 bitmap file format*, usually named with the *file extension* of .BMP (or .DIB for *device-independent bitmap*).
- Besides *BMP*, other file formats that store literal bitmaps include *InterLeaved Bitmap (ILBM)*, *Portable Bitmap (PBM)*, *X Bitmap (XBM)*, and *Wireless Application Protocol Bitmap (WBMP)*.
- Similarly, most other image file formats, such as *JPEG*, *TIFF*, *PNG*, and *GIF*, also store bitmap images (as opposed to *vector graphics*), but they are not usually referred to as *bitmaps*, since they use *compressed* formats internally

CONTROLLING PALLETS

- When a given application intends to output colorized graphics and/or images, it can set their own "logical palette".
- That is, its own private selection of colors (up to 256). It is supposed that every graphic element that the application tries to show on screen employs the colors of its logical palette.
- A common example is the 256-color palette commonly used in the GIF file format, in which 256 colors to be used to represent an image are selected from the whole 24 bpp color space, each being assigned an 8 bit index.

- This way, while the system can potentially reproduce any color in the RGB color space (as long as the 256 color restriction allows), the storage requirement per pixel is lowered from 24 to 8 bits per pixel.

TRIGGERING

What Do We Mean by Triggers?

- Triggers are visual or audio-visual elements like pictures, videos, or digital stories, which aim to stimulate curiosity, perception and fantasy.
- The word TRIGGER is used both as a noun and as a verb.

- A trigger is meant to trigger a reaction. It is an act that sets somebody or something in motion, an act causing something to happen, a catalyst.
- It can be a visual metaphor that gives students associations related to their professional theme.
- Triggers for learning are meant to stimulate communication, discussions, reflections, reactions, and emotions and put students in a specific mood.
- A good trigger is something you remember or don't easily forget. It reminds you of a learning situation or important concepts in your field of work.
- By looking at the same multimedia element and responding to some questions students collect information about a phenomenon in their own country and compare the situation with students from other countries.
- They are challenged to discuss their different interpretations and to see whether they can relate the visual elements to their professional work.
- The content of the triggers are a result of cooperation and brainstorming among the teachers, and are related to the content of the particular modules and themes.

HYPER TEXT

- The concepts of hypertext, multimedia and hypermedia are often confused, but can be usefully distinguished with the following definitions:
- hypertext is text with links, multimedia is synchronized media, and hypermedia is multimedia with links.
- The computer storage and processing requirements for multimedia are orders of magnitude greater than those for hypertext.
- Nevertheless, the hypertext model can be extended to deal with hypermedia by including multimedia synchronization capabilities.

HYPER PICTURE

- **Hypermedia**, an extension of the term *hypertext*, is a *nonlinear medium* of information that includes graphics, audio, video, plain text and *hyperlinks*.
- This designation contrasts with the broader term multimedia, which may include non-interactive linear presentations as well as hypermedia
- Hypermedia may be developed in a number of ways.
- Any *programming tool* can be used to write programs that link data from internal variables and *nodes* for external data files.
- Multimedia development software such as *Adobe Flash*, *Adobe Director*, *Macromedia Authorware*, and MatchWare Mediator may be used to create stand-alone hypermedia applications, with emphasis on entertainment content.
- Some *database* software, such as *Visual FoxPro* and *FileMaker Developer*, may be used to develop stand-alone hypermedia applications, with emphasis on educational and business content management.

BUTTONS

- Buttons are more powerful than simple hyperlinks.
- Buttons contain the code that can send you to destinations, flip pages, open Web pages, play movies, show and hide other buttons, and other tricks.
- You use the Buttons and Forms panel to create and apply actions to Buttons.

To view the Buttons and Forms panel:

Choose **Window > Interactive > Buttons and Forms** to open the Buttons and Forms panel .

To create and name a button:

1. Select an object. Any object, except media files, can be used as a button.
2. Choose **Object > Interactive > Convert to Button** or click the Convert Object to Button icon in the Buttons and Forms panel . The object displays the button icon .

The **Convert Object to Button** icon at the bottom of the Buttons and Forms panel.

The **Button icon** appears inside an object that has been converted into a button.

3. Use the Name field in the Buttons and Forms panel to change the default name to something more descriptive

EDITING LINK

- Using hypertext, a link is a selectable connection from one word, picture, or information object to another.

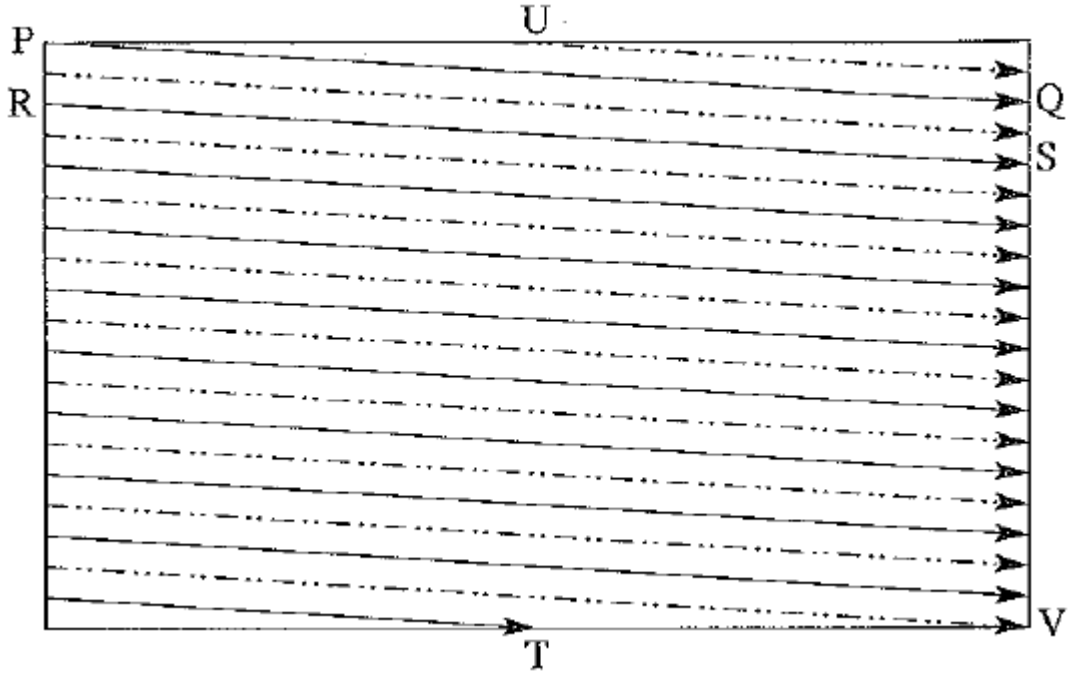
- In a **multimedia** environment such as the World Wide Web, such objects can include sound and motion video sequences. ... **Links** are what make the World Wide Web a web.
- Also see hypermedia and **hyperlink**.

ANALOG VIDEO

- ***Analog video*** is a video signal transferred by an analog signal.
- When combined in to one channel, it is called composite video as is the case, among others with NTSC, PAL and SECAM.
- Analog video may be carried in separate channels, as in two channel S - Video (YC) and multi - channel component video formats.
- Analog video is used in both consumer and professional television production applications.
- However, digital video signal formats with higher quality have been adopted, including serial digital interface (SDI), Firewire (IEEE 1394), Digital Visual Interface (DVI) and High - Definition Multimedia Interface (HDMI).
- Most TV is still sent and received as an analog signal.
- Once the electrical signal is received, we may assume that brightness is at least a monotonic function of voltage, if not necessarily linear, because of gamma correction.
- An analog signal f(t) samples a time - varying image. So - called *progressive* scanning traces through a complete picture (a frame) row - wise for each time interval.
- A high - resolution computer monitor typically uses a time interval of 1/72 second.
- In TV and in some monitors and multimedia standards, another system, *interlaced* scanning, is used.

- Here, the odd - numbered lines are traced first, then the even - numbered lines. This results in "odd" and *"even" fields* — two fields make up one frame.

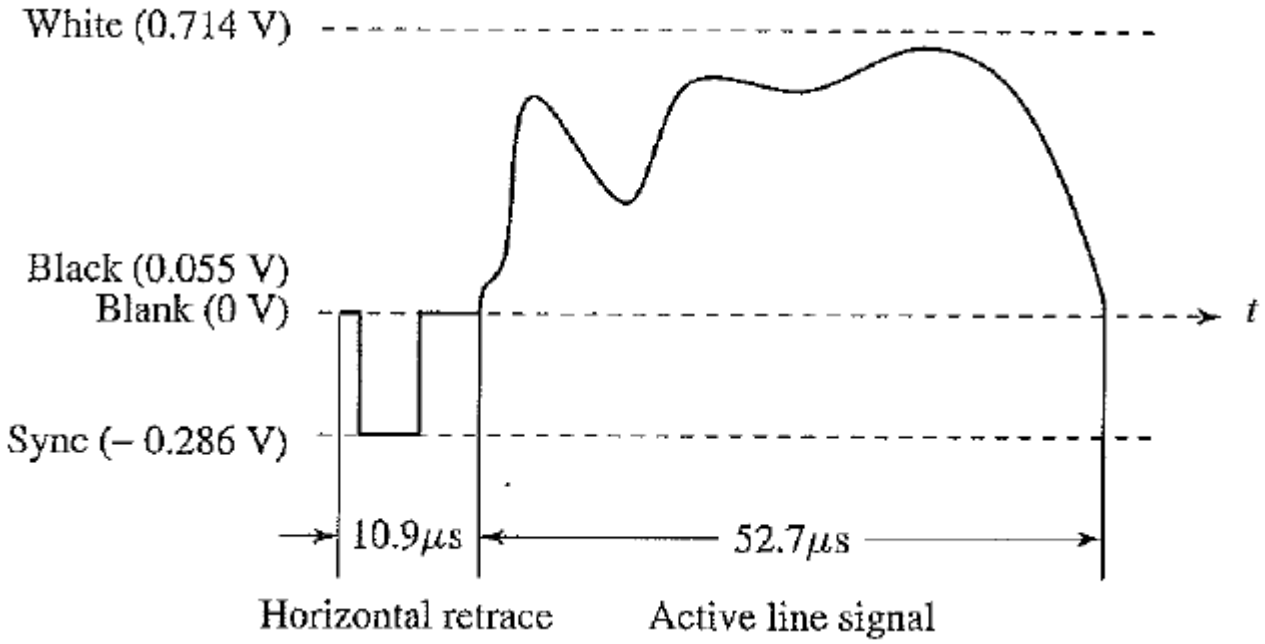
Interlaced raster scan



Interlacing was invented because, when standards were being defined, it was difficult to transmit the amount of information in a full frame quickly enough to avoid flicker.

The double number of fields presented to the eye reduces perceived flicker.

Electronic signal for one NTSC scan line



The vertical retrace and sync ideas are similar to the horizontal one, except that they happen only once per field.

Samples per line for various analog video formats

Format	Samples per line
VHS	240
S-VHS	400–425
Beta-SP	500
Standard 8 mm	300
Hi-8 mm	425

Different video formats provide different numbers of samples per line, as listed in the above table. Laser disks have about the same resolution as Hi - 8. (In comparison, mini DV 1/4 - inch tapes for digital video are 480 lines by 720 samples per line.)

DIGITAL VIDEO

- Video recording in digital form.
- In order to edit video in the computer or to embed video clips into multimedia documents, a video source must originate from a digital camera or be converted to digital.
- Frames from analog video cameras and VCRs are converted into digital frames (bitmaps) using frame grabbers or similar devices attached to a computer.
- Moving video is made up of a series of still frames (images) played at 25 frames per second (30 frames per second in the USA).
- One may be excused for thinking that the capture and playback of digital video is simply a matter of capturing each frame, or image, and playing them back in a sequence at 25 frames per second.
- Unfortunately it is not that simple.
- A single still image or frame with a window size or screen resolution of 640 x 480 pixels and 24 bit colour (16.8 million colours) occupies approximately 1MB of disc space .
- Therefore, roughly 25 MB of disc space are needed for every second of[1]video, 1.5 GB for every minute.
- Digital video files are large! Even if the storage space is available, it is not practical to play back that amount of data per second on today's personal computers.
- Therefore, file size must be reduced to within the data transfer rate of the final playback system.

There are three basic problems with digital video

- size of video window
- frame rate
- quality of image

- It is not difficult to deal with these three problems and, although we will now take a look at these issues one at a time, they are by no means independent of one another.
- All of these issues can be tackled using compression techniques.

Size of video window

Digital video stores a lot of information about each pixel in each image or frame. It takes time to display those pixels on your computer screen.

If the window size is small, then the time taken to draw the pixels is less.

If the window size is large, there may not be enough time to display the image

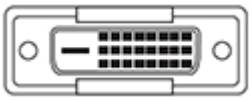
Frame Rates

- The issues here are similar to those above - too many pixels and not enough time.
- There is not enough time to move the data from hard disc or CD to screen.
- One way to overcome this is to compress the data so that less data is transferred from disc to screen.
- Image Quality
- The image quality will depend on the quality of the original source and the degree of compression used.
- During compression you will probably be asked to select a quality setting. This will be represented by an arbitrary scale of, 0-100%, 1-5, etc
- the quality of the resulting video sequence will be reduced. Digital Video Formats

SDI video

- The serial digital interface is a format most commonly found in high-end broadcasting applications.
- Although SDI transmits uncompressed, unencrypted digital video signals, it typically depends on 75-ohm BNC coax cable for transmission — the same cabling traditionally used for analog video communications.

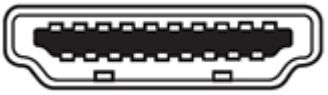
DVI video



The Digital Video Interface (DVI) is based on transition-minimized differential signaling (TMDS).
The two most common DVI connector interfaces are:

- **DVI-D**: This digital-only interface provides a high-quality image and fast transfer rates.
- It eliminates analog conversion and improves the display. Often used to link a source and a display, it can be used when one or both connections are DVI-D.
- **DVI-I**: It integrates both digital and analog RGB support, and it can transmit digital-to-digital or analog-to-analog signals.
- DVI-I can be used with adapters to enable analog connectivity to a VGA or DVI-I display or digital connectivity to a DVI-D display. You can achieve the best picture quality by using a digital DVI display with a DVI-D video source

HDMI video



The High-Definition Multimedia Interface (HDMI®) combines uncompressed HD video, multichannel audio, and intelligent format/command data in a single cable with a very compact connector.

DIGITAL AUDIO

For archiving and processing of audio signals, high quality formats with 96kHz sampling and 24 to 30 bit amplitude resolution.

Table:// Bit rates for various digital audio schemes

Applications	Format	Sampling rate	Audio bit rate	Overhead bit rate	Total bit rate
Compact Disc (CD)	PCM	44.1 kHz	1.41 Mb/s	2.91 Mb/s	4.32 Mb/s
Digital Audio Tape (DAT)	PCM	44.1 kHz	1.41 Mb/s	1.67 Mb/s	3.08 Mb/s
Digital Compact Cassette (DCC)	MPEG-1	48 kHz	384 kb/s	384 kb/s	768 kb/s
MiniDisc (MD)	ATRAC	44.1 kHz	292 kb/s	718 kb/s	1.01 Mb/s
Digital Audio Broadcast	MPEG-1	48 kHz	256 kb/s	256 kb/s	512 kb/s

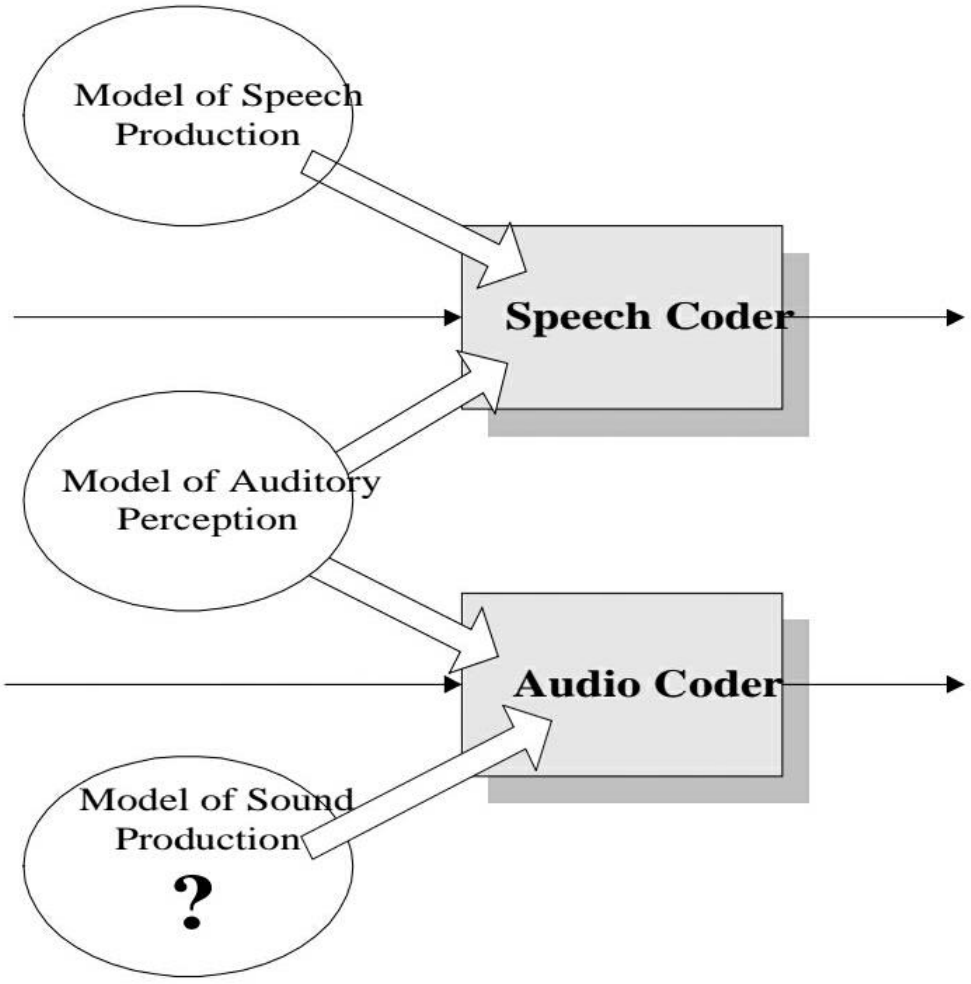
Key technology in Audio coding:

In recent audio coding Algorithms four key technologies play an important role.

1. Perceptual coding
2. Frequency domain coding
3. Window switching
4. Dynamic bit allocation

Perceptual coding:

The auditory system consisting of strongly overlapping bandpass filters with bandwidth in the order of 50 to100 Hz for signals below 500Hz and upto 5000Hz for signals at higher frequencies.



ch and audio compression by employing models of percep

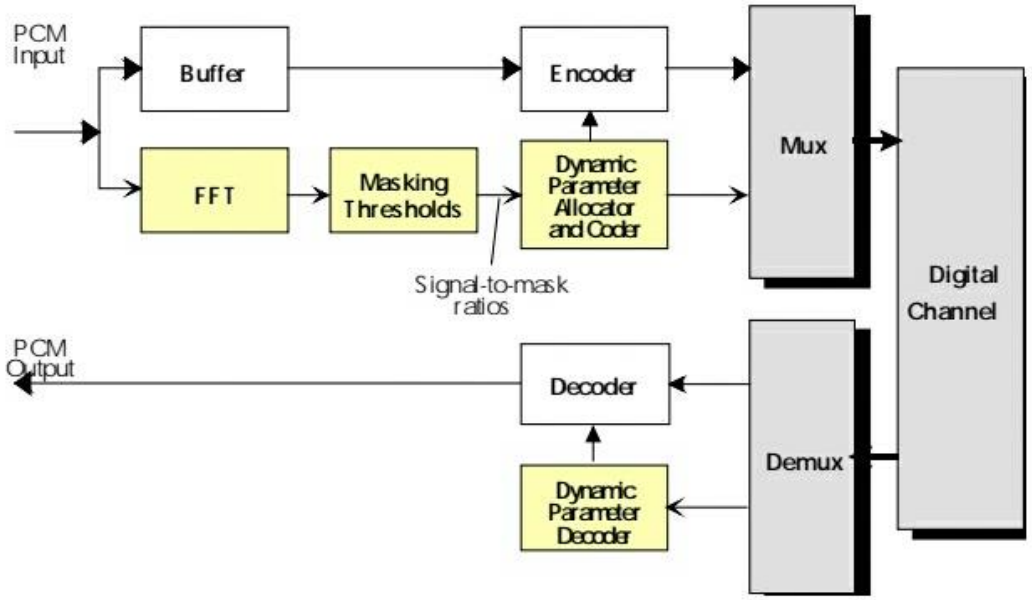


Fig. 3: Block diagram of perception-based coders

Frequency domain coding :

- Frequency domain coders with dynamic allocation of bits to subbands or transform coefficients offer an easy and accurate way to control quantization noise.

- A high spectral resolution can be obtained in an efficient way by using a cascade of a filterbank and a linear MDCT transform that splits each subband sequence further in frequency resolution.
- MPEG1 Audio coding:

Table 2: Approximate (conservative) MPEG-1 bit rates for transparent representations of audio signals and corresponding compression factors (compared to CD bit rate)
* Average bit rate; variable bit rate coding assumed.

MPEG-1 audio coding	Approximate stereo bit rates for transparent quality	Compression factor
Layer I	384 kb/s	4
Layer II	256 kb/s	6
Layer III	192 kb/s*	8

Layer I and Layer II coders map the digital into 32 subbands.

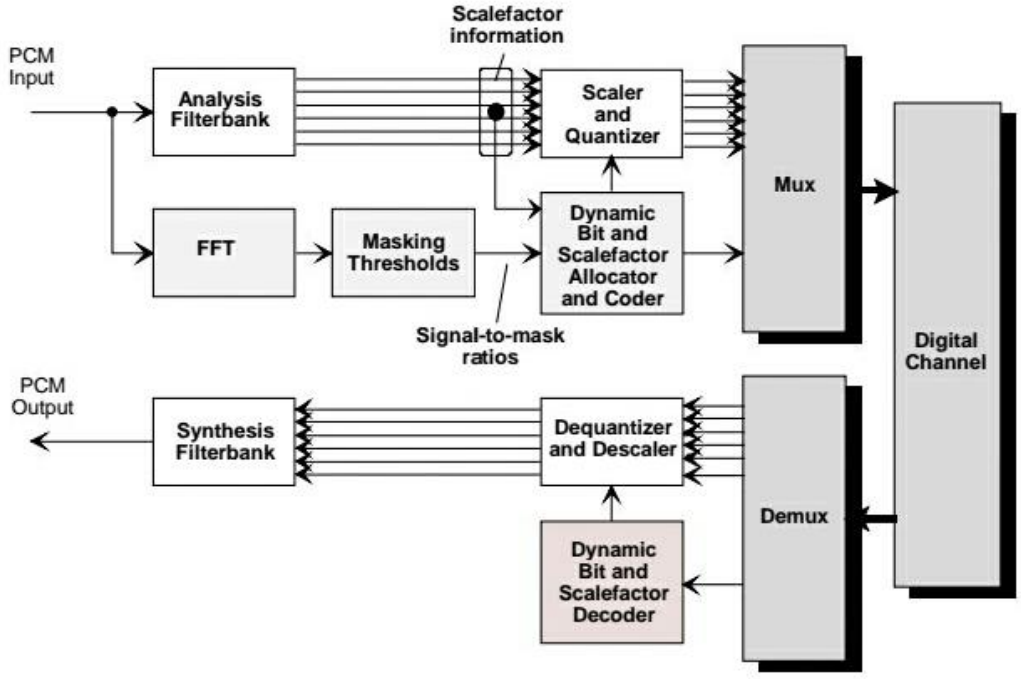


Fig. 4: Structure of MPEG-1/Audio encoder and decoder, layers I and II

PsychoAcoustics:

- Audio is defined as a disturbance in air pressure that reaches the human eardrum
- In terms of frequency ,amplitude, time and other parameters there are limits to the kinds of air pressure disturbance that will evoke an auditory percept in humans.

Masking

- **One** sound can make it impossible to hear another or one sound may shift the apparent loudness of another.
- If one tone is masking another, the effect depends on the separation in frequency.

MUSIC

- Once the Musical Instrument Digital Interface (MIDI) standard was defined, electronic instruments could exchange data over digital links. With the advent of the audio CD, music recording and distribution cros
- sed the threshold into the digital domain.
- More and more delivery media are going digital. With the wide use of pulse code modulation (PCM) in the telecommunications industry and of MPEG audio in multimedia systems, the coding, compression, and transmission of digital sound are now well understood.
- Radio stations have begun converting their archives to online digital disks, and a radio announcer can now play back any piece of music within seconds, based on a large index of titles and artists.

ANIMATION

Animation is the process of designing, drawing, making layouts and preparation of photographic sequences which are integrated in the multimedia and gaming products.

- Animation involves the exploitation and management of still images to generate the illusion of movement.
- A person who creates animations is called animator. He / she use various computer technologies to capture the still images and then to animate these in desired sequence.

Multimedia is the term used to represent combination of visual and audio materials gathered from various resources and then added into one single combination.

- A multimedia product can be sets of texts, graphic arts, sounds, animations and videos. Precisely, term multimedia is used to refer visual and audio materials into a single common presentation which can be played in a computer including CD ROM or digital video, internet or web technology, streaming audio or video and data projection system etc.

Modern entertainment industry i.e. film and television has gained new heights because of advances in animation, **graphics** and multimedia.

- ❖ Television advertisements, cartoons serials, presentation and model designs - all use animation and multimedia techniques.

Types of Animation

- Traditional animation (cel animation or hand-drawn animation)
- Stop motion animation (Claymation, Cut-outs)

- Motion Graphics (Typography, Animated logo)
- Computer animation
- 2D animation

- 3D animation

USES OF ANIMATION

- Education
- Entertainment
- Advertisement
- Marketing
- Scientific visualisation
- Creative Art
- Gaming
- Simulation
- Medical
- Architect and engineering
- Manufacturing

OPERATING SYSTEM SUPPORT FOR MULTIMEDIA

- ❖ Multimedia is an increasingly important part the mix of applications that users run on personal computers and workstations.
- ❖ The requirements placed on a multimedia operating system are demanding and often conflicting.
- ❖ After studying multimedia characteristics and multimedia system requirements, this paper presents a new operating system for multimedia files and applications and it calls this operating system an Optimal Multimedia Operating System as optimal operating system solution for multimedia applications and files and compare this optimal operating system with three existing operating system: QLinux, Mac osx Leopard, Windows Vista.

- Distributed multimedia applications will be an important part of tomorrow's application mix and require appropriate operating system (OS) support.
- Neither hard real-time solutions nor best-effort solutions are directly well suited for this support. One reason is the coexistence of real-time and best effort requirements in future systems.
- Another reason is that the requirements of multimedia applications are not easily predictable, like variable bit rate coded video data and user interactivity.

OS support for (distributed) multimedia systems, which include:

(1) development of new CPU and disk scheduling mechanisms that combine real-time and best effort in integrated solutions;

(2) provision of mechanisms to dynamically adapt resource reservations to current needs;

(3) establishment of new system abstractions for resource ownership to account more accurate resource consumption;

(4) development of new file system structures;

(5) introduction of memory management mechanisms that utilize knowledge about application behavior;

(6) reduction of major performance bottlenecks, like copy operations in I/O subsystems; and

(7) user-level control of resources including communication.

Multimedia data can be managed on disk in two different ways [Steinmetz 95]:

(1) the file organization on disk is not changed and the required real-time support is provided by special disk scheduling algorithms and large buffers to avoid jitter; or

(2) the data placement is optimized for continuous multimedia data in distributed storage hierarchies like disk arrays.

CD FAMILY

- In the time of gramophone records, there were not only 30 cm (12 inch) LPs, but also 17 cm (7 inch) 'singles' with a playing time of 3 to 4 minutes on each side.
- These were mainly popular with young people who wanted to buy 'hits' at a reasonably attractive price.
- There were also 17 cm 'EP' (Extended Play) discs with a playing time of 6 to 8 minutes. The 8 cm 'CD single' was launched to take over the 'singles' function, with a maximum playing time of around 20 minutes and the same sound quality as a normal 12 cm CD.
- Almost all today's CD players can play these 8 cm discs. These 'audio singles have proved to be less popular than expected, although they are being increasingly used in CD-R (CD-Recordable) form as a low-cost way to store MP3 music files.
- An 8 cm CD-R has a capacity of 156 MB, or approximately 3 hours of music in MP3 format.

CD Graphics

- CD Graphics makes it possible to store song lyrics and other information on a CD, which can be displayed on a TV screen when a disc is played.
- This is not a new development, but one of the special 'features' that were included when the CD was introduced.
- However, few manufacturers offered CD Graphics players with the required graphic decoder, and hardly any CD Graphics discs were issued, so this feature never became a success.

CD-ROM

- Digital audio is stored on a CD in almost the same way as computer data. Which is why the CD-ROM (Read Only Memory) was developed and launched around 1985.
- Like the audio CD the disc has a diameter of 12 cm and a storage capacity of 650 to 700 MB - equivalent to 450 floppy disks or more than 250,000 typed A4 pages. A CD-ROM allows fast data access and has a very high reliability. This is why it is now universally used to store computer software and data.

VARIOUS CD FORMATS

There are three main types: standard manufactured CDs (CD-DA), CD-R recordable and CD-RW rewriteable.

- Standard manufactured CDs can be played on any CD digital audio player.
- CD-Rs can be played on CD-R machines and many but not all CD digital audio players.
- CD-RWs can only be played on CD-RW compatible machines.

CD-ROM FORMAT

- The formats of CD-ROMs are defined by standards. They can be divided into two groups:
- firstly the basic standards, now followed by nearly every CD-ROM disk, which define how data files are recorded on disk regardless of what kind of data is contained in the files;
- secondly, more specialized standards for the handling of data of various types, such as sound, image, or text, or a mixture of these (multimedia).

MULTIMEDIA

UNIT-3

3.1. DIGITAL AUDIO REPRESENTATION AND PROCESSING

- **3.1.1. DIGITAL REPRESENTATION OF SOUND**
- **3.1.2. TRANSLATION OF SOUND**
- **3.1.3. DIGITAL SIGNAL PROCESSING OF SOUND**
- **3.1.4. SPEECH RECOGNIZATION SYNTHESIS**
- **3.1.5. WAVEFORM AUDIO RECORDING**
- **3.1.6. CD AUDIO CLIP MAKING**
- **3.1.7. MIDI SEQUENCING VIDEO TECHNOLOGY**

3.2. DIGITAL VIDEO AND IMAGE COMPRESSION

- **3.2.1. VIDEO COMPRESSION TECHNIQUE**
- **3.2.2. JPEG IMAGE COMPRESSION STANDARDS**
- **3.2.3. MPEG MOTION VIDEO COMPRESSION STANDARDS**
- **3.2.4. VARIOUS FILE STORAGE**
- **3.2.5. DIGITAL VIDEO RECORDING**
- **3.2.6. VIDEO CLIP MAKING**

3.1. DIGITAL AUDIO REPRESENTATION AND PROCESSING

3.1.1. DIGITAL REPRESENTATION OF SOUND

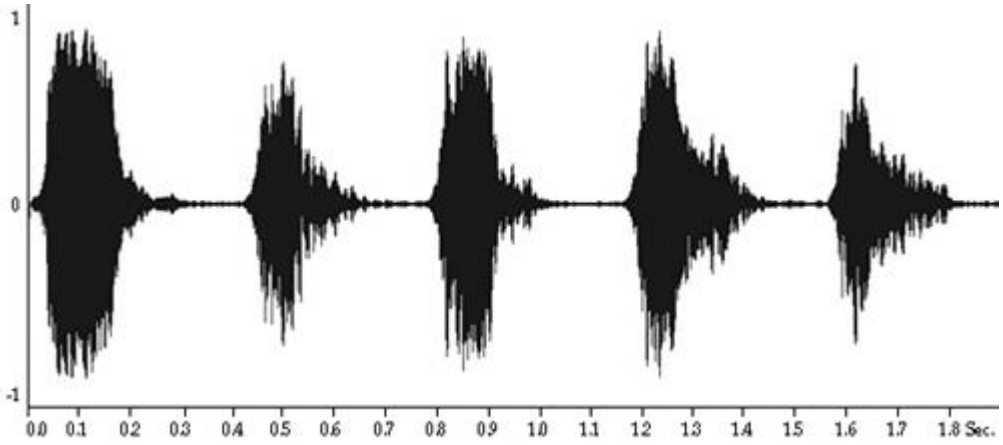
- **Digital audio** is a representation of sound recorded in, or converted into, digital form.
- In digital audio, the sound wave of the audio signal is typically encoded as numerical samples in a continuous sequence.
- For example, in CD audio, samples are taken 44,100 times per second, each with 16-bit sample depth.
- Digital audio is also the name for the entire technology of sound recording and reproduction using audio signals that have been encoded in digital form.

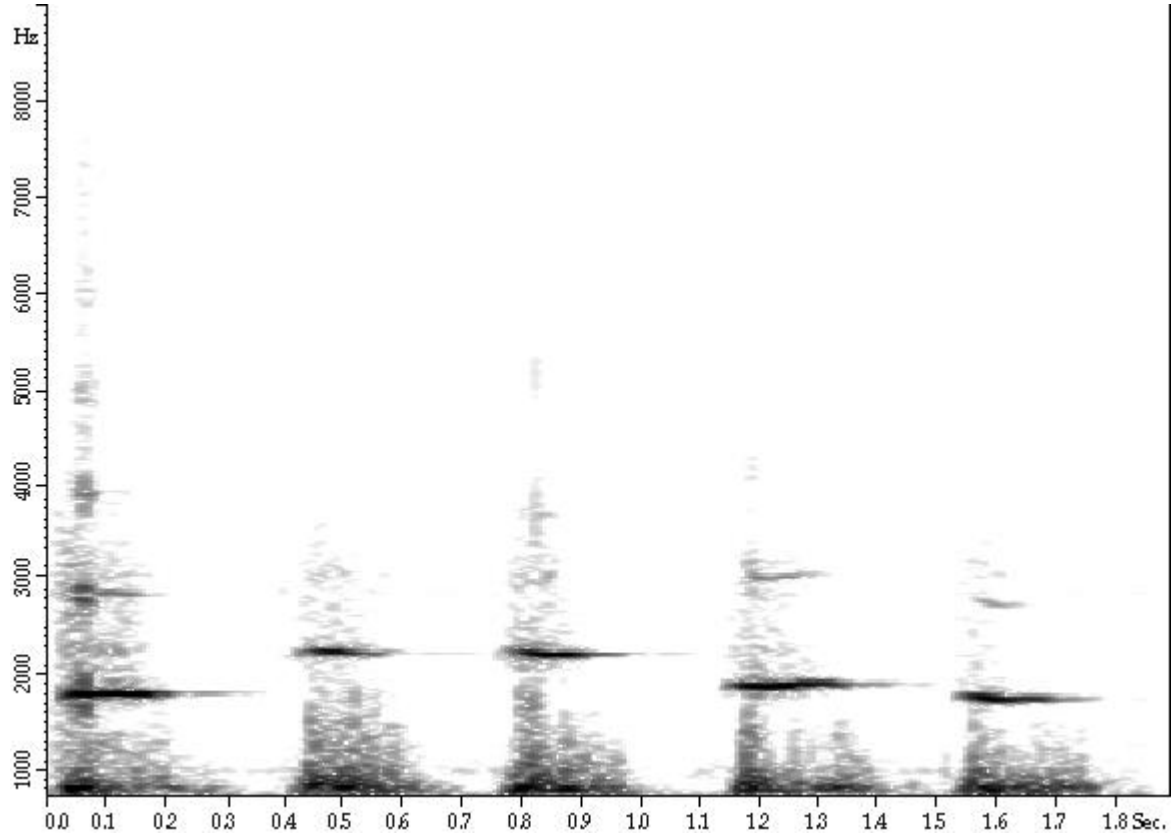
- In a digital audio system, an analog electrical signal representing the sound is converted with an analog-to-digital converter (ADC) into a digital signal, typically using pulse-code modulation (PCM).
- This digital signal can then be recorded, edited, modified, and copied using computers, audio playback machines, and other digital tools.
- When the sound engineer wishes to listen to the recording on headphones or loudspeakers (or when a consumer wishes to listen to a digital sound file), a digital-to-analog converter (DAC) performs the reverse process, converting a digital signal back into an analog signal, which is then sent through an audio power amplifier and ultimately to a loudspeaker.

- Digital audio systems may include compression, storage, processing, and transmission components. Conversion to a digital format allows convenient manipulation, storage, transmission, and retrieval of an audio signal.
- Unlike analog audio, in which making copies of a recording results in generation loss and degradation of signal quality, digital audio allows an infinite number of copies to be made without any degradation of signal quality.

3.1.2. TRANSMISSION OF DIGITAL SOUND:

- To convert sounds between our analog world and the digital world of the computer, we use a device called an *analog to digital converter* (ADC).
- A *digital to analog converter* (DAC) is used to convert these numbers back to sound (or to make the numbers usable by an analog device, like a loudspeaker). An ADC takes *smooth* functions (of the kind found in the physical world) and returns a list of *discrete* values.
- A DAC takes a list of *discrete* values (like the kind found in the computer world) and returns a *smooth,* continuous function, or more accurately the ability to create such a function from the computer memory or storage medium.





3.1.3. DIGITAL SIGNAL PROCESSING :

- **Digital signal processing** (**DSP**) is the use of digital processing, such as by computers or more specialized digital signal processors, to perform a wide variety of signal processing operations.
- The digital signals processed in this manner are a sequence of numbers that represent samples of a continuous variable in a domain such as time, space, or frequency.

- In digital electronics, a digital signal is represented as a pulse train,[1][2] which is typically generated by the switching of a transistor.[3]
- Digital signal processing and analog signal processing are subfields of signal processing.
- DSP applications include audio and speech processing, sonar, radar and other sensor array processing, spectral density estimation, statistical signal processing, digital image processing, data compression, video coding, audio coding, image compression, signal processing for telecommunications, control systems, biomedical engineering, and seismology, among others.
- DSP can involve linear or nonlinear operations. Nonlinear signal processing is closely related to nonlinear system identification[4] and can be implemented in the time, frequency, and spatio-temporal domains.
- The application of digital computation to signal processing allows for many advantages over analog processing in many applications, such as error detection and correction in transmission as well as data compression.[5]
- Digital signal processing is also fundamental to digital technology, such as digital telecommunication and wireless communications.[6] DSP is applicable to both streaming data and static (stored) data.

3.1.4. SPEECH RECOGNITION AND SYNTHESIS :

- **Speech recognition** is an interdisciplinary subfield of computer science and computational linguistics that develops methodologies and technologies that enable the recognition and translation of spoken language into text by computers.
- It is also known as **automatic speech recognition** (**ASR**), **computer speech recognition** or **speech to text** (**STT**). It incorporates knowledge and research in the computer science, linguistics and computer engineering fields.
- The system analyzes the person's specific voice and uses it to fine-tune the recognition of that person's speech, resulting in increased accuracy.

- **Speech synthesis** is the artificial production of human speech. A computer system used for this purpose is called a **speech computer** or **speech synthesizer**, and can be implemented in software or hardware products.
- A **text-to-speech** (**TTS**) system converts normal language text into speech; other systems render symbolic linguistic representations like phonetic transcriptions into speech.[1]
- Synthesized speech can be created by concatenating pieces of recorded speech that are stored in a database

3.1.5. WAVEFORM AUDIO RECORDING:

WAVEFORM-AUDIO INPUT DATA TYPES	
Type	**Description**
HWAVEIN	Handle of an open waveform-audio input device.
WAVEFORMATEX	Structure that specifies the data formats supported by a particular waveform-audio input device. This structure is also used for waveform-audio output devices.
WAVEHDR	Structure used as a header for a block of waveform-audio input data. This structure is also used for waveform-audio output devices.
WAVEINCAPS	Structure used to inquire about the capabilities of a particular waveform-audio input device.

Querying Waveform-Audio Input Devices

- Before recording waveform audio, you should call the **waveInGetDevCaps** function to determine the waveform-audio input capabilities of the system.
- This function fills a **WAVEINCAPS** structure with information about the capabilities of a specified device. This information includes the manufacturer and product identifiers, a product name for the device, and the version number of the device driver.
- In addition, the **WAVEINCAPS** structure provides information about the standard waveform-audio formats that the device supports.

Opening Waveform-Audio Input Devices

- Use the **waveInOpen** function to open a waveform-audio input device for recording. This function opens the device associated with the specified device identifier and returns a handle of the open device by writing the handle of a specified memory location.
- Some multimedia computers have multiple waveform-audio input devices. Unless you know you want to open a specific waveform-audio input device in a system, you should use the WAVE_MAPPER constant for the device identifier when you open a device.

- The **waveInOpen** function will choose the device in the system best able to record in the specified data format.

Managing Waveform-Audio Recording

- After you open a waveform-audio input device, you can begin recording waveform-audio data. Waveform-audio data is recorded into application-supplied buffers specified by a **WAVEHDR** structure.
- These data blocks must be prepared before they are used; for more information, see Audio Data Blocks.
- Windows provides the following functions to manage waveform-audio recording.

- **MANAGING WAVEFORM-AUDIO RECORDING**

Function	Description
waveInAddBuffer	Sends a buffer to the device driver so it can be filled with recorded waveform-audio data.
waveInReset	Stops waveform-audio recording and marks all pending buffers as done.
waveInStart	Starts waveform-audio recording.
waveInStop	Stops waveform-audio recording.

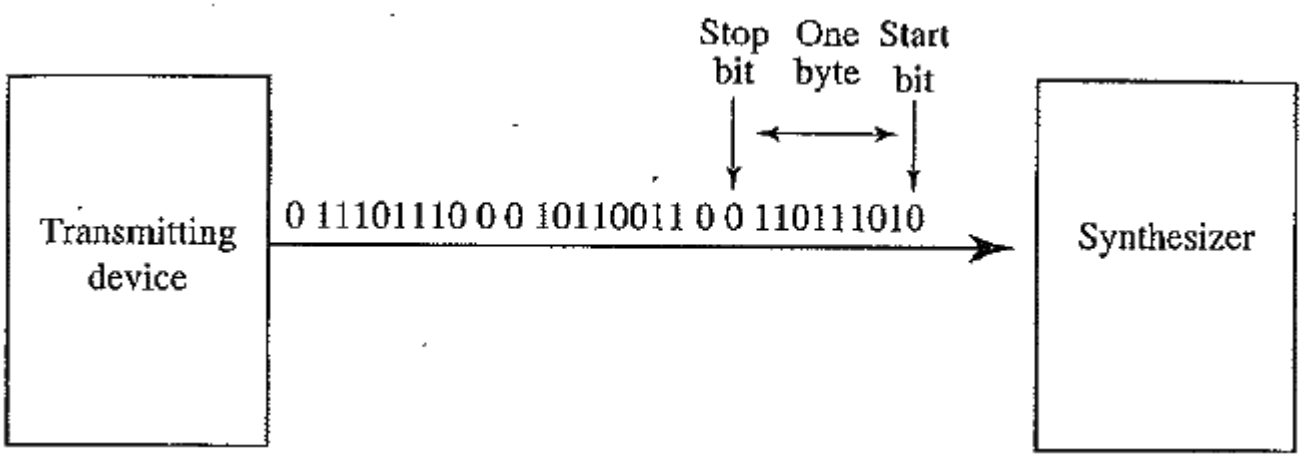
3.1.6. CD AUDIO CLIP MAKING

- **Compact Disc Digital Audio** (**CDDA** or **CD-DA**), also known as **Audio CD**, is the standard format for audio compact discs.
- The standard is defined in the ***Red Book***, one of a series of Rainbow Books (named for their binding colors) that contain the technical specifications for all CD formats.
- The audio contained in a CD-DA consists of two-channel signed 16-bit Linear PCM sampled at 44,100 Hz.
- The sampling rate is adapted from that attained when recording digital audio on a PAL (or NTSC) videotape with a PCM adaptor, an earlier way of storing digital audio.[8]
- An audio CD can represent frequencies up to 22.05 kHz, the Nyquist frequency of the 44.1 kHz sample rate.
- There was a long debate over the use of 16-bit (Sony) or 14-bit quantization, and 44,056 or 44,100 samples/s (Sony) or approximately 44,000 samples/s .
- When the Sony/Philips task force designed the Compact Disc, IT had already developed a 14-bit D/A converter (DAC), but Sony insisted on 16-bit.
- In the end Sony won, so 16 bits and 44.1 kilosamples per second prevailed. IT found a way to produce 16-bit quality using its 14-bit DAC by using four times oversampling.[9]
- Some CDs are mastered with pre-emphasis, an artificial boost of high audio frequencies.

3.1.7. MIDI SEQUENCING VIDEO TECHNOLOGY

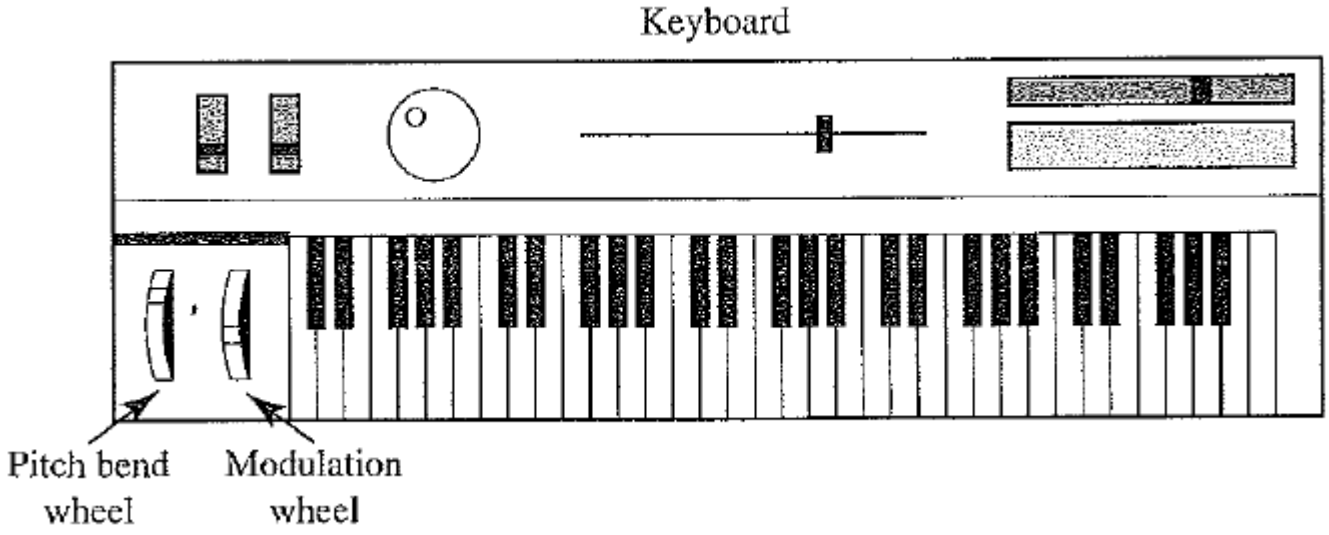
- MIDI, is an acronym that stands for *Musical Instrument Digital Interface.*
- It forms a protocol adopted by the electronic music industry that enables computers, synthesizers, keyboards, and other musical devices to communicate with each other.
- A *sequencer* started off as a special hardware device for storing and editing a *sequence* of musical events, in the form of MIDI data.
- Now it is more often a software *music editor* on the computer.
- A *MIDI keyboard* produces no sound, instead generating sequences of MIDI instructions, called MIDI messages.
- These are rather like assembler code and usually consist of just a few bytes.
- You might have 3 minutes of music, say, stored in only 3 kB. In comparison, a wave - table file (WAV) stores 1 minute of music in about 10 MB. In MIDI parlance, the keyboard is referred to as a *keyboard controller.*
- ***MIDI Concepts*.** Music is organized into *tracks* in a sequencer. Each track can be turned on or off on recording or playing back.
- Usually, a particular instrument is associated with a MIDI *channel.* MIDI channels are used to separate messages.
- There are 16 channels, numbered from 0 to 15. The channel forms the last four bits (the least significant bits) of the message.
- The idea is that each channel is associated with a particular instrument — for example, channel 1 is the piano, channel 10 is the drums.
- Nevertheless, you can switch instruments midstream, if desired, and associate another instrument with any channel.
- The channel can also be used as a placeholder in a message. If the first four bits are all ones, the message is interpreted as a *system common* message.

Stream - of 10 - bit bytes; for typical MIDI messages, these consist of {status byte, data byte, data byte) = (Note On, Note Number, Note Velocity}

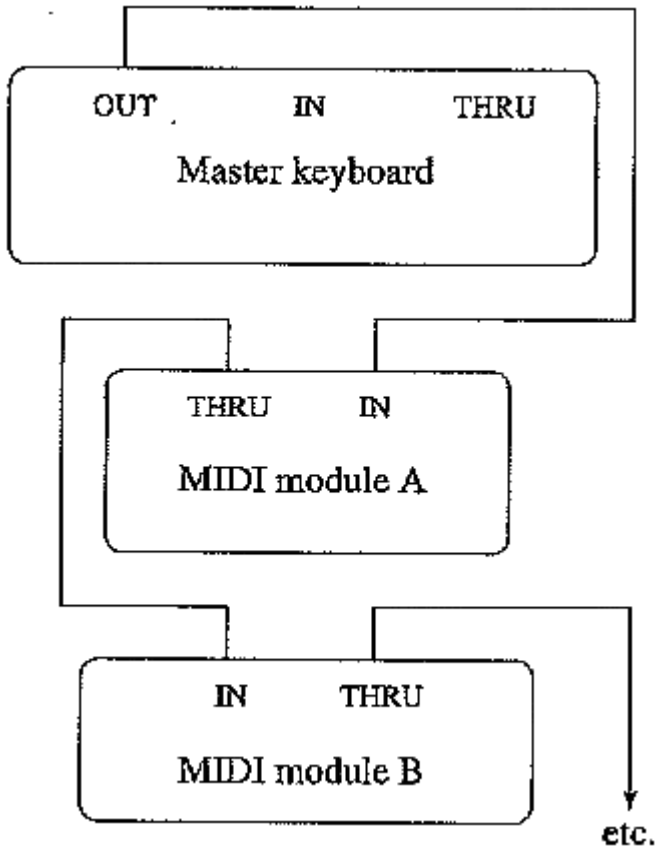


- The data in a MIDI status byte is between 128 and 255; each of the data bytes is between 0 and 127.
- Actual MIDI bytes are 8 bit, plus a 0 start and stop bit, making them 10 - bit "bytes". The above figure shows the MIDI datastream.

A MIDI Synthesizer



A typical MIDI setup

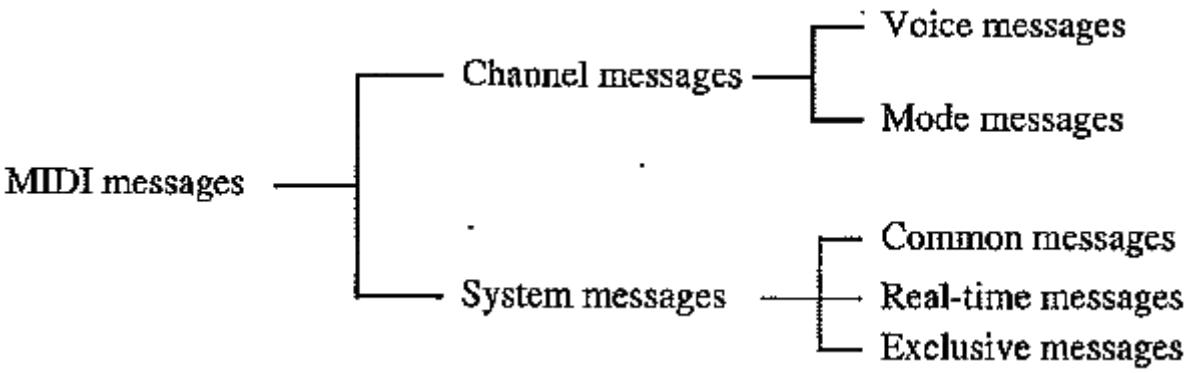


- The above figure shows a typical MIDI sequencer setup. Here, the MIDI OUT of the keyboard is connected to the MIDI IN of a synthesizer and then THRU to each of the additional sound modules.
- During recording, a keyboard - equipped synthesizer sends MIDI messages to a sequencer, which records them.
- During playback, messages are sent from the sequencer to all the sound modules and the synthesizer, which play the music.

Structure of MIDI Messages

- MIDI messages can be classified into two types, as in the following figure — channel messages and system messages — and further classified as shown.
- Each type of message will be examined below.

MIDI message taxonomy


MIDI messages
Channel messages
Voice messages
Mode messages
System messages
Common messages
Real-time messages
Exclusive messages

3.2.DIGITAL VIDEO AND IMAGE COMPRESSION

3.2.1. Video Compression Technology

- Video compression technology is a set of techniques for reducing and removing redundancy in video data.
- The compressed video must have a much smaller size compared to the uncompressed video.
- This allows the video to be saved in a smaller file or sent over a network more quickly.
- The video compression efficiency is related to the video bitrate for a given resolution and framerate.
- The compression is more efficient if it results in lower bitrates.

Video compression may be lossy, in which case the image quality is reduced compared to the original image.

- For lossy compression, the goal is to develop compression techniques that are efficient and result in perceptually lossless quality.
- In effect, even though the compressed video is different from the original uncompressed video, the differences are not easily visible to the human eye.

Spatial Compression

- Spatial compression techniques are based on still image compression.
- The most popular technique, which is adopted by many standards, is the transform technique.
- In this technique, the image is split into blocks and the transform is applied to each block. The result of the transform is scaled and quantized.
- The quantized data is compressed by a lossless entropy encoder and the output bitstream is formed from the result.
- The most popular transform algorithm is the Discrete Cosine Transform (DCT) or its modifications.
- There are many other algorithms for spatial compression such as wavelet transform, vector coding, fractal compression, etc.

Temporal Compression

- Temporal compression can be a very powerful method.
- It works by comparing different frames in the video to each other.
- If the video contains areas without motion, the system can issue a short command that copies that part of the previous frame, bit-for-bit, into the next one.
- If some of the pixels are changed (moved, rotated, change brightness, etc.) with respect to the reference frame or frames, then a prediction technique can be applied.
- For each area in the current frame, the algorithm searches for a similar area in the previous frame or frames.

- If a similar area is found, it's subtracted from the current area and the difference is encoded by the transform coder.
- The reference for the current frame area may also be obtained as a weighted sum of corresponding areas from previous and consecutive frames.
- If consecutive frames are used, then the current frame must be delayed by some number of frame periods.

3.2.2. JPEG COMPRESSION STANDARDS

- JPEG is an image compression standard that was developed by the "Joint Photographic Experts Group".
- JPEG is a **lossy** image compression method. It employs a **transform coding** method using the DCT (*Discrete Cosine Transform*).
- An image is a function of *i* and *j* (or conventionally *x* and *y*) in the *spatial domain*. The 2D DCT is used as one step in JPEG in order to yield a frequency response which is a function *F(u, v)* in the *spatial frequency domain*, indexed by two integers *u* and *v*.
- The effectiveness of the DCT transform coding method in JPEG relies on 3 major observations:
-

Observation 1: Useful image contents change relatively slowly across the image, i.e., it is unusual for intensity values to vary widely several times in a small area, for example, within an 8×8 image block.

• much of the information in an image is repeated, hence "spatial redundancy

Observation 2: Psychophysical experiments suggest that humans are much less likely to notice the loss of very high spatial frequency components than the loss of lower frequency components.

• the spatial redundancy can be reduced by largely reducing the high spatial frequency contents.

Observation 3: Visual acuity (accuracy in distinguishing closely spaced lines) is much greater for gray ("black and white") than for color.

• chroma subsampling (4:2:0) is used in JPEG

Main Steps in JPEG Image Compression

• Transform RGB to YIQ or YUV and subsample color.

• DCT on image blocks.

• Quantization.

• Zig-zag ordering and run-length encoding.

• Entropy coding

3.2.3. MPEG MOTION VIDEO COMPRESSION STANDARDS

- Direct application of the Joint Photographic Experts Group (JPEG) image compression standard, used for compression of continuous-tone still images, to video sequences is known as Motion JPEG (MJPEG).
- This approach is used when random access to each picture is essential in applications such as video editing and enhanced VCR functionality.
- It is also used in high-quality video applications in the motion picture industry. The use of MJPEG exploits the spatial redundancy of the image.
- However, this approach fails to benefit from the high temporal redundancy of consecutive image frames in video sequences.
- A video compression standard that exploits both spatial and temporal redundancies was proposed by MPEG-1.
- Its goal was to produce VCR NTSC (352 × 240) quality video compression to be stored on CD-ROM (CD-I and CD-video format) using a data rate of 1.5 Mbps.
- The next goal of the MPEG community was to develop a broadcast-quality video compression standard.
- A new method, based on the fundamental concepts present in MPEG-1, had emerged.

- This method is the well-known MPEG-2 video compression standard. Its popularity and efficiency in high-quality video compression resulted in the expansion of the standard to support higher resolution video formats including HDTV.
- MPEG-4 video compression standard, the MPEG community attempted to address low-bandwidth video compression at data rate of 64 kbps that can be transmitted over a single N-Integrated Services Digital Networks (ISDN) B channel.
- This goal of MPEG-4 had become largely superfluous due to the release of the H.263 suite of video compression standards.
- The greatest impact of MPEG-4 on practical video communication systems has focused on a couple of specific profiles:
- One popular implementation of the MPEG-4 standard relies on a version of the standard known as MPEG-4 Part 2—Simple Profile/Advanced Simple Profile (SP/ASP).
- MPEG-4 SP/ASP has been adopted by various commercial video codecs.
- Another profile of the MPEG-4 compression standard that has emerged as a powerful technique is called MPEG-4 Part 10—Advanced Video Coding (AVC).

3.2.4. VARIOUS FILE STORAGE

- Multimedia data and information must be stored in a disk file using formats similar to image file formats.
- Multimedia formats, however, are much more complex than most other file formats because of the wide variety of data they must store.
- Such data includes text, image data, audio and video data, computer animations, and other forms of binary data, such as Musical Instrument Digital Interface (MIDI), control information, and graphical fonts.
- Typical multimedia formats do not define new methods for storing these types of data. Instead, they offer the ability to store data in one or more existing data formats that are already in general use.

- For example, a multimedia format may allow text to be stored as PostScript or Rich Text Format (RTF) data rather than in conventional ASCII plain-text format.
- Still-image bitmap data may be stored as BMP or TIFF files rather than as raw bitmaps.
- Similarly, audio, video, and animation data can be stored using industry-recognized formats specified as being supported by that multimedia file format.
- Multimedia formats are also optimized for the types of data they store and the format of the medium on which they are stored.
- Multimedia information is commonly stored on CD-ROM. Unlike conventional disk files, CD-ROMs are limited in the amount of information they can store.
- A multimedia format must therefore make the best use of available data storage techniques to efficiently store data on the CD-ROM medium.
- There are many types of CD-ROM devices and standards that may be used by multimedia applications.
- CD-DA (also called the Red Book) is an optical data storage format that allows the storage of up to 74 minutes of audio (764 megabytes of data) on a conventional CD-ROM.
- The CD-DA standard evolved into the CD-XA (Compact Disc-Extended Architecture) standard, or what we call the CD-ROM (Compact Disc-Read Only Memory).
- CD-XA (also called the Yellow Book) allows the storage of both digital audio and data on a CD-ROM. Audio may be combined with data, such as text, graphics, and video, so that it may all be read at the same time.
- An ISO 9660 file system may also be encoded on a CD-ROM, allowing its files to be read by a wide variety of different computer system platforms.
- The CD-I (Compact Disc-Interactive) standard defines the storage of interactive multimedia data. CD-I (also called the Green Book) describes a computer system with audio and video playback capabilities designed specifically for the consumer market.
- CD-I units allow the integration of fully interactive multimedia applications into home computer systems.
- A still-evolving standard is CD-R (Compact Disc-Recordable or Compact Disc-Write Once), which specifies a CD-ROM that may be written to by a personal desktop computer and read by any CD-ROM player.

3.2.5. DIGITAL VIDEO RECORDING

- A **digital video recorder** comes with its own internal hard drive and users can start **recording** without the need to insert any sort of storage media.
- When it comes to analog camera **recording**, **digital video recording** supports features such as remote access motion detection, real-time playback, **recording** and backup.
- Digital video recorder (DVR) is a consumer electronics device designed for recording video in a digital format within a mass storage device such as USB flash drive, hard disk drive or any other storage device.
- Compared to other video recording alternatives, a digital video recorder has many advantages such as being tapeless, faster data retrieval and higher image quality. It is mostly used in home entertainment and in surveillance/security systems.
- Digital video recorders are also known as personal video recorders (PVR).

- A digital video recorder comes with its own internal hard drive and users can start recording without the need to insert any sort of storage media.
- When it comes to analog camera recording, digital video recording supports features such as remote access motion detection, real-time playback, recording and backup.
- When it comes to home entertainment, the television signal goes directly into the digital video recorder, and is then converted into a digital format with the help of an MPEG-2 encoder.
- From there it is transmitted to two different targets, one to the hard drive for storage and the other to the television screen for viewing.
- Newer versions of digital video recorders are capable of recording different videos from different channels simultaneously.
- Digital video recorders have many distinct advantages over other methods of video recording.
- Compared to other similar devices, digital video recorder systems are easy to set up and use.
- They also require less storage space and can provide higher image quality. Digital video recorders are also capable of faster data retrieval and immune to noise.
- However, compared to video management software or network video recorders, a digital video recorder would not be able to support multi-cameras on a single system compared to others and also would not be able to process as many frames per second.

- They do not have the advantage of edge device processing capabilities that the newer systems such as video management software and network video recorder have.

Unit IV - File Standard for Internet

- SGML, HTML, XML
- MIME
- Voice Mail
- Video
- Tele conferencing
- Problems:
  - Bandwidth
  - Performance measurement
- Multimedia Presentation
  - Authoring Design Paradigms
  - User Interfaces
- Multimedia Applications with case studies

SGML (Standard Generalized Markup Language)

- SGML (Standard Generalized Markup Language) is a standard for how to specify a document markup language or tag set. Such a specification is itself a document type definition (DTD).
- SGML is not in itself a document language, but a description of how to specify one. It is metadata.
- SGML is based on the idea that documents have structural and other semantic elements that can be described without reference to how such elements should be displayed.
- The actual display of such a document may vary, depending on the output medium and style preferences.
- Some advantages of documents based on SGML are:
  - They can be created by thinking in terms of document structure rather than appearance characteristics (which may change over time).
  - They will be more portable because an SGML compiler can interpret any document by reference to its document type definition (DTD).
  - Documents originally intended for the print medium can easily be re-adapted for other media, such as the computer display screen.
- The language that this Web browser uses, Hypertext Markup Language (HTML), is an example of an SGML-based language.
- There is a document type definition for HTML (and reading the HTML specification is effectively reading an expanded version of the document type definition).
- In today's distributed networking environment, many documents are being described with the Extensible Markup Language (XML) which is a data description language (and a document can be viewed as a collection of data) that uses SGML principles.
- SGML is based somewhat on earlier generalized markup languages developed at IBM, including General Markup Language (GML) and ISIL.

HTML (Hyper Text Markup Language)

- **HTML** stands for **Hyper Text Markup Language**, which is the most widely used language on Web to develop web pages.

- **HTML** was created by Berners-Lee in late 1991 but "HTML 2.0" was the first standard HTML specification which was published in 1995.
- HTML 4.01 was a major version of HTML and it was published in late 1999. Though HTML 4.01 version is widely used but currently we are having HTML-5 version which is an extension to HTML 4.01, and this version was published in 2012.

Features of HTML

- Originally, **HTML** was developed with the intent of defining the structure of documents like headings, paragraphs, lists, and so forth to facilitate the sharing of scientific information between researchers.
- Now, HTML is being widely used to format web pages with the help of different tags available in HTML language.
- Some of the key advantages of learning HTML:
  - ✓ **Create Web site** - You can create a website or customize an existing web template if you know HTML well.
  - ✓ **Become a web designer** - If you want to start a carrer as a professional web designer, HTML and CSS designing is a must skill.
  - ✓ **Understand web** - If you want to optimize your website, to boost its speed and performance, it is good to know HTML to yield best results.
  - ✓ **Learn other languages** - Once you understands the basic of HTML then other related technologies like javascript, php, or angular are become easier to understand.

XML (Extensible Markup Language)

- XML stands for **E**xtensible **M**arkup **L**anguage. It is a text-based markup language derived from Standard Generalized Markup Language (SGML).
- XML tags identify the data and are used to store and organize the data, rather than specifying how to display it like HTML tags, which are used to display the data. XML is not going to replace HTML in the near future, but it introduces new possibilities by adopting many successful features of HTML.
- There are three important characteristics of XML that make it useful in a variety of systems and solutions –
  - **XML is extensible** – XML allows you to create your own self-descriptive tags, or language, that suits your application.
  - **XML carries the data, does not present it** – XML allows you to store the data irrespective of how it will be presented.
  - **XML is a public standard** – XML was developed by an organization called the World Wide Web Consortium (W3C) and is available as an open standard.

XML Usage

A short list of XML usage says it all,

- XML can work behind the scene to simplify the creation of HTML documents for large web sites.
- XML can be used to exchange the information between organizations and systems.
- XML can be used for offloading and reloading of databases.
- XML can be used to store and arrange the data, which can customize your data handling needs.
- XML can easily be merged with style sheets to create almost any desired output.
- Virtually, any type of data can be expressed as an XML document.

Markup

- XML is a markup language that defines set of rules for encoding documents in a format that is both human-readable and machine-readable.
- Markup is information added to a document that enhances its meaning in certain ways, in that it identifies the parts and how they relate to each other.
- More specifically, a markup language is a set of symbols that can be placed in the text of a document to demarcate and label the parts of that document.
- Following example shows how XML markup looks, when embedded in a piece of text –

Is XML a Programming Language

- A programming language consists of grammar rules and its own vocabulary which is used to create computer programs.
- These programs instruct the computer to perform specific tasks.
- XML does not qualify to be a programming language as it does not perform any computation or algorithms.
- It is usually stored in a simple text file and is processed by special software that is capable of interpreting XML.

MIME (Multipurpose Mail Extension)

- Multipurpose Internet Mail Extensions (MIME) is an Internet standard that extends the format of email messages to support text in character sets other than ASCII, as well as attachments of audio, video, images, and application programs.
- Message bodies may consist of multiple parts, and header information may be specified in non-ASCII character sets.
- Email messages with MIME formatting are typically transmitted with standard protocols, such as the Simple Mail Transfer Protocol (SMTP), the Post Office Protocol (POP), and the Internet Message Access Protocol (IMAP).

MIME Header Fields

MIME-Version

- The presence of this header field indicates the message is MIME-formatted.
- The value is typically "1.0". The field appears as follows:

```
MIME-Version: 1.0
```

- According to MIME co-creator Nathaniel Borenstein, the version number was introduced to permit changes to the MIME protocol in subsequent versions.
- However, Borenstein admitted short-comings in the specification that hindered the implementation of this feature.

Content-Type

- This header field indicates the media type of the message content, consisting of a *type* and *subtype*, for example

```
Content-Type: text/plain
```

- Through the use of the *multipart* type, MIME allows mail messages to have parts arranged in a tree structure where the leaf nodes are any non-multipart content type and the non-leaf nodes are any of a variety of multipart types.
- This mechanism supports:
  - simple text messages using *text/plain* (the default value for "Content-Type: ")
  - text plus attachments (*multipart/mixed* with a *text/plain* part and other non-text parts). A MIME message including an attached file generally indicates the file's original name with the field "Content-Disposition", so that the type of file is indicated both by the MIME content-type and the (usually OS-specific) filename extension
  - reply with original attached (*multipart/mixed* with a *text/plain* part and the original message as a *message/rfc822* part)
  - alternative content, such as a message sent in both plain text and another format such as HTML (*multipart/alternative* with the same content in *text/plain* and *text/html* forms)
  - image, audio, video and application (for example, *image/jpeg*, *audio/mp3*, *video/mp4*, and *application/msword* and so on)
  - many other message constructs

Content-Disposition

- The original MIME specifications only described the structure of mail messages.
- They did not address the issue of presentation styles.
- The content-disposition header field was added in RFC 2183 to specify the presentation style.
- A MIME part can have:
  - an *inline* content disposition, which means that it should be automatically displayed when the message is displayed, or
  - an *attachment* content disposition, in which case it is not displayed automatically and requires some form of action from the user to open it.
- In addition to the presentation style, the field *Content-Disposition* also provides parameters for specifying the name of the file, the creation date and modification date, which can be used by the reader's mail user agent to store the attachment.
- The following example is taken from RFC 2183, where the header field is defined:

```
Content-Disposition: attachment; filename=genome.jpeg;
 modification-date="Wed, 12 Feb 1997 16:29:51 -0500";
```

Content-Transfer-Encoding

- In June 1992, MIME (RFC 1341, since made obsolete by RFC 2045) defined a set of methods for representing binary data in formats other than ASCII text format.
- The *content-transfer-encoding:* MIME header field has 2-sided significance:
- It indicates whether or not a binary-to-text encoding scheme has been used on top of the original encoding as specified within the Content-Type header:

1. If such a binary-to-text encoding method has been used, it states which one.
2. If not, it provides a descriptive label for the format of content, with respect to the presence of 8-bit or binary content.

- The RFC and the IANA's list of transfer encodings define the values shown below, which are not case sensitive.
- Note that '7bit', '8bit', and 'binary' mean that no binary-to-text encoding on top of the original encoding was used.
- In these cases, the header field is actually redundant for the email client to decode the message body, but it may still be useful as an indicator of what type of object is being sent.
- Values 'quoted-printable' and 'base64' tell the email client that a binary-to-text encoding scheme was used and that appropriate initial decoding is necessary before the message can be read with its original encoding (e.g. UTF-8).
- Suitable for use with normal SMTP:
    - 7bit – up to 998 octets per line of the code range 1..127 with CR and LF (codes 13 and 10 respectively) only allowed to appear as part of a CRLF line ending. This is the default value.
    - quoted-printable – used to encode arbitrary octet sequences into a form that satisfies the rules of 7bit. Designed to be efficient and mostly human readable when used for text data consisting primarily of US-ASCII characters but also containing a small proportion of bytes with values outside that range.
    - base64 – used to encode arbitrary octet sequences into a form that satisfies the rules of 7bit. Designed to be efficient for non-text 8 bit and binary data. Sometimes used for text data that frequently uses non-US-ASCII characters.
- Suitable for use with SMTP servers that support the 8BITMIME SMTP extension (RFC 6152):
    - 8bit – up to 998 octets per line with CR and LF (codes 13 and 10 respectively) only allowed to appear as part of a CRLF line ending.
- Suitable for use with SMTP servers that support the BINARYMIME SMTP extension (RFC 3030):
    - binary – any sequence of octets.
- There is no encoding defined which is explicitly designed for sending arbitrary binary data through SMTP transports with the 8BITMIME extension.
- Thus, if BINARYMIME isn't supported, base64 or quoted-printable (with their associated inefficiency) are sometimes still useful. This restriction does not apply to other uses of MIME such as Web Services with MIME attachments or MTOM.

Voice Mail

- A voicemail system (also known as voice message or voice bank) is a computer-based system that allows users and subscribers to exchange personal voice messages; to select and deliver voice information; and to process transactions relating to individuals, organizations, products, and services, using an ordinary phone.
- The term is also used more broadly to denote any system of conveying a stored telecommunications voice messages, including using an answering machine.
- Most cell phone services offer voicemail as a basic feature; many corporate private branch exchanges include versatile internal voice-messaging services, and *98 vertical service code subscription is available to most individual and small business landline subscribers (in the US).

History

- The term *Voicemail* was coined by Televoice International (later Voicemail International, or VMI) for their introduction of the first US-wide Voicemail service in 1980.
- Although VMI trademarked the term, it eventually became a generic term for automated voice services employing a telephone.
- Voicemail popularity continues today with Internet telephone services such as Skype, Google Voice and ATT that integrate voice, voicemail and text services for tablets and smart phones.
- Voicemail systems were developed in the late 1970s by Voice Message Exchange (VMX).
- They became popular in the early 1980s when they were made available on PC-based boards.
- In September 2012 a report from *USA Today* and Vonage claimed that voicemail was in decline.
- The report said that the number of voicemail messages declined eight percent compared to 2011.

Features

- Voicemail systems are designed to convey a caller's recorded audio message to a recipient.
- To do so they contain a user interface to select, play, and manage messages; a delivery method to either play or otherwise deliver the message; and a notification ability to inform the user of a waiting message.
- Most systems use phone networks, either cellular- or landline-based, as the conduit for all of these functions.
- Some systems may use multiple telecommunications methods, permitting recipients and callers to retrieve or leave messages through multiple methods such as PCs, PDA, cell phones, or smartphones.
- Simple voicemail systems function as a remote answering machine using touch-tones as the user interface.
- More complicated systems may use other input devices such as voice or a computer interface.
- Simpler voicemail systems may play the audio message through the phone, while more advanced systems may have alternative delivery methods, including email or text message delivery, message transfer and forwarding options, and multiple mailboxes.
- Almost all modern voicemail systems use digital storage and are typically stored on computer data storage. Notification methods also vary based on the voicemail system.
- Simple systems may not provide active notification at all, instead requiring the recipient to check with the system, while others may provide an indication that messages are waiting.
- More advanced systems may be integrated with a company's PABX, with a call center ACD for automatic call distribution; with mobile or paging terminals for message alert; and computer systems/data bases for delivering information or processing orders.
- Interactive voice response (IVR) systems may use digital information stored in a corporate data base to select pre-recorded words and phrases stored in a voicemail vocabulary to form sentences that are delivered to the caller.

Video Tele Conferencing

- Video teleconferencing (VTC) is a technology that facilitates the communication and interaction of two or more users through a combination of high-quality audio and video over Internet Protocol (IP) networks.

- Such setups are highly useful in business and enterprise computing because they simulate real and face-to-face communication over sophisticated digital platforms and established telecommunication networks.
- VTC uses standard video and voice protocols, including H.323, H.320 and Session Initiation Protocol (SIP).
- Video teleconferencing has progressed in recent decades.
- As device computing power developed during the 1990s and later, higher quality digital audio and video became more widely available - all at lower costs, leading to an increased accessibility of new videoconferencing technologies.
- There are two types of VTC systems, as follows:

    - ✓ **Dedicated systems**: Built with all of the PC and network components required for VTC sessions.
    - ✓ **Desktop systems**: These PC add-ons include a video camera, speakers, microphone and PC add-in card.

- Video teleconferencing helps users save money, time and effort. Because VTC may be used to remotely connect users from all over the world, an effective VTC setup can replace the high costs of travel to meetings and conferences.
- New hardware infrastructure for global IP networks helps support this type of usage.
- Frequent cons to teleconferencing are awkward communication due to time lags, usability, and the overall desire to meet face to face.

Problems

- ✓ Bandwidth
- ✓ Performance Measurements

Multimedia Presentation

Authoring Design Paradigms

- Multimedia authoring systems are designed with two primary target users:
- They are,
    - ✓ Professionals who prepare documents, audio or sound tracks, and full motion video clips for wide distribution.
    - ✓ Average business users preparing documents, audio recordings, or full motion video clips for stored messages' or presentations.
- The authoring system covers user interface. The authoring system spans issues such as data access, storage structures for individual components embedded in a document, the user's ability to browse through stored objects, and so on.
- Most authoring systems are managed by a control application.

Design Issues for Multimedia Authoring

- Enterprise wide standards should be set up to ensure that the user requirements are fulfilled with good quality and made the objects transferable from one system to another.
- So standards must be set for a number of design issues

    1. Display resolution

2. Data formula for capturing data
3. Compression algorithms
4. Network interfaces
5. Storage formats

Display resolution

- A number of design issues must be considered for handling different display outputs.
- They are:

  (a) Level of standardization on display resolutions.
  (b) Display protocol standardization.
  (c) Corporate norms for service degradations
  (d) Corporate norms for network traffic degradations
- As they relate to resolution issues Setting norms will be easy if the number of different work station types, window managers, and monitor resolutions are limited in number.
- But if they are more in number, setting norms will be difficult.
- Another consideration is selecting protocols to use. Because a number of protocols have emerged, including AVI, Indeo, Quick Time and so on.So, there should be some level of convergence that allows these three display protocols to exchange data and allow viewing files in other formats.

File Format and Data Compression Issues

- There are variety of data formats available for image, audio, and full motion video objects.
- Since the varieties are so large, controlling them becomes difficult. So we should not standardize on a single format.
- Instead, we should select a set for which reliable conversion application tools are available.
- Another key design Issue is to standardize on one or two compression formula for each type of data object.
- For example for facsimile machines, CCITT Group 3 and 4 should be included in the selected standard. Similarly, for full motion video, the selected standard should include MPEG and its derivatives such as MPEG2.
- While doing storage, it is useful to have some information (attribute information) about the object itself available outside the object to allow a user to decide if they need to access the object data. one of such attribute information are:

  (i) Compression type
  (ii) Size of the object
  (iii) Object orientation
  (iv) Data and time of creation
  (v) Source file name
  (vi) Version number (if any)
  (vii) Required software application to display or playback the object.

Service degradation policies

- Setting up Corporate norms for network traffic degradation is difficult as they relate to resolution Issues.
- To address these design issues, several policies are possible. They are:
  - Decline further requests with a message to try later.
  - Provide the playback server but at a lower resolution.

- Provide the playback service at full resolution but, in the case of sound and full motion video, drop intermediate frames.

Design Approach to Authoring

- Designing an authoring system spans a number of design issues. They include:
- Hypermedia application design specifics, User Interface aspects, Embedding/Linking streams of objects to a main document or presentation, Storage of and access to multimedia objects. Playing back combined streams in a synchronized manner.
- A good user interface design is more important to the success of hypermedia applications.

Types of Multimedia Authoring Systems

- There are varying degrees of complexity among the authoring systems.
- For example, dedicated authoring systems that handle only one kind of an object for a single user is simple, where as programmable systems are most complex.

Dedicated Authority Systems

- Dedicated authoring systems are designed for a single user and generally for single streams.
- Designing this type of authoring system is simple, but if it should be capable of combining even two object streams, it becomes complex.
- The authoring is performed on objects captured by the local video camera and image scanner or an objects stored in some form of multimedia object library.
- In the case of dedicated authoring system, users need not to be experts in multimedia or a professional artist.
- But the dedicated systems should be designed in such a way that. It has to provide user interfaces that are extremely intuitive and follow real-world metaphors.
- A structured design approach will be useful in isolating the visual and procedural design components.

TimeLine –based authoring

- In a timeline based authoring system, objects are placed along a timeline. The timeline can be drawn on the screen in a window in a graphic manner, or it created using a script in a mann.er similar to a project plan. But, the user must specify a resource object and position it in the timeline.
- On playback, the object starts playing at that point in the time Scale. Fig: TimeLine based authoring
- In most timeline based approaches, once the multimedia object has been captured in a timeline. It is fixed in location and cannot be manipulated easily, So, a single timeline causes loss of information about the relative time lines for each individual object.

Structured Multimedia Authoring

- A structured multimedia authoring approach was presented by Hardman.

- It is an evolutionary approach based on structured object-level construction of complex presentations. This approach consists of two stages:

  (i) The construction of the structure of a presentation.
  (ii) Assignment of detailed timing constraints.

- A successful structured authoring system must provide the following capabilities for navigating through the structure of presentation.

  1. Ability to view the complete structure.
  2. Maintain a hierarchy of objects.
  3. Capability to zoom down to any specific component.
  4. View specific components in part or from start to finish.
  5. Provide a running status of percentage full of the designated length of the presentation.
  6. Clearly show the timing relations between the various components.
  7. Ability to address all multimedia types including text, image, audio, video and frame based digital images.

- The author must ensure that there is a good fit within each object hierarchy level.
- The navigation design of authoring system should allow the author to view the overall structure while examining a specific object segment more closely.

Programmable Authoring Systems

- Early structured authoring tools were not able to allow the authors to express automatic function for handling certain routine tasks.
- But, programmable authoring system bas improved in providing powerful functions based on image processing and analysis and embedding program interpreters to use image-processing functions.
- The capability of this authoring system is enhanced by Building user programmability in the authoring tool to perform the analysis and to manipulate the stream based on the analysis results and also manipulate the stream based on the analysis results.
- The programmability allows the following tasks through the program interpreter rather than manually. Return the time stamp of the next frame.
- Delete a specified movie segment. Copy or cut a specified movie segment to the clip board. Replace the current segment with clip board contents.

Multisource Multi-user Authoring Systems

- We can have an object hierarchy in a geographic plane; that is, some objects may be linked to other objects by position, while others may be independent and fixed in position".
- We need object data, and information on composing it. Composing means locating it in reference to other objects in time as Well as space.
- Once the object is rendered (display of multimedia object on the screen) the author can manipulate it and change its rendering information must be available at the same time for display.
- If there are no limits on network bandwidth and server performance, it would be possible to assemble required components on cue at the right time to be rendered.
- In addition to the multi-user compositing function A multi user authoring system must provide resource allocation and scheduling of multimedia objects.

Telephone Authoring systems

- There is an application where the phone is linking into multimedia electronic mail applications:
- Telephone can be used as a reading device by providing fill text to-speech synthesis capability so that a user on the road can have electronic mail messages read out on the telephone.
- The phone can be used for voice command input for setting up and managing voice mail messages.
- Digitized voice clips are captured via the phone and embedded in electronic mail messages.
- As the capability to recognize continuous speech is deploy phones can be used to create electronic mail messages where the voice is converted to ASCII text on the fly by high-performance voice recognition engines.
- Phones provide a means of using voice where the alternative of text on a screen is not available.
- A phone can be used to provide interactive access to electronic mail, calendar information databases, public information database and news reports, electronic news papers and a variety of other applications.
- Integrating of all these applications in a common authoring tool requires great skill in planning.
- The telephone authoring systems support different kinds of applications. Some of them are:
    - Workstation controls for phone mail
    - Voice command controls for phone mail
    - Embedding of phone mail in electric mail

Hypermedia Application Design Consideration

- The user interface must be highly intuitive to allow the user to learn the tools quickly and be able to use them effectively.
- In addition, the user interface should be designed to cater to the needs of both experienced and inexperienced user.
- In addition to control of their desktop environments, user also need control of their system environment.
- This control the ability should to include specify some primary of the following: serverfor each object class within a domain specified by the system administrative. A domain can be viewed as a list of servers to which they have unrestricted access.
    - The ability to specify whether all multimedia -objects or only references should be replicated.
    - The ability to specify that the multimedia object should be retrieved immediately for display versus waiting for a signal to "play" the object. This is more significant if the object must be retrieved from a remote server.
    - Display resolution defaults for each type of graphics or video object.

Essential for good hypermedia design

1. Determining the type of hypermedia application.
2. Structuring the information.
3. Determining the navigation throughout the application.
4. Methodologies for accessing the information.
5. Designing the user interface.

Integration of Applications

- The computer may be called upon to run a diverse set of applications, including some combination of the following:
    - Electronic mail
    - Word processing or technical publishing
    - Graphics and formal presentation preparation software
    - Spreadsheet or some other decision support software
    - Access to a relational on object-oriented database
    - Customized applications directly related to job function
- Integration of these applications consists of two major themes: the appearance of the applications and the ability of the applications to exchange of data.

Common UI and Application Integration

- Microsoft Windows has standardized the user interface for a large number of applications by providing standardization at the following levels: Overall visual look and feel of the application windows
- This standardization level makes it easier for the user to interact with applications designed for the Microsoft Windows operational environment. Standardization is being provided for Object Linking and Embedding (OLE), Dynamic Data Exchange (DOE), and the Remote Procedure Call (RPC).

User Interface Design

- Multimedia applications contain user interface design.
- There are four kinds of user interface development tools. They are
    1. Media editors
    2. An authoring application
    3. Hypermedia object creation
    4. Multimedia object locator and browser
- A media editor is an application responsible of the creation and editing of a specific multimedia object such as an image, voice, or Video object.
- Any application that allows the user to edit a multimedia object contains a media editor.
- Whether the object is text, ~voice, or full-motion video, the basic functions provided by the editor are the same: create, delete, cut, copy, paste, move, and merge.

Navigation through the application

- Navigation refers to the sequence in which the application progresses and objects are created, searched and used.
- Navigation can be of three modes:

  (i) Direct: It is completely predefined. In this case, the user needs to know what to expect with successive navigation actions.
  (ii) Free-form mode: In this mode~ the user determines the next sequence of actions.
  (iii) Browse mode: In this mode, the user does not know the precise question and wants to get general information about a particular topic. It is a very common mode in application

based on large volumes of non-symbolic data. This mode allows a user to explore the databases to support the hypothesis.

Designing user Interfaces

- User Interface should be designed by structured following design guidelines as follows:
    - Planning the overall structure of the application
    - Planning the content of the application
    - Planning the interactive behaviour
    - Planning the look and feel of the application
- A good user interface must be efficient and intuitive by most users.
- The interactive behaviour of the application determines how the User interacts with the application. A number of issues are determined at this level.
- They are Data entry dialog boxes

Special Metaphors for Multimedia Applications

The organizer metaphor

- One must begin to associate the concept of embedding multimedia object in the appointment diary or notepad to get obvious view of the multimedia aspe.cts of the organizer.
- Other use of multimedia object in an organizer is to associate maps or voice mail directions with addresses in address books.
- The lotus organizer was the first to use a screen representation of the office diary type organizer **'Telephone Metaphor:** The role of the telephone was changed b the advent of voice mail system.
- Voice mail servers convert the analog voice and store it in digital form. With the standards for voice ~ail file formats and digital storage of sound for computer.
- Now, computer system is used to manage the phone system. The two essential components of a phone system are speakers and microphones. They are included in most personal computers.
- The telephone keypad on the screen allows using the interface just as a telephone keypad is used.
- Push buttons in dialog boxes and function selections in memos duplicate the function provided by the keypad. Push buttons, radio buttons, list boxes, and data entry fields and menu selections allow a range of functionality than can be achieved by the telephone.

Aural User Interface

- A Aural user interface allows computer systems to accept speech as direct input and provide an oral response to the user actions.
- Speech enabling is an important feature in this UI. To design AUI system first, we have to create an aural desk top which substitutes voice and ear for the keyboard and display and be able to mix and match them Aural cues should be able to represent icons, voice, menus and the windows of graphical user interface.
- AUl design involves human perception, congnitive science and psycho-acoustic theory. AUI systems learn systems to perform routine functions without user's feedback. An AUI must be temporal and use time based metaphors.

- AUI has to address the following issues
    - Recent user memory
    - Attention span
    - Rhythms
    - Quick return to missed oral cues
- The VCR metaphor: The User interface metaphor for VCR is to draw a TV on screen and provide live buttons on it for selecting channels, increasing sound volume and changing channel.
- User interface for functions such as video capture, channel play, and stored video playback is to emulate the camera, television and VCR on screen Fi5.6 shows all functions of typical video camera when it is in a video capture mode.

Multimedia Applications and case studies

- **Electronic messaging:** sending audio and video as attachments via email. Downloading audio and video. Sending simple text data through mails. It also provides store and forward message facility.

- **Image Enhancement**: highlighting details of image by increasing contrast. Making picture darker and increasing grey scale level of pixels. Rotating image in real time. Adjusting RGB to get image with proper colors.

- **Document Imaging:** storing, retrieving and manipulating large volumes of data i.e. documents. Complex documents can be send in electronics form rather than on paper. Document image systems uses workflow method.

- **Multimedia in Education field:** Multimedia is used to instruct as a master (guide) because nowadays, multimedia CD are used instead of text books. Knowledge can be easily obtained by using multimedia CD in computer because multimedia CD includes text, pictures, sound and film which helps the students to understand more easily and clearly than the text books. For the use of multimedia as an education help the PC contains a high quality display. This all has promoted the development of a wide range of computer based training .

- **Multimedia in Entertainment:** Now a days the live internet pay to play gaming with multiple players has become popular. Actually the first application of multimedia system was in the field of entertainment and that too in the video game industry. The integrated audio and video effects make various types of games more entertaining. Generally most of the video games need joystick play. Multimedia is mostly used in games. Text, audio, images and animations are mostly used in computer games. The use of multimedia in games made possible to make innovative and interactive games. It is also used in movies for entertainment, especially to develop special effects in movies and animations. Multimedia application that allows users to actively participate is called Interactive multimedia.

- **Multimedia in Advertising**: Multimedia technology is commonly used in advertisement. To promote the business and products multimedia is used for preparing advertisement.

- **Multimedia in Business:** The business application of multimedia includes, product demos, instant messaging. Multimedia is used in business for training employees using projectors, presenting sales, educating customers etc. It helps for the promotion of business and new

products. One the excellent application is voice and live conferencing. A multimedia can make a audience come live.

- **Science and Technology**: Multimedia had a wide application in the field of science and technology. The multimedia system is capable of transferring audio, and clips in addition to the regular text. It is even capable of sending message and formatted multimedia documents. At the same time the multimedia also help in live which is a live interaction through audio messages and it is only possible with the multimedia. It reduces the time and cost and can be arranged at any moment even in emergencies. It is enough for communication and meetings. At the same time the multimedia is enough useful services based on images. Similarly it is useful for surgeons as they can use images created from imaging scans of human body to practice complicated procedures such as brain removal and reconstructive surgery. The plans can be made in a better way to reduce the costs and complication.

- **Multimedia in software:** Software Engineers may use multimedia in computer from entertainment to designing digital games; it can be used as a learning process. This multimedia software's are created by professionals and software engineers.

- **Multimedia on the Web:** offering various online facilities like live TV, Pre-recorded videos, photos, animations. Plug-in and Media Players are software programmes that allow us to experience multimedia on the web. Plug-ins is software programmes that work with web browser to display multimedia. When web browser encounters a multimedia file it hands off the data to the plug-in to play (or) display the file. Multimedia players are also software programmes that can play audio and video files both ON and OFF the web.

Unit V - Virtual Reality

- Introduction
- A generic VR system
  - Virtual environment
  - Technology
  - Modes of Interaction
- VR Hardware
  - Sensor Hardware
  - Head Coupled displays
  - Acoustic hardware
  - Integrated VR
- VR Software
  - Modeling Virtual worlds
  - Physical simulations
- VR Applications

Virtual reality (VR)

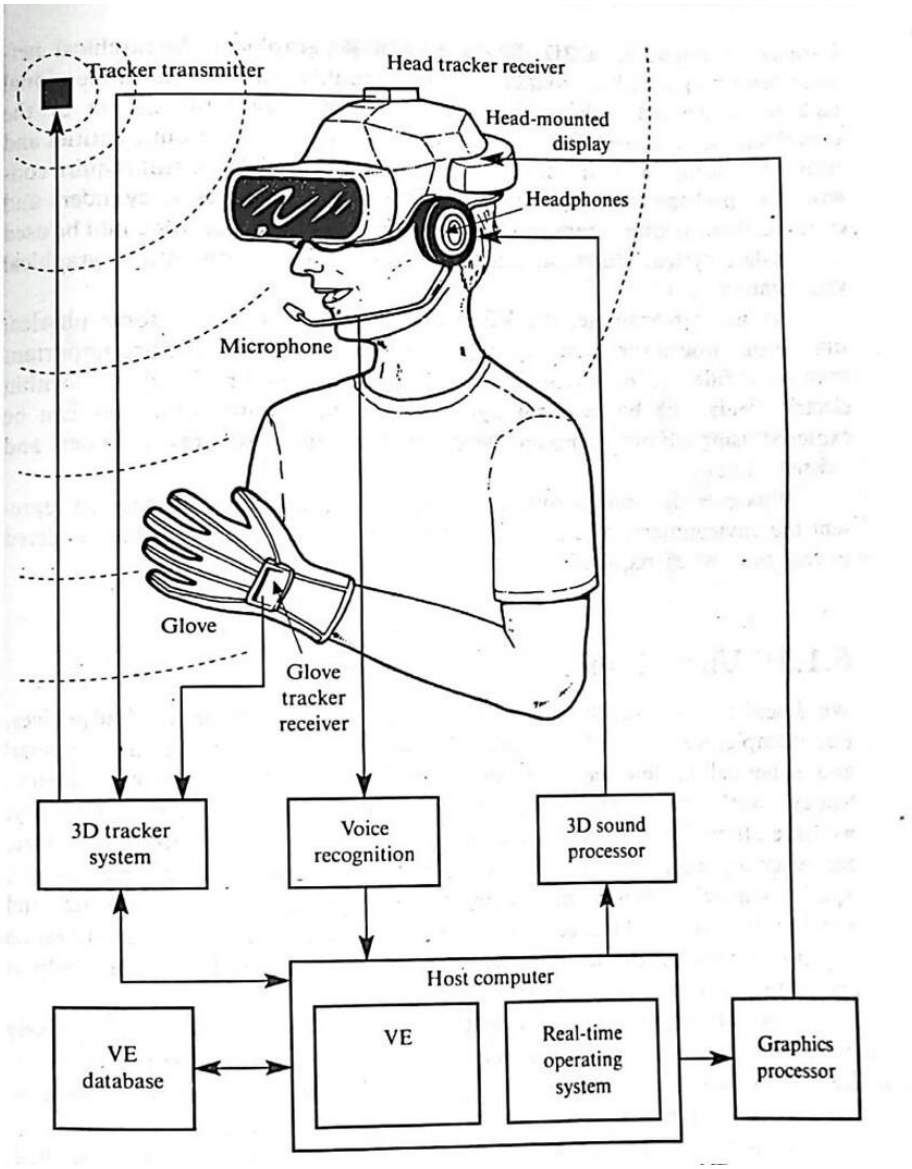
- Virtual Reality refers to a computer-generated simulation in which a person can interact within an artificial three-dimensional environment using electronic devices, such as special goggles with a screen or gloves fitted with sensors.
- Virtual reality is a simulated experience that can be similar to or completely different from the real world.
- Applications of virtual reality can include entertainment (i.e. video games) and educational purposes (i.e. medical or military training). Other, distinct types of VR style technology include augmented reality and mixed reality, sometimes referred to as extended reality or XR.

Generic VR System

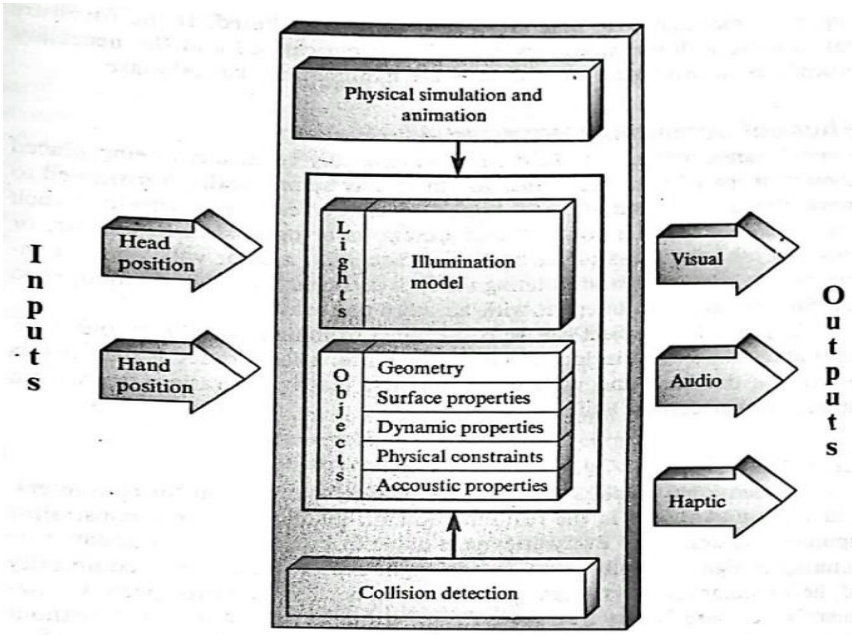
- There are four system elements to consider in virtual environment:
  - Virtual Environment
  - Computer Environment
  - VR Technology
  - Modes of Interaction
- The virtual Environment covers the ideas such as:
  - Model building
  - Introducing dynamic features
  - Physical constraints,
  - Illumination
  - Collision detection.
- The Computer Environment includes,
  - Processor configuration
  - I/O Channels

- Virtual environment database
- Real-time operating system

- Virtual Reality Technology encompasses,
  - Hardware used for head tracking
  - Hardware used for image display
  - Hardware used for sound
  - Hardware used for haptics
  - Hardware used for hand tracking
- Mode of interaction involves,
  - Hand gestures
  - 3D interfaces
  - Multi participant systems
- The integration of the various elements of generic VR system is shown below:



- The input, processes and the output s in a generic VR system is shown in below:



The VE

Virtual Reality Environment

- Virtual meaning near or proximate, virtual reality can loosely be defined as something near reality or to what we feel and experience.
- Basically a realm created beyond the scope of the real world via latest computer hardware and software technology is known as a virtual reality.

Woking of VR Environment

- Virtual reality environments, much like video games, provide sensory stimulation in a closed sensory environment.
- By isolating the user from real-world sensations, it emulates the setting by duplicating not only the objects and faces that we see in everyday lives, but also audio feedback, motion, and movements as well as orientation mechanics.
- Moreover, it provides the illusion of a placement to another location by offering an enhanced display accompanied by other modalities.
- The architecture of a VR environment consists of a high-tech computer, a human-computer interface in combination with one or more users which interact with and perceive the artificially created world.
- Three basic types of hardware devices are used to create the illusion of a virtual environment for human interaction.
- They include:
    - a set of sensors, which help detect the user's bodily movements,
    - a set of effectors, which provide the stimulation necessary for immersion into a virtual world,
    - piece of hardware that creates a connection between the sensors and the effectors.

- This, connection in turn, produces an environment that bears an uncanny resemblance to the real world.
- These hardware devices are in turn are connected to explicitly designed software which monitors the shape of the actors and surrounding objects, the virtual interactions based on rules of kinematic rules of behavior as well as the characterizations.
- A virtual reality environment focuses on each of the human senses. Sensory feedback to the user is provided numerous output devices which work in conjunction with input sensors.
- Graphic workstations are responsible for providing visual feedback while MIDI output provides the audio.

Types of VR Environment

- The cornerstone of Augmented as well as VR systems, virtual reality environments give the consumer a context preview of the experience they are about to have.
- There are a number of different VR Environments. Tailor made with vastly different features, the various types give the users extremely diverse immersive experiences.
- As such, they are broadly categorized into four types. Each category is graded based on the level of immersion and perceptiveness it provides to the users. These four main categories are:
    - Non-immersive
    - Semi-immersive
    - Completely Immersive
    - Collaborative

Non-Immersive

- Implementing the least amount of VR techniques, Non-immersive type uses the desktop system for viewing.
- By using a standard high-resolution monitor, along with conventional interactive tools such as keyboards, trackballs, or mice, Non Immersive systems are the most basic.
- Viewed via a portal or window, non-immersive systems are perfect for casual use as they do not require any fancy hardware, nor any complex virtual reality environment in computer graphic performance. They can and are easily, and economically used on a regular high specification personal computers via a VR software.

Semi Immersive

- Using slightly more complex VR technologies, a semi- immersive virtual reality environment or system is one of the latest of the lot.
- Providing a greater sense of immersion and presence than the non-immersive version, the perfect example of a semi-immersive type would be a flight simulator.
- A flight simulator with large projection screens and a great projection system and monitors allows the user to indulge partly in an immersive atmosphere but still be aware of real world surroundings.
- Ease of use, cost and logistics are proving semi-immersive VR environment to far better than the fully immersive system. Another example of a system utilizing a semi-immersive type would be the use of Liquid Crystal Shutter Glasses.

Completely Immersive

- VR systems that provide the most direct and encompassing experience are the fully immersive virtual reality environments.
- They are usually provided with the help of Head-Mounted Displays (HMD) or a head-coupled display for example Binocular Omni-Orientation Monitor (BOOM).
- One of the main systems to provide a fully immersive experience is CAVE (Cave Automatic Virtual Environment).
- A multi-user, high-resolution video, and audio virtual environment, CAVE is a full room sized VR Device.
- Projection setup which involves the user wearing a pair of head-mounted display, a fully immersive system is achieved by displaying two identical three dimensional images at very close range to the eye which the brain processes into one single image.

Collaborative

- Another type that is becoming increasingly popular these days is a collaborative virtual environment.
- Allowing a number of people based at various locations to interact with one another in a similar space, collaborative system gives a group of individuals a collective experience.
- It is the collaborative system, which when accompanied by a mix of the real world fragments, is known as augmented reality environment.

Virtual Reality Technology

- Virtual reality (VR) technology is based on computer graphics, which can build virtual scenes and items to be manipulated by the user through input devices, and to be seen, heard, touched, even smelled through output devices, and the user can feel high immersion during the interaction.
- By using a well-designed and built VR system, users can feel almost like they were in the real world.
- In VR, the environment shown is totally virtual, which is opposite to the real world, and between them there are augmented reality and augmented virtuality.
- Virtual reality (VR) technology could be divided into three types:
    - Screen-based general type
    - Projector-based customized type
    - Head-mounted display (HMD)-based intuitive type

Modes of Interaction

- VR has three distinct characteristics: interaction, immersion, and imagination.
- Interaction refers to the natural interaction between the user and the virtual scene. It provides the users with the same feeling as the real world through feedback.

- Immersion means that the users feel that they are part of the virtual world in the VR scene, as if they are immersed.
- Imagination refers to the use of multi-dimensional perception information provided by VR scenes to acquire the same feelings as the real world while acquiring the feelings that are not available in the real world.

Virtual Reality Hardware

- The hardware produces stimuli that override the senses of the user based on human motions.
- The VR hardware accomplishes this by using sensors for tracking motions of user such as button presses, controller movements, eye and other body part movements.
- It also considers the physical surrounding world because only engineered hardware and software does not constitute the complete VR system.
- The organism (users) and its interaction with the hardware is equally important.
- VR hardware constitutes of sensors which act as transducer to convert the energy it receives into a signal from an electrical circuit.
- This sensor has receptor to collect the energy for conversion and organism has sense organs such as eyes and ears for the same purpose. As the user moves through the physical world, it has its own configuration space which are transformed or configured correspondingly.
- It has four types:
    - ✓ Sensor Hardware
    - ✓ Head Coupled displays
    - ✓ Acoustic hardware
    - ✓ Integrated VR

Sensor Hardware

- When interacting with virtual environment, various sensors and transducers are needed to monitor user's actions and feedback signals that reflects the status of something within the environment.
- Designing of sensors to capture the data is not a difficulty problem. The difficulty is making these devices reliable, repeatable, accurate, fast, portable, safe, robust and low cost.
- Some of the important sensors that are being integrated with VR systems are:
    - Tracking Sensors
        - ADL-1
        - Logitech Head tracker, Dextrous Hand master
        - Space ball 2003 and Biomuse
    - Force feedback sensors
        - Touch Master
        - SAFiRE and Power Stick
        - Force Arm Master and Force Feedback Master
    - The GLAD-IN-ART Project

Head-Coupled Displays (HMD's)

- HMD's are developed for military pilots for integrating and navigational and tactical data.
- Some of the widely used HMD's are as follows:
    - Military HMD's
    - General Purpose HMD's
        - Datavisor
        - MRG2
        - VIM (Visual Immersion Model)
        - Visette2
        - VR4
    - Boom devices
    - Virtual Screens

Acoustic Hardware

- Crystal River engineering, Inc., provides special support in 3D sound with their four products such as:
    - Convolvotron
    - Beachtron
    - Acoustetron
    - Alphatron

Integrated VR System

- The term *integrated* described as, they provide a coherent system where a virtual world can be created, simulated, visualized and if necessary, experienced through immersion.
- There are some companies involved in VR systems such as,
    - Division Ltd
    - Sense 8 Corporation
    - Super scape Ltd
    - Virtuality Ltd

Virtual Reality Software

- Virtual Reality Software is used to create immersive 3D environments that could be used for training and product prototyping.

- VR software environment, in particular look at modelling tools for building virtual world, simulating physical behaviours and how this environment is supported when subjected to real time interaction.

Modeling of virtual worlds

- Virtual worlds are dynamic computer-based three-dimensional visual environments in which the user can participate.
- The user can manipulate the objects in the virtual world (e.g., pick up, turn, ...) which creates the feeling that the objects are physically present in the space.
- Therefore the goal of a virtual world is to come as close as possible to the reality it simulates.
- Virtual worlds are relatively new and most research in this domain is situated in the context of hardware, visualization techniques and algorithms, programming languages for interactive 3D applications and in applications for building 3D environments.
- In a majority of the cases the design of a virtual world happens in an ad hoc way and is very close to the implementation level. It stays a job for specialists.
- This research consists of the introduction of a conceptual level for modeling virtual worlds.
- The main goal of this research in to introduce a conceptual modeling language for virtual reality (VR).
- Conceptual modeling is the activity of building a model of an application domain in terms that are familiar to actors in the domain and not in terms of a technical implementation.
- The introduction of a conceptual level for modeling virtual worlds must open up the use of VR and must also allow to handle the complexity of developing a virtual world.
- The main purpose of this project is to introduce conceptual modeling concepts to specify complex 3D objects in Virtual World and to rigorously define the semantics of these new modeling concepts using logic.

Physical Simulation

- A virtual reality physics simulation (VRPS) is an educational tool using a virtual reality interface that brings together a 3D model of real apparatus and a virtual visualization of physical situations in an interactive manner.
- VRPS enhances students' understanding by providing a degree of reality unattainable in a traditional two-dimensional interface, creating a sensory-rich interactive learning environment.
- A computer-based virtual reality simulation that helps students to learn physics concepts such as wave propagation, ray optics, relative velocity, electric machines, etc. at the level of high school or college physics.

Virtual Reality Applications

- Virtual reality applications are applications that make use of virtual reality (VR), an immersive sensory experience that digitally simulates a virtual environment.
- Applications have been developed in a variety of domains, such as education, architectural and urban design, digital marketing and activism, engineering and robotics, entertainment,

fine arts, healthcare and clinical therapies, heritage and archaeology, occupational safety, social science and psychology.

Architecture and urban design

- One of the first recorded uses of virtual reality in architecture was in the late 1990s when the University of North Carolina virtually modelled Sitterman Hall, home of its computer science department.
- Designers wore a headset and used a hand controller to simulate moving around a virtual space.
- With an Autodesk Revit model they could "walk through" a schematic. VR enables architects to better understand the details of a project such as the transition of materials, sightlines, or visually displays of wall stress, wind loads, solar heat gain, or other engineering factors.
- By 2010, VR programs had been developed for urban regeneration, planning and transportation projects.Entire cities were simulated in VR.
- Studies on exposure to nature environments shows how it is able to produce relaxation, recover attention capacity and cognitive function, reduce stress and stimulate positive mood.
- Immersive virtual reality technology is able to replicate believable restorative nature experiences, either using 360 degree video footage or environments created from 3D real-time rendering often developed using game engines.
- This is useful for users who are deprived from accessing certain areas, due to e.g. physical restraints or complications, such as senior citizens or nursing home residents.
- Restorative virtual environments are able replicate and mediate real world experiences using video footage, replicate these using 3D rendering or can be based loosely on real world environment using real-time 3D rendering.

Healthcare

- VR began to appear in rehabilitation in the 2000s. For Parkinson's disease, evidence of its benefits compared to other rehabilitation methods is lacking.
- A 2018 review on the effectiveness of VR mirror therapy and robotics found no benefit.
- Virtual reality exposure therapy (VRET) is a form of exposure therapy for treating anxiety disorders such as post traumatic stress disorder (PTSD) and phobias.
- Studies have indicated that combining VRET with behavioral therapy, patients experience a reduction of symptoms. In some cases, patients no longer met the DSM-V criteria for PTSD.
- Immersive VR can motivate exercise with challenged sedentary users, such as for rehabilitation centers or senior citizen homes, increasing quality of life and independence through increased physical activity.
- Immersive VR has also been shown useful for acute pain management, on the theory that it may distract people, reducing their experience of pain.
- Some companies and researchers are adapting VR for fitness, either motivating physical therapy or exercise, e.g. by contextualizing e.g. biking through VR-based experiences, or by using gamification concepts to encourage exercise.

Digital marketing

- Virtual reality presents an opportunity and an alternative channel for digital marketing.
- International Data Corporation expected spending to increase for augmented and virtual reality, forecasting a compound annual growth rate of 198% in 2015–2020. Revenues were expected to rise to $143.3 billion in 2020.

- Global spending on digital advertisements was forecast to increase to $335.5 billion by 2020.
- A 2015 study found that 75% of companies on Forbes' World's Most Valuable Brands list had developed a VR or AR experience.
- Although VR is not widespread among consumers compared to other forms of digital media, many companies have invested in VR. Some companies adopted VR to enhance workplace collaboration.
- VR can present high definition, three-dimensional interactive imaging.
- Its marketing benefits were observed by Suh and Lee through via laboratory experiments: with a VR interface, participants' product knowledge and product attitude noticeably increased. VR marketing can engage consumers' emotions.[28] Both studies indicate an increased desire to purchase products marketed through VR; however, these benefits showed minimal return on investment (ROI). Suh and Lee found that products that are primarily experienced through hearing and vision benefit more from VR marketing.
- Ads that appear during a VR experience may be considered invasive.
- Consumers want to decide whether to accept an ad. Organizations can for example require the user to download a mobile app before experiencing their VR campaign.
- Non-profit organizations have used VR to bring potential supporters closer to distant social, political and environmental issues in immersive ways not possible with traditional media. Panoramic views of the conflict in Syria and face-to-face encounters with CGI tigers in Nepal are some examples.
- Retailers use VR to show how a product will fit in consumers' homes. Consumers looking at digital photos of the products can virtually spin the product to view it from the side or back.
- Architectural design firms allow clients to tour virtual models of proposed buildings. Architects can use VR to experience their developing designs.
- VR models can replace scale models. Developers and owners can create VR models of existing structures.

Education and training

- VR is used to help learners develop skills without the real-world consequences of failing, especially useful in realms with life-or-death implications.
- The specific device used to provide the VR experience, whether it be through a mobile phone or desktop computer, does not appear to impact on any educational benefit.

Flight and vehicular applications

- Flight simulators are a form of VR training. They can range from a fully enclosed module to computer monitors providing the pilot's point of view.
- Driving simulations can train tank drivers on the basics before allowing them to operate the real vehicle.
- Similar principles are applied in truck driving simulators for specialized vehicles such as fire trucks. As these drivers often have limited opportunity for real-world experience, VR training provides additional training time.

Medicine

- VR technology has many useful applications in the medical field.
- Through VR, novice surgeons have the ability to practice complex surgeries without stepping into the operating room.
- Physicians who experience VR simulations improved their dexterity and performance in the operating room significantly more than control groups.
- VR can produce a three dimensional representation of a particular patient's anatomy that allows surgeons to map out the surgery ahead of time.

Military

- In 1982 Thomas A. Furness III presented the United States Air Force with a working model of his virtual flight simulator, the Visually Coupled Airborne Systems Simulator (VCASS).
- The second phase of his project, which he called the "Super Cockpit", added high-resolution (for the time) graphics and a responsive display.
- The United Kingdom has been using VR in military training since the 1980s.
- The United States military announced the Dismounted Soldier Training System in 2012. It was cited as the first fully immersive military VR training system.
- Virtual training environments have been claimed to increase realism while minimizing cost, e.g., by saving ammunition.
- In 2016, researchers at the U.S. Army Research Laboratory reported that instructor feedback is necessary for virtual training.
- Virtual training has been used for combined arms training and instructing soldiers to learn when to shoot.
- Military programs such as Battle Command Knowledge Systems (BCKS) and Advanced Soldier Sensor Information and Technology (ASSIST) were intended to assist the development of virtual technology.
- Described goals of the ASSIST initiative were to develop software and wearable sensors for soldiers to improve battlefield awareness and data collection.
- Researchers stated that these programs would allow the soldier to update their virtual environment as conditions change.
- Virtual Battlespace 3 (VBS3, successor to the earlier versions named VBS1 and VBS2) is a widely used military training solution adapted from a commercial off the shelf product.
- Live, Virtual, Constructive – Integrated Architecture (LVC-IA) is a U.S. military technology that allows for multiple training systems to work together to create an integrated training environment.
- Reported primary uses of the LVC-IA were live training, virtual training, and constructive training. In 2014, the LVC-IA version 1.3 included VBS3.

Space

- NASA has used VR technology for decades. Most notable is their use of immersive VR to train astronauts before flights.
- VR simulations include exposure to zero-gravity work environments, training on how to spacewalk and tool usage using low cost tool mock-ups.

Engineering and robotics

- In the mid-to-late 1990s 3D computer-aided design (CAD) data took over when video projectors, 3D tracking and computer technology enabled its use in virtual reality environments.
- Active shutter glasses and multi-surface projection units appeared. Virtual reality has been used in automotive, aerospace, and ground transportation original equipment manufacturers.
- Virtual reality aids prototyping, assembly, service and performance use-cases. This enables engineers from different disciplines to experience their design.
- Engineers can view the bridge, building or other structure from any angle. Simulations allow engineers to test their structure's resistance to winds, weight, and other elements.
- Virtual reality can control robots in telepresence and telerobotic systems. VR has been used in experiments that investigate how robots can be applied as an intuitive human user interface. Another example is remotely-controlled robots in dangerous environments.

Entertainment

Video games

- Early commercial virtual reality headsets were released for gaming during the early-mid 1990s. These included the Virtual Boy, iGlasses, Cybermaxx and VFX1 Headgear.
- Since 2010, commercial headsets for VR gaming include the Oculus Rift, HTC Vive and PlayStation VR. The Samsung Gear VR is an example of a phone-based device.
- Other modern examples of VR for gaming include the Wii Remote, the Kinect, and the PlayStation Move/PlayStation Eye, all of which track and send player motions to the game. Many devices complement VR with controllers or haptic feedback.
- VR-specific and VR versions of popular video games have been released.

Cinema

- Films produced for VR permit the audience to view scenes in 360 degrees. This can involve the use of VR cameras to produce interactive films and series. Pornography makers use VR, usually for POV-style porn.
- The 2016 World Chess Championship match between Magnus Carlsen and Sergey Karjakin was promoted as "the first in any sport to be broadcast in 360-degree virtual reality."
- However, a VR telecast featuring Oklahoma hosting Ohio State, preceded it on September 17, 2016. The telecasts (which used roughly 180 degrees of rotation, not the 360 required for full VR) were made available through paid smartphone apps and head-mounted displays.

Music

- VR can allow individuals to virtually attend concerts. VR concerts can be enhanced using feedback from the user's heartbeat and brainwaves.
- Virtual reality can be used for other forms of music, such as music videos and music visualization or visual music applications.