UNIT 2 MULTIMEDIA

Structure **Page Nos.**

2.0 INTRODUCTION

Multimedia is a new aspect of literacy that is being recognised as technology expands the way people communicate. The concept of literacy increasingly, is a measure of the ability to read and write. In the modern context, the word, means reading and writing at a level adequate for written communication. A more fundamental meaning is now needed to cope with the numerous media in use, perhaps meaning a level that enables one to function successfully at a certain status in society. Multimedia is the use of several different media to convey information. Several different media are already a part of the canon of global communication and publication: (text, audio, graphics, animation, video, and interactivity). Others, such as virtual reality, computer programming and robotics are possible candidates for future inclusion. With the widespread use of computers, the basic literacy of

'reading' and 'writing' are often done via a computer, providing a foundation stone for more advanced levels of multimedia literacy.

Multimedia is the use of several media (e.g. text, audio, graphics, animation, video) to convey information. Multimedia also refers to the use of computer technology to create, store, and experience multimedia content.

In this unit, we will learn about the basics of multimedia and its applications including graphics, audio, video etc. We will also learn some basic multimedia authoring tools.

2.1 OBJECTIVES

After going through this unit, you should be able to:

- describe hypertext and hypermedia concepts,
- describe how multimedia applications are influencing every aspect of life,
- discuss different file formats used for multimedia applications, and
- give basic description of various multimedia tools.

2.2 CONCEPT OF HYPER TEXT AND HYPER MEDIA

Any student, who has used online help for gaming etc., will already be familiar with a fundamental component of the Web-Hypertext.

Hypertext is the concept whereby, instead of reading a text in a liner fashion (like a book), you can at many points jump from one place to another, go forward or back, get much more detail on the current topic, change direction and navigate as per your desire.

- **Hypertext:** Hypertext is conceptually the same as regular text - it can be stored, read, searched, or edited - with an important difference: hypertext is text with pointers to other text. The browsers let you deal with the pointers in a transparent way -- select the pointer, and you are presented with the text that is pointed at.

- **Hypermedia:** Hypermedia is a superset of hypertext. Hypermedia documents contain links not only to other pieces of text, but also to other forms of media - sounds, images, and movies. Images themselves can be selected to link to sounds or documents. Hypermedia simply combines hypertext and multimedia.

Some examples of Hypermedia might be:

- You are reading a text that is written in Hindi. You select a Hindi phrase, then hear the phrase as spoken in the native tongue.
- You are viewing a manufacturing plant's floor plan, you select a section by clicking on a room. The employee's name and picture appears with a list of their current projects.
- You are a law student studying the University Revised Statutes. By selecting a passage, you find precedents from a 1920 Supreme Court ruling stored at Law Faculty. Cross-referenced hyperlinks allow you to view any one of 500 related cases with audio annotations.

Hypertext and HyperMedia are concepts, not products and both terms were coined by **Ted Nelson**.

2.2.1 Definitions of Hypertext

- A way of presenting information online with connections between one piece of information and another. These connections are called hypertext links. Thousands of these hypertext links enable you to explore additional or related information throughout the online documentation. See also hypertext link.
- This term describes the system that allows documents to be cross- linked in such a way that the reader can explore related documents by clicking on a highlighted word or symbol.
- A non-sequential method for reading a document displayed on a computer screen. Instead of reading the document in sequence from beginning to end, the reader can skip to topics by choosing a highlighted word or phrase embedded within the document. This activates a link, connecting the reader to another place in the same document or to another document. The resultant matrix of links is called a web.
- This is a mark-up language that allows for non-linear transfers of data. The method allows your computer to provide the computational power rather than attaching to a mainframe and waiting for it to do the work for you.
- In computing, hypertext is a user interface paradigm for displaying documents which, according to an early definition (Nelson 1970), "branch or perform on request." The most frequently discussed form of hypertext document contains automated cross-references to other documents called hyperlinks. Selecting a hyperlink causes the computer to display the linked document within a very short period of time.

2.2.2 Definitions of Hypermedia

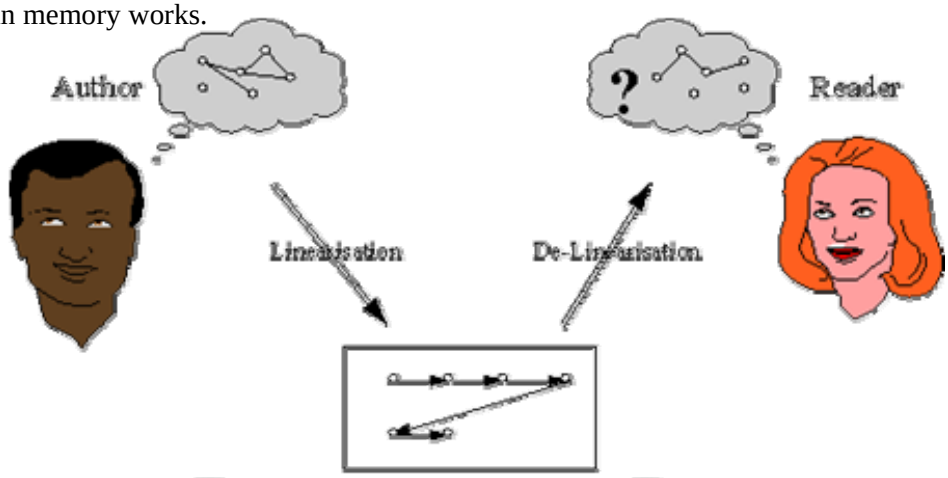
- **Hypermedia** is a term created by **Ted Nelson** in 1970. It used as a logical extension of the term hypertext, in which graphics, audio, video, plain text and hyperlinks intertwine to create a generally non-linear medium of information. This contrasts with multimedia, which, although often capable of random access in terms of the physical medium, is essentially linear in nature. The difference should also be noted with hypergraphics or super-writing which is a Lettrist form from the 1950s which systemises creativity across disciplines.

A classic example of hypermedia is World Wide Web, whereas, a movie on a CD or DVD is an example of standard multimedia. The difference between the two can (and often do) blur depending on how a particular technological medium is implemented. The first hypermedia system was the Aspen Movie Map.

2.2.3 Understanding the Concept

For understanding the concept of Hypertext and Hypermedia we will look at how the human memory works.

(a)



(b)

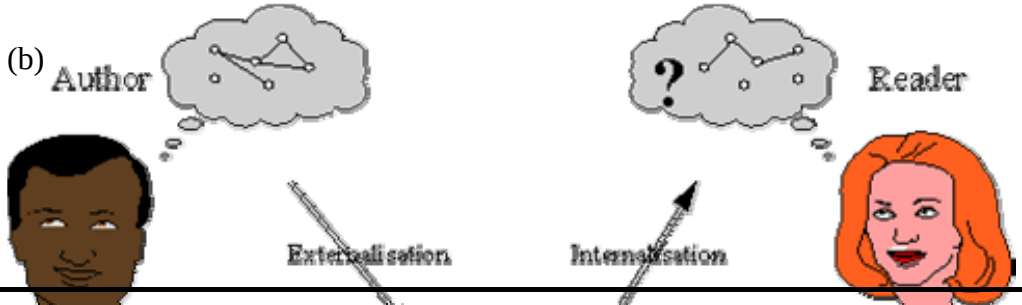


Figure 1: (a) Process of writing and reading using traditional linear media (b) Process of writing and reading using non-linear hypermedia.

2.2.4 Hypertext/media and Human Memory

Humans associate pieces of information with other information and create complex knowledge structures. Hence, it is also said that the human memory is associative. We often remember information via association. For example, a person starts with an idea which reminds of a related idea or a concept which in turn reminds him/her of another idea. The order in which a human associates an idea with another idea depends on the context under which the person wants information.

When writing, an author converts his/her knowledge which exists as a complex knowledge structure into an external representation. Information can be represented only in a linear manner using physical media such as printed material and video tapes. Therefore, the author has to convert his/her knowledge into a linear representation using a linearisation process. This is not easy. So the author will provide additional information, such as a table of contents and an index, to help the reader understand the overall organisation information.

The reading process can be viewed as a transformation of external information into an internal knowledge base combined with integration into existing knowledge structures, basically a reverse operation of the writing process. For this, the reader breaks the information into smaller pieces and rearranges those based on the readers' information requirement. We rarely read a text book or a scientific paper from start to finish. We tend to browse through the information and then follow the information headings that are interesting to us.

Hypermedia, using computer enabled links, allows us to partially imitate writing and reading processes as they take place inside our brain. We can create non linear information structures by associating pieces of information in different ways using links. Further, we can use a combination of media comprising of text, images, video, sound and animation for value addition in the representation of information. It is not necessary for an author to go through a linearisation process of his/her knowledge when writing. Also, the reader can access some of the information structures the author had when writing the information. This will help the reader create his/her own representation of knowledge and to amalgamate that knowledge into the existing knowledge structures.

In addition to being able to access information through association, hypermedia applications are supported by a number of additional aspects. These include an ability to incorporate various media, interactivity, vast data sources, distributed data sources, and powerful search engines. All these make hypermedia an extremely powerful tool to create, store, access and manipulate information.

2.2.5 Linking

Hypermedia systems as well as information in general contains various types of relationships between various information elements. Examples of typical relationships include similarity in meaning or context , similarity in logical sequence or temporal sequence, and containment.

Hypermedia allows these relationships to be installed as links which connect the various information elements, so that these links can be used to navigate within the information space.

One possible structure is based on the mechanics of the links. We can also look at the number of sources and destinations for links (single-source single-destination, multiple-source single-destination, etc.) the directionality of links (unidirectional, bi-directional), and the anchoring mechanism (generic links, dynamic links, etc.).

A more useful link structure is based on the type of information relationships being represented. In particular, we can divide relationships into those based on the organisation of the information space called structural links and those related to the content of the information space called associative and referential links.

Let us take a brief look at these links.

Structural Links: The information contained within the hypermedia application is typically organised in some suitable fashion. This organisation is represented using structural links. We can group structural links together to create different types of application structures. If we look, for example, at a typical book, then this has both a linear structure i.e. from the beginning of the book linearly to the end of the book and usually a hierarchical structure in the form of the book contains chapters, the chapters contain sections, the sections containing matter. Typically in a hypermedia application we try to create and utilise appropriate structures.

Associative Links: An associative link is a link which is completely independent of the specific structure of the information. For instance we have links based on the meaning of different information components. The most common example which most people would be familiar with is cross-referencing within books for example – for more information on X refer to Y. It is these relationships - or rather the links which are a representation of the relationships – which provide the essence of hypermedia, and in many respects can be considered to be the defining characteristic of hypermedia.

Referential Links: A third type of link is a referential link. It is related to the associative link. Rather than representing an association between two related concepts, a referential link provides a link between an item of information and an explanation of that information. A simple example would be a link from a word to a definition of that word. One simple way of understanding the difference between associative and referential links is that the items linked by an associative link can exist independently, but are related at a conceptual level.

☞Check Your Progress 1

1) Define hypertext and hypermedia?

   ……

   ……

   ……

   ……

2) Explain the concept of hypermedia/text in terms of human memory.

   ……

   ……

……

……

3) Illustrate various links used in hypermedia.

……

……

……

……

2.3 MULTIMEDIA APPLICATIONS

Multimedia, the term itself clarifies that, it is a combination of different medias of communication like, text, graphic, audio etc. Now-a-days this field of multimedia is taken as the tool as well as one of the best option to communicate your throughout electronically.

In the section, after having briefings of the descipline of multimedia we will discuss its application in various fields.

2.3.1 What is Multimedia

Introduction

People only remember 20% of what they see and 30% of what they hear. But they remember 50% of what they see and hear, and as much as 80% of what they see, hear, and do simultaneously. Computer Technology Research, 1993

Multimedia is any mixture of text, graphics, art, sound, animation and video with links and tools that let the person navigate, interact, and communicate with the computer. When you allow the viewer to control what and when these elements are delivered, it is **interactive multimedia.** When you provide a structure of linked elements through which the learner can navigate, interactive multimedia becomes **hypermedia.**

Although the definition of multimedia is simple, making it work can be very complex. Not only do you need to understand how to make each multimedia element work, but you also need to know how to effectively blend the elements together using educational multimedia computer tools. If done properly, **interactive multimedia** excels in leaving lasting impressions in the learning process. Retention rates increase by 25% to 50%.

Interactive Multimedia: What is “interactive”, “multi” and “media” about it?

Interactive: Users can use a variety of input devices to interact with the computer, such as a joystick, keyboard, touch screen, mouse, trackball, microphone, etc.

Multi refers to the multiple file usages used in the multimedia product, such as sound, animation, graphics, video, and text.

Media: Many media sources can be used as components in the multimedia product, such as a videodisk, CDROM, videotape, scanner, CD or other audio source, camcorder, digital camera, etc. Media may also refer to the storage medium used to store the interactive multimedia product, such as a videodisk or CDROM.

Examples of environments where interactive multimedia is being used

- Touch screen kiosks (museums, hospitals, bank lobbies)
- Distance education (via computer, compressed video, satellite...)
- Interactive, educational software on CDROM or videodisk
- Virtual Reality “theatres”.

2.3.2 Importance of Multimedia

Multimedia will help spread the information age to millions of teachers/learners. Multimedia educational computing is one of the fastest growing markets in the world today.

Multimedia is fast emerging as a basic skill that will be as important to life in the twenty-first century as reading is now. In fact, multimedia is changing the way people read, interact and distribute information. Instead of limiting one to the linear re-presentation of text as printed in books, multimedia makes reading enjoyable with a whole new dimension by giving words an important new dynamics. In addition to conveying meaning, words in multimedia serve as triggers that readers can use to expand the text in order to learn more about a topic. This is accomplished not only by providing more text but by bringing it to life with audio, video and graphics.

Accelerating this growth are advances in technology and price wars that have dramatically reduced the cost of multimedia computers. The growing number of internet users has created a huge market for multimedia. The new tools are enabling educators to become developers. Noting how multimedia is used to enable individuals to create course material, that once required teams of specialists, individuals can now produce multimedia desktop video productions.

2.3.3 Role in Education and Training

Multimedia presentations are a great way to introduce new concepts or explain a new technology. Individuals find it easy to understand and use.
Multimedia can be used for education, training, simulations, digital publications, museum exhibits and so much more. With the advent of multimedia authoring applications like Flash, Shockwave and Director amongst a host of other equally enchanting applications are available in the market today. Your application of multimedia is only limited by your imagination. Training or instructional methods and advancement in technologies have always gone hand in hand. For example:

Historical method – Oral tradition:

The teacher was the only source of information
The teacher served as a role model.
The teacher was the primary resource to meet individual learning needs.

Printing Press discovered in 16th century:

Books provided more role models and multiple perspectives.
Exposure to books demanded that learners use critical thinking to resolve conflicting interpretations.
Teachers helped learners identify books, develop critical thinking skills, interpret different texts etc.
Books made learners independent of teacher. They had access to information which they could themselves read and learn on their own.

Photo and Video were discovered in the 19th century:

Visuals as add on to texts in books.
They enabled distance education.
They improved learning where verbal description was not adequate.

Teachers could select print, photo, video or some other combination to best suit teaching content.

Digital and Interactive Media has been developed in 20th century:

New media enhances visual and verbal content.
It doesn¹t replace earlier media.
New media allows dynamic alteration of instruction based on learner responses.
The teacher's role now is one of a guide and is not center stage any more.
Active learners create, integrate ideas, approach learning according to their interests and learning styles.

Use of Interactive Multimedia in Education

- Virtual reality, where 3-D experimental training can simulate real situations.
- Computer simulations of things too dangerous, expensive, offensive, or time-sensitive to experience directly Interactive tutorials that teach content by selecting appropriate sequencing of material based on the ongoing entry of student responses, while keeping track of student performance.
- Electronic presentations.
- Instruction or resources provided on the Internet (World Wide Web; 24 hours a day).
- Exploratory hypertext software (i.e. encyclopedias, databases) used for independent exploration by learners to complete research for a paper, project, or product development. They may use IMM resources to collect information on the topic or use multimedia components to create a product that blends visual, audio or textual information for effectively communicating a message.

Education courses, skills, and knowledge are sometimes taught out of context due to lack of application of real time examples. To overcome this, educators are using multimedia to bring into their classrooms real-world examples to provide a in-context framework important for learning. Multimedia and tools like the Internet give Faculty instant access to millions of resources.

Examples

- CyberMath
  - Animation, Plug-in,VRML (3D)
- Discovery Channel On-Line
  - Latest and greatest about the world we live in
- Frog Dissection
  - mpeg
- Dare Ware
  - Multimedia education software, "Talking Teacher
- Yahooligans
  - Answers to questions via e-mail
  - Several topics explained with complete class notes
- Scientific American
  - Easy to understand science, Good presentation
- National Geographic
  - Good multimedia - RealAudio, Chat

Education training procedures fall into three general categories:

1) **Instructor Support Products:** These are used by teachers in addition to text books, lectures and other activities within a class room environment.
2) **Standalone or Self Paced Products:** These are also called Computer based training and are designed for students to replace the teacher.

3) **Combination Products:** As the name implies these fall between support and standalone products. These are used by students on the directions of the instructors or to enhance classroom activities.

Education and training systems are built with three main objectives:

a) The learning objectives and purpose of the training.

b) Assessment or testing of the students to make sure they have learnt something.

c) The background and abilities of the student.

2.3.4 Multimedia Entertainment

The field of entertainment uses multimedia extensively. One of the earliest and the most popular applications of multimedia is for games. Multimedia made possible innovative and interactive games that greatly enhanced the learning experience. Games could come alive with sounds and animated graphics. These applications attracted even those to computers, who, otherwise would never have used them for any other application.

Games and entertainment products may be accessed on standard computer workstations via CDs or networks or on special purpose Game machines that connect to television monitors for display. These functions are quiet complex and challenging for the users.

These products rely on fairly simple navigational controls to enable the user to participate. Joystick and track ball are often used for moving objects, pointing guns or flying aircrafts while mouse buttons and keystrokes are used to trigger events like firing guns / missiles..

Multimedia based entertainment and game products depend on the use of graphics, audio, animation and video to enhance their operation. A game may include computer graphics taking the user on a hunt on a deserted island for hidden treasures or a princess. Audio is used for sound effects while video and animation are used for special effects.

These type of products also offer multi player features in which competition is managed between two or more players.

2.3.5 Multimedia Business

Even basic office applications like a MS word processing package or a MS Excel spreadsheet tool becomes a powerful tool with the aid of multimedia business.

Pictures, animation and sound can be added to these applications, emphasizing important points in the documents and other business presentations.

2.3.6 Video Conferencing and Virtual Reality

Virtual reality is a truly fascinating multimedia application. In this, the computer creates an artificial environment using hardware and software. It is presented to the user in such a way that it appears and feels real. Three of the five senses are controlled by the computer in virtual reality systems. Virtual reality systems require extremely expensive hardware and software and are confined mostly to research laboratories.

Another multimedia application is videoconferencing. When a conference is conducted between two or more participants at different sites by using computer networks to transmit audio and video data, then it is called video conferencing. A videoconference is a set of interactive telecommunication technologies which allow

two or more locations to interact via two-way video and audio transmissions simultaneously. It has also been called visual collaboration and is a type of groupware.

Digital compression of audio and video streams in real time is the core technology behind video conferencing. Codec is the hardware or software that performs compression . Compression rates of up to 1:500 can be achieved. The resulting digital stream of 1's and 0's is subdivided into labelled packets, which are then transmitted through a digital network usually ISDN or IP.

The other components required for a VTC(Video Tele Conference) system include:

Video input: video camera or webcam

Video output: computer monitor or television

Audio input: microphones

Audio output: usually loudspeakers associated with the display device or telephone

Data transfer: analog or digital telephone network, LAN or Internet

There are basically two kinds of VTC systems:

1) **Desktop systems** are add-ons to normal PC's, transforming them into VTC devices. A range of different cameras and microphones can be used with the board, which contains the necessary codec and transmission interfaces.
2) **Dedicated systems** have all required components packaged into a single piece of equipment, usually a console with a high quality remote controlled video camera. These cameras can be controlled from a distance to move left and right, tilt up and down, and zoom. They are known as PTZ cameras. The console contains all electrical interfaces, the control computer, and the software or hardware-based codec. Omnidirectional microphones are connected to the console, as well as a TV monitor with loudspeakers and/or a video projector.

There are several types of dedicated VTC devices.

Large group VTC are non-portable, large, more expensive devices used for large rooms and auditoriums.

Small group VTC are non-portable or portable, smaller, less expensive devices used for small meeting rooms. Individual VTC are usually portable devices, meant for single users, have fixed cameras, microphones and loudspeakers integrated into the console.

2.3.7 Electronic Encyclopedia

It is the application of multimedia for the creation of an encyclopedia with millions of entries and hypertext cross references covering a wide variety of research and refernece topics mainly for educational and training purposes.

☞Check Your Progress 2

1) What is interactive multimedia ?

   ……

   ……

   ……

……

……

2) Explain the application of multiledia in education and training.

……

……

……

……

……

3) How does a video tele conference system work?

……

……

……

……

……

2.4 GRAPHICS

Graphics is one of the core component of any multimedia application. We all have heard a famous saying that “one picture conveys a message of 1000 words”, so without graphics the multimedia is quite expressionless. So let us discuss the topic of graphics from multimedia point of view.

2.4.1 What is Graphics

Graphics is a term, which refers to any computer device or program that makes a computer capable of displaying and manipulating pictures. The term also refers to the images themselves.

For example, laser printers and plotters are graphics devices because they permit the computer to output pictures.

A graphics monitor is a display monitor that can display pictures.

A graphics board or card is a printed circuit board of which, when installed in a computer, permits the computer to display pictures.

Many software applications include graphics components. Such programs are said to support graphics. For example, certain word processors support graphics because they let you draw or import pictures. All CAD/CAM systems support graphics.

The following are also considered graphics applications :

- **Paint Programs:** Allow you to create rough freehand drawings. The images are stored as bit maps and can easily be edited.
- **Illustration/Design Programs:** Supports more advanced features than paint programs, particularly for drawing curved lines. The images are usually stored in vector-based formats. Illustration/design programs are often called draw programs.
- **Presentation Graphics** S**oftware:** This software lets you create bar charts, pie-charts, graphics, and other types of images for slide shows and reports. The charts can be based on data imported from spreadsheet applications.
- **Animation** S**oftware:** Enables you to chain and sequence a series of images to simulate movement. Each image is like a frame in a movie.
- **CAD Software:** Enables architects and engineers to draft designs.

- **Desktop Publishing:** Provides a full set of word-processing features as well as fine control over placement of text and graphics, so that you can create newsletters, advertisements, books, and other types of documents.

In general, applications that support graphics require a powerful CPU and a large amount of memory. Many graphics applications—for example, computer animation systems—require more computing power and hence, run only on powerful workstations or specially designed graphics computers. The same is also true of complex 3-D graphics applications.

In addition to the CPU and memory, graphics software requires a graphic monitor and support for one of the many graphics standards. Most PC programs, for instance, require VGA graphics. Sometimes this is inbuilt and sometimes it is an add on feature.

The quality of most graphics devices is determined by their resolution—how many points per square inch they can represent—and their colour capabilities.

Images have high information content, both in terms of information theory (i.e., the number of **bits** required to represent images) and in terms of the meaning that images can convey to the viewer. Because of the importance of images in any domain in which complex information is displayed or manipulated, and also because of the high expectations that consumers have of image quality, computer graphics have always placed heavy demands on computer hardware and software.

In the 1960s early computer graphics systems used vector graphics to construct images out of straight line segments, which were combined for display on specialised computer video monitors. Vector graphics is economical in its use of memory, as an entire line segment is specified simply by the coordinates of its endpoints. However, it is inappropriate for highly realistic images, since most images have at least some curved edges, and using all straight lines to draw curved objects results in a noticeable “stair-step” effect.

In the late 1970s and '80s raster graphics, derived from television technology, became more common, though was still limited to expensive graphics **workstation computers**. Raster graphics represents images by “**bit maps**” stored in the computer’s memory and displayed on a screen composed of tiny **pixels**. Each pixel is represented by one or more memory bits. One bit per pixel suffices for black-and-white images, while four bits per pixel specify a 16-step gray-scale image. Eight bits per pixel specifies an image with 256 colour levels; the so-called “true color” requires 24 bits per pixel (specifying more than 16 million colours). At that resolution, or bit depth, a full-screen image requires several megabytes (millions of bytes; 8 bits = 1 byte) of memory. Since the 1990s, raster graphics has become ubiquitous, personal computers are now commonly equipped with dedicated video memory for holding high-resolution bit maps.

2.4.2 Types of Graphic Images

Graphic images that have been processed by a computer can usually be divided into two distinct categories. Such images are either bitmap files or vector graphics

As a general rule, scanned images are bitmap files while drawings made in applications like Corel Draw or Illustrator are saved as vector graphics. But images between these two data types can be converted and it is even possible to mix them in a file.

Bitmap Graphics

The information below describes bitmap data.

Bitmap images are a collection of bits that form an image. The image consists of a matrix of individual dots (or pixels) that have their own colour described using bits.

Lets take a look at a typical bitmap image to demonstrate the principle:

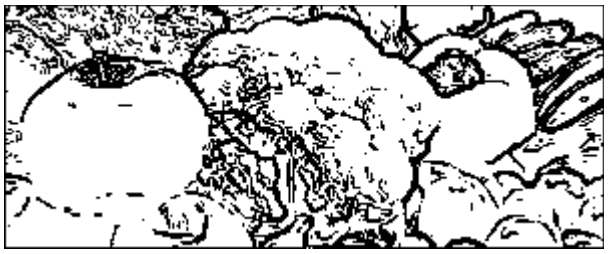
To the left you see an image and to the right a 250 percent enlargement of the top of one of the mountains. As you can see, the image consists of hundreds of rows and columns of small elements that all have their own colour. One such element is called a pixel. The human eye is not capable of seeing each individual pixel so we perceive a picture with smooth gradations.

Application of the image decides the number of pixels you need to get a realistic looking image.

Types of Bitmap Images

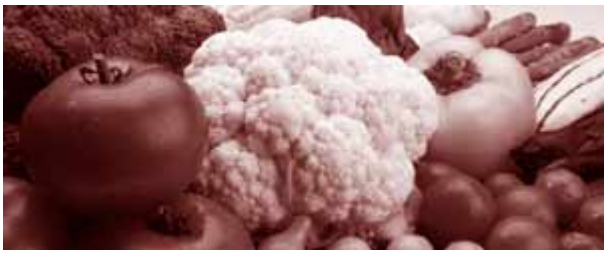
Bitmap images can contain any number of colours but we distinguish between four main categories:

1) Line-art: These are images that contain only two colours, usually black and white.



2) Grayscale images, which contain various shades of grey as well as pure black and white.

3) Multitones: Such images contain shades of two or more colours.



4) Full colour images: The colour information can be described using a number of colour spaces: RGB, CMYK for instance.

Characteristics of Bitmap Data

Bitmap data can take up a lot of room. A CMYK A4-size picture that is optimised for medium quality printing (150 lpi) takes up 40 MB. Compression can reduce the size of the file.

The image with the enlargement showed one of the main disadvantages of bitmap images: once they are enlarged too much, they look unnatural and blocky. But reducing a picture too much also has a bad influence as it looses sharpness.

Applications that can Handle Bitmap Data

There are hundreds of applications on the market that can be used to create or modify bitmap data. For example, Adobe PhotoShop, Corel Photo-Paint etc

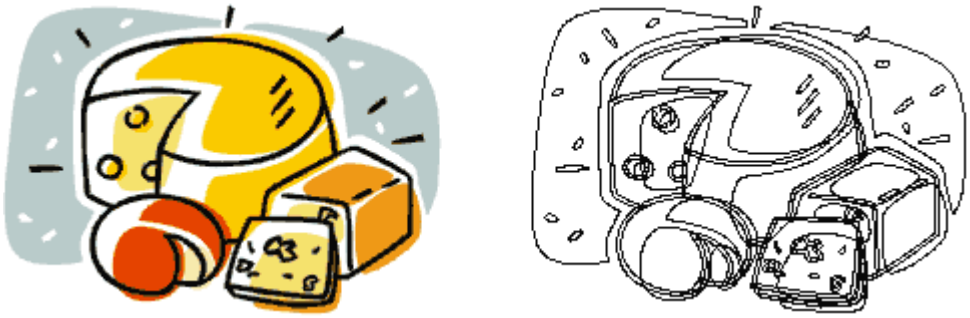
File Formats that are used for Bitmap Data

Bitmap data can be saved in a wide variety of file formats. Among these are:

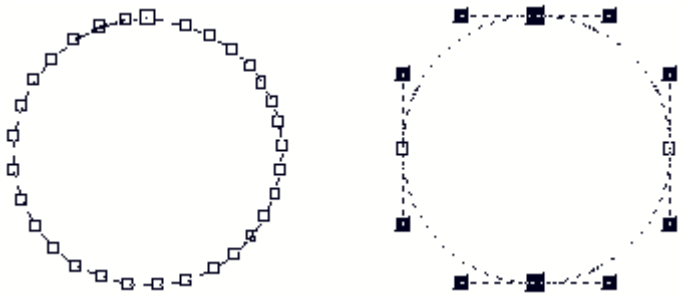
- BMP: limited file format that is not suitable for use in prepress.
- EPS: flexible file format that can contain both bitmap and vector data.
- GIF: mainly used for internet graphics.
- JPEG: or rather the JFIF file format, which is mainly used for internet graphics.
- PDF: versatile file format that can contain just about any type of data including complete pages, not yet widely used to exchange just images
- PICT: file format that can contain both bitmap and vector data but that is mainly used on Macintosh computers and is not very suitable for prepress.
- TIFF: the most popular bitmap file format in prepress

Vector Graphics

Vector graphics are images that may be entirely described using mathematical definitions. The image below shows the principle. To the left you see the image itself and to the right you see the actual lines that make up the drawing.



Each individual line is made up a large number of small lines that interconnect a large number of or, just a few control points that are connected using Bezier curves. It is this latter method that generates the best results and that is used by most drawing programs.



This drawing demonstrates the two principles. To the left a circle is formed by connecting a number of points using straight lines. To the right, you see the same circle that is now drawn using 4 points (nodes) only.

Characteristics of vector drawings

Vector drawings are usually pretty small files because they contain only data about the bezier curves that form the drawing. The EPS-file format that is often used to store vector drawings includes a bitmap preview image along the Bezier data.

The file size of this preview image is usually larger than the actual bezier data themselves.

Vector drawings can usually be scaled without any loss in quality. This makes them ideal for company logo's, maps or other objects that have to be resized frequently.

Applications that can Handle Vector Data

There are hundreds of applications on the market that can be used to create or modify vector data. In prepress, Adobe Illustrator, Corel Draw and Macromedia Freehand are the most popular.

File Formats that are used for Vector Data

This data can be saved in a wide variety of file formats. Among these are:

- EPS: the most popular file format to exchange vector drawings although EPS-files can also contain bitmap data.
- PDF: versatile file format that can contain just about any type of data including complete pages, not yet widely used to exchange just images.
- PICT: file format that can contain both bitmap and vector data but that is mainly used on Macintosh computers.

It is often necessary to convert images from bitmap data to vector data or back. Some possible uses include:

- Vector drawings often have to be converted to bitmaps if they will be used on a web page.
- If you scan a logo, it is a bitmap image but if it is going to be resized time and again depending upon its application then, it becomes more practical to have that logo as a vector drawing so its file size is smaller and you can change the size without worrying about any loss in quality.
- Vector drawings are sometimes too complicated for a RIP to be output on film or plate. Sometimes converting them to bitmap simplifies the file.

2.4.3 Graphic File Compression Formats

Web graphics are by necessity compressed because of the bandwidth issues surrounding networked delivery of information and because image files contain so much information. File format is the specific format in which the image is saved. The format is identified by the three-letter extension at the end of the file name. Every format has its own characteristics, advantages and disadvantages. By defining the file format it may be possible to determine the number of pixels and additional information. Each file format will have a reference to the numbers of bits per pixel that the format is capable of supporting

- 1 bit per pixel refers to an image with 2 colours
- 4 bit per pixel refers to an image with up to 16 colours
- Similarly 24 bits per pixel refers to 16,777,216 colours

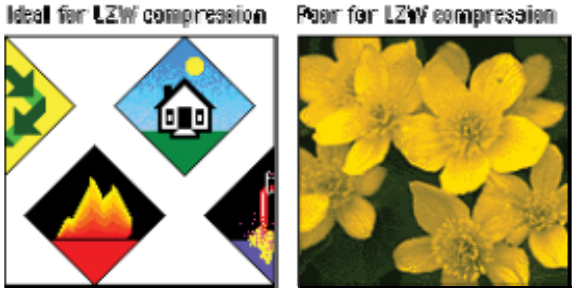
Different graphic file formats employ varying compression schemes, and some are designed to work better than others for certain types of graphics. The two primary Web file formats are GIF and JPEG.

Graphic Interchange Format (GIF)

The Graphic Interchange Format is an efficient means to transmit images across data networks. In the early 1990s the original designers of the World Wide Web adopted GIF for its efficiency and widespread familiarity. The overwhelming majority of images on the Web are now in GIF format, and virtually all Web browsers that support graphics can display GIF files. GIF files incorporate a compression scheme to keep file sizes at a minimum, and they are limited to 8-bit (256 or fewer colours) colour palettes.

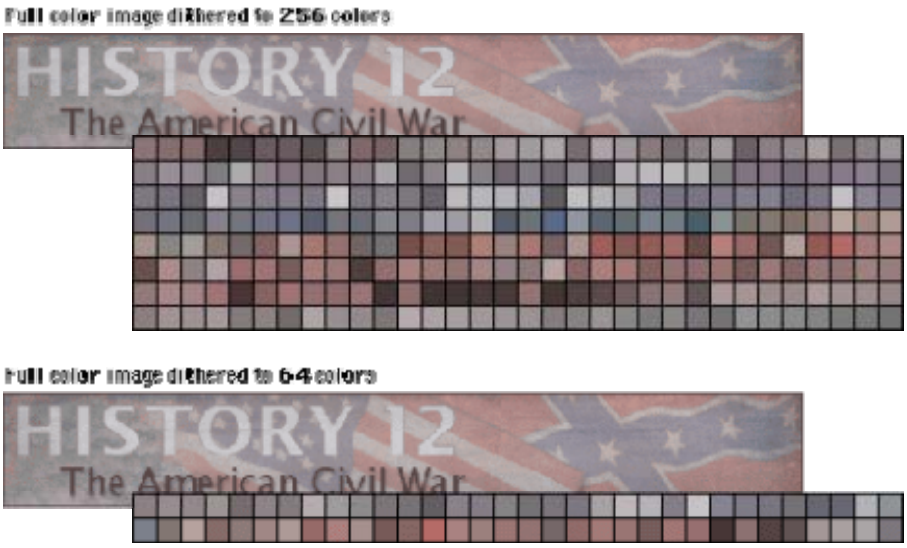
GIF File Compression

The GIF file format uses a relatively basic form of file compression that squeezes out inefficiencies in the data storage without losing data or distorting the image. The LZW compression scheme is best at compressing images with large fields of homogeneous colour. LZW is the compression scheme used in GIF format. It is less efficient at compressing complicated pictures with many colours and complex textures as illustrated below with the help of two graphics.



Improving GIF Compression

Characteristics of LZW compression can be used to improve its efficiency and thereby reduce the size of your GIF graphics. The strategy is to reduce the number of colours in your GIF image to the minimum number necessary and to remove stray colours that are not required to represent the image. A GIF graphic cannot have more than 256 colors but it can have fewer colours, down to a minimum of two (black and white). Images with fewer colours will compress more efficiently under LZW compression.

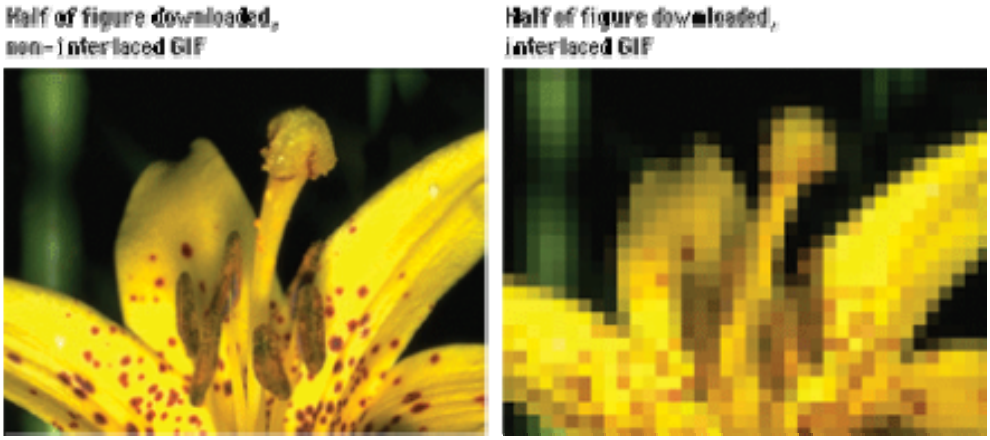


Interlaced GIF

The conventional i.e. non-interlaced GIF graphic downloads one line of pixels at a time from top to bottom, and browsers display each line of the image as it gradually builds on the screen.

In interlaced GIF files the image data is stored in a format that allows browsers to build a low-resolution version of the full-sized GIF picture on the screen while the file is downloading. The most important benefit of interlacing is that it gives the reader a preview of the full area of the picture while the picture downloads into the browser.

Interlacing is best for larger GIF images such as illustrations and photographs. Interlacing is a poor choice for small GIF graphics such as navigation bars, buttons, and icons.



Animated GIF

For combining multiple GIF images into a single file to create animation, GIF file format is used.

There are a number of drawbacks to this functionality.

The GIF format applies no compression between frames, so if you are combining four 30-kilobyte images into a single animation, you will end up with a 120 KB GIF file to push through the wire.

Another drawback of GIF animations is that there are no interface controls for this file format, GIF animations play whether you want them to not. And if looping is enabled, the animations play again and again and again.

JPEG Graphics

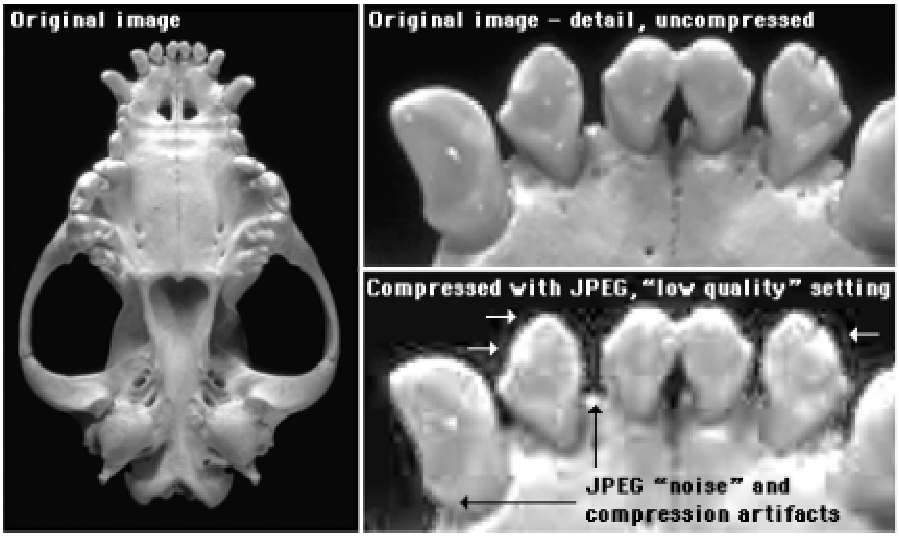
The other graphic file format commonly used on the Web to minimize graphics file sizes is the Joint Photographic Experts Group (JPEG) compression scheme. Unlike, GIF graphics, JPEG images are full-colour images (24 bit, or "true color"). JPEG images find great acceptability among photographers, artists, graphic designers, medical imaging specialists, art historians, and other groups for whom image quality is paramount and where colour fidelity cannot be compromised.

JPEG compression uses a complex mathematical technique called a discrete cosine transformation to produce a sliding scale of graphics compression. The degree of compression can be chosen but it is inversely proportional to image. The more you squeeze a picture with JPEG compression, the more you degrade its quality.

JPEG can achieve incredible compression ratios up to 1:100.

This is possible because the JPEG algorithm discards "unnecessary" data as it compresses the image, and it is thus called a "lossy" compression technique.

Notice in the example below, how increasing the JPEG compression progressively degrades the details of the image:



Another example of JPEG compression is shown below. Note, the extensive compression noise and distortion present in the bottom dolphin — the download time saved is not worth the degrading of the images.

2.4.4 Uses for GIF and JPEG Files

Netscape Navigator, Microsoft Internet Explorer, and most other browsers support both GIF and JPEG graphics.

In theory, you could use either graphic format for the visual elements of your Web pages. In practice, however, most Web developers still favour the GIF format for most page design elements, diagrams, and images that must not dither on 8-bit display screens.

Designers choose the JPEG format mostly for photographs and complex "photographic" illustrations.

Advantages of GIF Files

- GIF is the most widely supported graphics format on the Web.
- GIFs of diagrammatic images look better than JPEGs.
- GIF supports transparency and interlacing.

Advantages of JPEG Images

- Huge compression ratios mean faster download speeds.
- JPEG produces excellent results for most photographs and complex images.
- JPEG supports full-colour (24-bit, "true color") images.

Other File Formats

BMP/DIB/RLE File Formats

These are known as device independent bitmap files. They exist in two different formats a) OS2 format and b) Windows format. BMP is the standard MS-windows raster format created with windows paintbrush and used as wallpaper for the background while running windows. DIB or device independent bitmap file are mainly applied in computer multimedia systems and can be used as image files in the windows environment. RLE or run length coding files are actually DIB files that use one of the RLE compression routines.

IMG/MAC/MSP File Formats

IMG files were originally designed to work with GEM paint program and can handle monochrome and grey level images only.

MAC files are used in Macintosh Mac Paint application. MAC file format has two basic options:

- Ported Mac Paint files that include a Mac Binary header, and

- are used with PFS first publisher with no header.

MSP files originated in the pre-historic MS-Paint and can be converted into BMP files.

WPG

WPG or word perfect graphic file is used by Word Perfect. It first appeared with the release of word perfect 5.0. These files can contain bitmaps, line arts and vector graphics. WPG specifications allows files up to 256 colours.

IFF

Amiga Interchange File Format is used to transfer documents to and from Commodore Amiga Computers. The IFF format is extremely flexible and allows images and text to be stored inside an IFF file. The format can also be created on a PC but the extension of file name will change to **LBM or CE.**

PIXEL PAINT

The pixel paint file format allows a document to be opened in the pixel paint and pixel paint professional graphics application. This format allows you to specify the image size or canvas. It also enable you to decide whether you want the image to appear in the center or the upper left corner of the canvas when the document is opened.

JAS

The JAS file formats were designed to create the smallest possible image files for 24bits per pixel image and 8 bit per pixel gray scaled images. It uses a discrete cosine transformation to alter and compress the image data. This type of storage and retrieval results in some loss of image data and this loss is dependant on the compression level selected by the application.

TIFF

Tagged Image file format is used mainly for exchanging documents between different applications and different computers.

It was primarily designed to become the standard file format. The result of this design provided the flexibility of an infinite numbers of possibilities of how a TIFF image can be saved.

This format uses 6 different encoding routines:

- No compression
- Huffman
- Pack Bits
- LZW
- Fax Group 3
- Fax Group 4

In addition, it differentiates between three types of images in three different categories:

- Black and White
- Grey Scaled
- Colored

☞Check Your Progress 3

1) What is computer graphics ?

……

……

……

……

2) What are the various types of graphic images?

……

……

……

……

3) Why file compression techniques is beneficial in computer graphics ?

……

……

……

……

4) JPEG is ideal for faster downloads. Justify.

……

……

……

……

2.5 AUDIO AND VIDEO

Audio and Video are working as ear and eye of multimedia. Both of them are heavily contributing to any multimedia application. Let us discuss something about the association of these fields with multimeida.

2.5.1 Sound and Audio

Sound is a mechanical energy disturbance that propagates through matter as a wave. Sound is characterised by the various properties which are frequency, wavelength, period, amplitude and velocity or speed.

Noise and sound often mean the same thing but a noise is an unwanted sound. In science and engineering, noise is an undesirable component that obscures a signal.

Humans perceive sound by the sense of hearing. By sound, we commonly mean the vibrations that travel through air and can be heard by humans. However, scientists and engineers use a wider definition of sound that includes low and high frequency vibrations in air that cannot be heard by humans, and vibrations that travel through all forms of matter, gases, liquids and solids. The matter that supports sound is called the medium.

Sound propagates as waves of alternating pressure, causing local regions of compression and rarefaction. Particles in the medium are displaced by the wave and oscillate as result of the displacement. The scientific study of sound is called

acoustics. The sound portion of a program, or, a track recorded on a videotape which contains sound, music, or narration is called **Audio**.

2.5.2 Analog Sound vs. Digital Sound

Sound engineers have been debating the respective merits of analog and digital sound reproduction ever since the appearance of digital sound recordings. This is one of the never ending controversies in the field, much like that comparison of vacuum tube amplifiers against those of solid state (transistor) electronics. In consumer audio, the opposition is usually between vinyl LP recordings and compact discs.

An analog recording is one where the original sound signal is modulated onto another physical signal carried on some media or the groove of a gramophone disc or the magnetic field of a magnetic tape. A physical quantity in the medium (e.g., the intensity of the magnetic field) is directly related to the physical properties of the sound (e.g., the amplitude, phase and possibly direction of the sound wave.)

A digital recording, on the other hand is produced by first encoding the physical properties of the original sound as digital information which can then be decoded for reproduction. While it is subject to noise and imperfections in capturing the original sound, as long as the individual bits can be recovered, the nature of the physical medium is of minimum consequence in recovery of the encoded information.

A damaged digital medium, such as a scratched compact disc may also yield degraded reproduction of the original sound, due to the loss of some digital information in the damaged area (but not due directly to the physical damage of the disc).

Arguments made in favour of Analog Sound

- Shape of the waveforms: sound reconstructed from digital signals is claimed to be harsher and unnatural compared to analog signals.
- Lower distortion for low signal levels.
- Absence of quantisation noise.
- Absence of aliasing.
- Not subject to jitter.
- Euphonic characteristics.

Arguments made in favor of Digital Sound

- Lower noise floor.
- Dynamic range.
- Signal to noise ratio.
- Absence of generation loss.
- Resistance to media deterioration.
- Immunity to wow and flutter.
- Ability to apply redundancy like error-correcting codes, to prevent data loss.

Digital audio comprises audio signals stored in a digital format. Specifically, the term encompasses the following:

1) Audio conversion:
    1. Analogue to digital conversion (ADC)
    2. Digital to analogue conversion (DAC).

An **analog-to-digital converter** (abbreviated **ADC**, **A/D** or **A to D**) is an electronic circuit that converts continuous signals to discrete digital numbers. The reverse operation is performed by a digital-to-analog converter (DAC).

Typically, an ADC is an electronic device that converts an input analog voltage to a digital number. The digital output may be using different coding schemes, such as binary and two's complement binary. However, some non-electronic or only partially electronic devices, such as shaft encoders, can also be considered to be ADCs.

2) Audio signal processing - processing the digital signal to perform sample rate conversion.

Audio signal processing, sometimes referred to as **audio processing**, is the processing of auditory signals, or sound represented in digital or analog fromat. An analog representation is usually electrical; a voltage level represents the air pressure waveform of the sound. Similarly, a digital representation is in the form of pressure wave-form represented as a sequence of binary numbers, which permits digital signal processing.

The focus in audio signal processing is most typically a mathematical analysis of the parts of the signal that are audible. For example, a signal can be modified for different purposes such that the modification is controlled by the auditory domain.

Processing methods and application areas include storage, level compression, data compression, transmission, enhancement (e.g., equalisation, filtering, noise cancellation, echo or reverb removal or addition, etc.), source separation, sound effects and computer music.

3) Storage, retrieval, and transmission of digital information in an audio format such as CD, MP3, Ogg Vorbis, etc.

An **audio format** is a medium for storing sound and music. The term is applied to both the physical medium and the format of the content.

Music is recorded and distributed using a variety of audio formats, some of which store additional information.

Sound inherently begins and ends as an analogue signal, and in order for the benefits of digital audio to be realised, the integrity of the signal during transmission must be maintained. The conversion process at both ends of the chain must also be of low loss in order to ensure sonic fidelity.

In an audio context, the digital ideal would be to reproduce signals sounding as near as possible to the original analogue signal. However, conversion is “lossy”: conversion and compression algorithms deliberately discard the original sound information, mainly harmonics, outside the theoretical audio bandwidth

Digital information is also lost in transfer through misreading, but can be “restored” by error correction and interpolation circuitry. The restoration of the original music waveforms by decompression during playback should be exactly the same as the compression process. However, a few harmonics such as the upper harmonics which have been discarded can never be restored, with complete accuracy or otherwise. Upon its re-conversion into analogue via the amplifier/loudspeaker, the scheme relies heavily on the human brain to supply the missing sound during playback.

Pulse-code Modulation (PCM) is by far the most common way of representing a digital signal. It is simple and is compressed. A PCM representation of an analogue signal is generated by measuring (sampling) the instantaneous amplitude of the analogue signal, and then quantising the result to the nearest bit. However, such rounding contributes to the loss of the original information.

Digital audio technologies

- Digital Audio Tape (DAT)
- DAB (Digital Audio Broadcasting)
- Compact disc (CD)
- DVD DVD-A
- Minidisc (obsolete as of 2005)
- Super audio compact disc
- Digital audio workstation
- Digital audio player
- and various audio file formats

2.5.3 Audio File Formats

An **audio file format** is a container format for storing audio data on a computer system. There are numerous file formats for storing audio files.

The general approach towards storing digital audio formats is to sample the audio voltage in regular intervals (e.g. 44,100 times per second for CD audio or 48,000 or 96,000 times per second for DVD video) and store the value with a certain resolution (e.g. 16 bits per sample in CD audio). Therefore sample rate, resolution and number of channels (e.g. 2 for stereo) are key parameters in audio file formats.

Types of Formats

It is important to distinguish between a file format and a codec. Though most audio file formats support only one audio codec, a file format may support multiple codecs, as AVI does.

There are three major groups of audio file formats:

- common formats, such as WAV, AIFF and AU.
- formats with lossless compression, such as FLAC, Monkey's Audio (filename extension APE), WavPack, Shorten, TTA, Apple Lossless and lossless Windows Media Audio (WMA).
- formats with lossy compression, such as MP3, Vorbis, lossy Windows Media Audio (WMA) and AAC.

Uncompressed / Common Audio Format

There is one major uncompressed audio format: PCM. It is usually stored as a .wav on Windows. WAV is a flexible file format designed to store more or less any combination of sampling rates or bitrates. This makes it an adequate file format for storing and archiving an original recording. A lossless compressed format would require more processing for the same time recorded, but would be more efficient in terms of space used. WAV, like any other uncompressed format, encodes all sounds, whether they are complex sounds or absolute silence, with the same number of bits per unit of time.

The WAV format is based on the RIFF file format, which is similar to the IFF format.

Lossless Audio Formats

Lossless audio formats (such as TTA and FLAC) provide a compression ratio of about 2:1, sometimes more. In exchange, for their lower compression ratio, these codecs do not destroy any of the original data. This means that when the audio data is uncompressed for playing, the sound produced will be identical to that of the original

sample. Taking the free TTA lossless audio codec as an example, one can store up to 20 audio CDs on one single DVD-R, without any loss of quality. The negative aspect of this was that this DVD would not only require a DVD reader but a system which could decode the chosen codec as well for playing. This will most likely be a home computer. Although these codecs are available for free, one important aspect of choosing a lossless audio codec is hardware support. It is in the area of hardware support that FLAC is ahead of the competition. FLAC is supported by a wide variety of portable audio playback devices.

Lossy Audio Formats

Lossy file formats are based on sound models that remove audio data that humans cannot or can hardly hear, e.g. a low volume sound after a big volume sound. MP3 and Vorbis are popular examples. One of the most popular lossy audio file formats is MP3, which uses the MPEG-1 audio layer 3 codec to provide acceptable lossy compression for music files. The compression is about 10:1 as compared to uncompressed WAV files (in a standard compression scheme), therefore, a CD with MP3 files can store about 11 hours of music, compared to 74 minutes of the standard CDDA, which uses uncompressed PCM.

There are many newer lossy audio formats and codecs claiming to achieve improved compression and quality over MP3. Vorbis is an unpatented, free codec.

Multiple Channels

Since the 1990s, movie theatres have upgraded their sound systems to surround sound systems that carry more than two channels. The most popular examples are Advanced Audio Coding or AAC (used by Apple's iTunes) and Dolby Digital, also known as AC-3. Both codecs are copyrighted and encoders/decoders cannot be offered without paying a licence fee. Less common are Vorbis and the recent MP3-Surround codec. The most popular multi-channel format is called 5.1, with 5 normal channels (front left, front middle, front right, back left, back right) and a subwoofer channel to carry low frequencies only.

2.5.4 Image Capture Formats

Video cameras come in two different image capture formats: interlaced and progressive scan.

Interlaced Scan

Interlace is a technique of improving the picture quality of a video transmission without consuming any extra bandwidth. It was invented by the RCA engineer **Randall Ballard** in the late 1920s .

It was universally used in television until the 1970s, when the needs of computer monitors resulted in the reintroduction of progressive scan. While interlace can improve the resolution of still images, on the downside, it causes flicker and various kinds of distortion. Interlace is still used for all standard definition TVs, and the 1080i HDTV broadcast standard, but not for LCD, micromirror (DLP, or plasma displays).

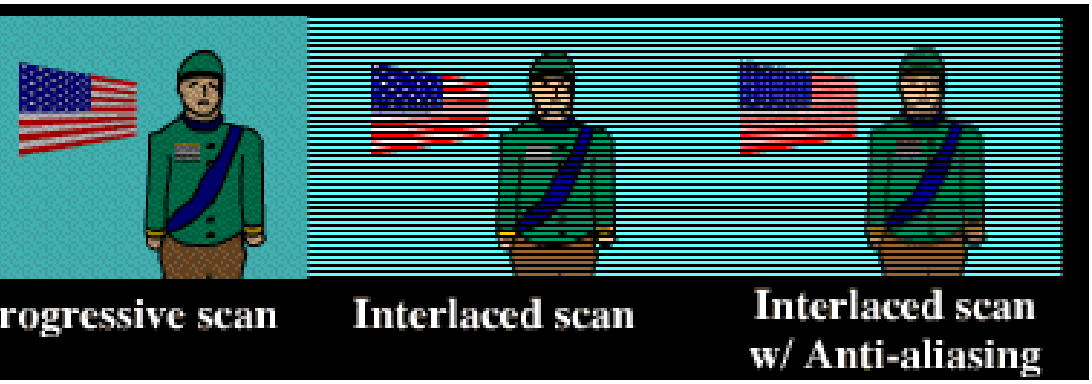
These devices require some form of deinterlacing which can add to the cost of the set.

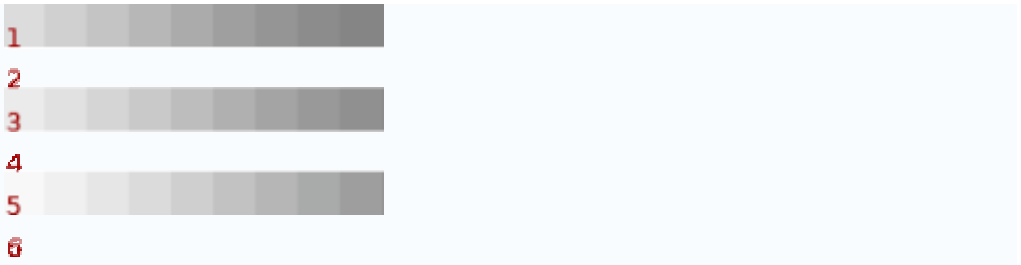
With progressive scan, an image is captured, transmitted and displayed in a path similar to the text on a page: line by line, from top to bottom.

The interlaced scan pattern in a CRT (cathode ray tube) display would complete such a scan too, but only for every second line and then the next set of video scan lines would be drawn within the gaps between the lines of the previous scan.

Such scan of every second line is called a field.

The afterglow of the phosphor of CRT tubes, in combination with the persistence of vision results in two fields being perceived as a continuous image which allows the viewing of full horizontal detail but with half the bandwidth which would be required for a full progressive scan while maintaining the necessary CRT refresh rate to prevent flicker.





Odd field

Even Feild

Since, after glow or persistence of vision plays an important part in iterlaced scan, only CRTs can display interlaced video directly – other display technologies require some form of deinterlacing.

In the 1970s, computers and home video game systems began using TV sets as display devices. At this point, a 480-line NTSC signal was well beyond the graphics abilities of low cost computers, so these systems used a simplified video signal in which each video field scanned directly on top of the previous one, rather than each line between two lines of the previous field.

By the 1980s computers had outgrown these video systems and needed better displays. Solutions from various companies varied widely. Because PC monitor signals did not need to be broadcast, they could consume far more than the 6, 7 and 8 MHz of bandwidth that NTSC and PAL signals were confined to.

In the early 1990s, monitor and graphics card manufacturers introduced newer high resolution standards that once again included interlace. These monitors ran at very high refresh rates, intending that this would alleviate flicker problems. Such monitors proved very unpopular. While flicker was not obvious on them at first, eyestrain and lack of focus nevertheless became a serious problem. The industry quickly abandoned this practice, and for the rest of the decade all monitors included the assurance that their stated resolutions were "non-interlace".

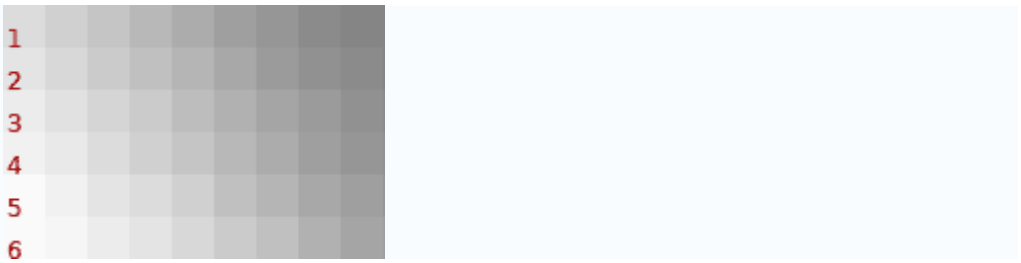
Application

Interlacing is used by all the analogue TV broadcast systems in current use:

- **PAL**: 50 fields per second, 625 lines, odd field drawn first
- **SECAM**: 50 fields per second, 625 lines
- **NTSC**: 59.94 fields per second, 525 lines, even field drawn first

Progressive Scan

Progressive or **non-interlaced scanning** is a method that displays, stores, or transmits moving images in which, the lines of each frame are drawn in sequence. This is in contrast to the interlacing used in traditional television systems.



Progressive Scan

Progressive scan is used for most CRT computer monitors. (Other CRT-type displays, such as televisions, typically use interlacing.) It is also becoming increasingly common in high-end television equipment.

Advantages of progressive scan include:

- Increased vertical resolution. The perceived vertical resolution of an interlaced image is usually equivalent to multiplying the active lines by about 1.6
- No flickering of narrow horizontal patterns
- Simpler video processing equipment
- Easier compression

2.5.5 Digital Video

Digital video is a type of video recording system that works by using a digital, rather than analog, representation of the video signal. This generic term is not to be confused with the name DV, which is a specific type of digital video. Digital video is most often recorded on tape, then distributed on optical discs, usually DVDs. There are exceptions, such as camcorders that record directly to DVDs Digital8 camcorders which encode digital video on conventional analog tapes, and the most recent JVC Everio G camcorders which record digital video on hard disks.

Digital video is not like normal analogue video used by everyday televisions. To understand how digital video works it is best to think of it as a sequence of non-interlaced images, each of which is a two-dimensional frame of picture elements or pixels. Present day analogue television systems such as:

- The National Television Standards Committee (NTSC), used in North America and Japan
- Phase Alternate Line (PAL), used in western Europe,

employ line interlacing. Systems that use line interlacing alternately scan odd and even lines of the video, which can produce images when analogue video is digitized.

In case of Digital video, there are two terms associated with each pixel, luminance and chrominance. The luminance is a value proportional to the pixel's intensity. The chrominance is a value that represents the colour of the pixel and there are a number of representations to choose from. Any colour can be synthesised by an appropriate mixture of three properly chosen primary colours. Red, Green and Blue (RGB) are usually chosen for the primary colours.

When an analogue signal is digitised, it is quantised. Quantisation is the process by which a continuous range of values from an input signal is divided into non-overlapping discrete ranges and each range assigned a unique symbol. A digitised monochrome photograph might, for example, contain only 256 different kinds of pixel. Such an image would be said to have a pixel depth of 8 bits. A higher quality image might be quantised allowing 24 bits per pixel.

Digital video can be characterised by a few variables:

Frame rate: The number of frames displayed per second. The illusion of motion can be experienced at frame rates as low as 12 frames per second, but modern cinema uses 24 frames per second, and PAL television 25 frames per second.

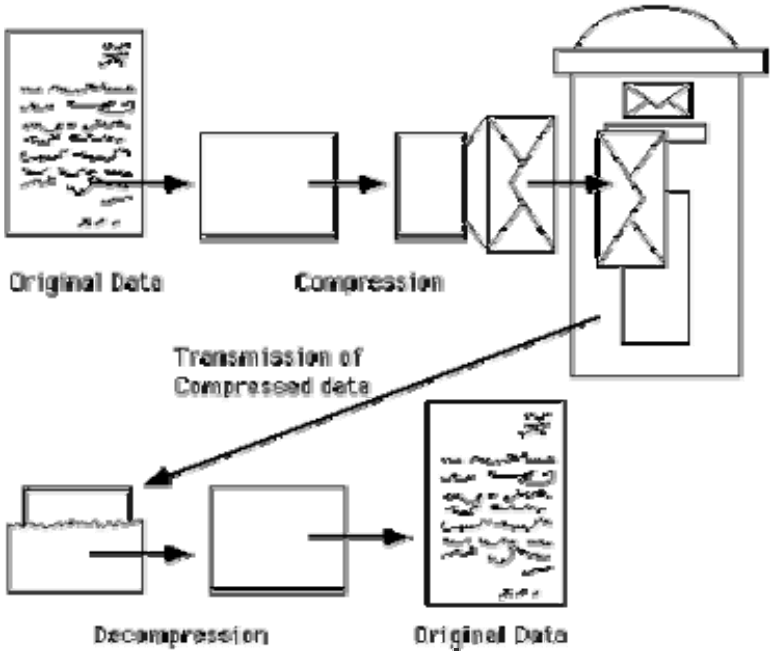
Frame dimensions: The width and height of the image expressed in the number of pixels. Digital video comparable to television requires dimensions of around 640 x 480 pixels.

Pixel depth: The number of bits per pixel. In some cases it might be possible to separate the bits dedicated to luminance from those used for chrominance. In others, all the bits might be used to reference one of a range of colours from a known palette.

The table below illustrates possible values of these parameters for typical applications of digital video.

Application	Frame rate	Dimensions	Pixel Depth
Multimedia	15	320 x 240	16
Entertainment TV	25	640 x 480	16
Surveillance	5	640 x 480	12
Video Telephony	10	320 x 240	12
HDTV	25	1920 x 1080	24

Advances in compression technology more than anything else have led to the arrival of the video to the desktop and hundreds of channels to homes.



Compression is a reversible conversion of data to a format that requires fewer bits, usually performed so that the data can be stored or transmitted more efficiently. The size of the data in compressed form (C) relative to the original size (O) is known as the compression ratio (R=C/O). If the inverse of the process, decompression, produces an exact replica of the original data then the compression is lossless.

Lossy compression, usually applied to image data, does not allow reproduction of an exact replica of the original image, but has a higher compression ratio. Thus, lossy compression allows only an approximation of the original to be generated.

Compression is analogous to folding a letter before placing it in a small envelope so that it can be transported more easily and cheaply (as shown in the figure). Compressed data, like the folded letter, is not easily read and must first be decompressed, or unfolded, to restore it to its original form.

The success of data compression depends largely on the data itself and some data types are inherently more compressible than others. Generally some elements within the data are more common than others and most compression algorithms exploit this property, known as redundancy. The greater the redundancy within the data, the more successful the compression of the data is likely to be. Fortunately, digital video contains a great deal of redundancy and thus, is very suitable for compression.

A device (software or hardware) that compresses data is often know as an encoder or coder, whereas a device that decompresses data is known as a decoder. A device that acts as both a coder and decoder is known as a codec.

Compression techniques used for digital video can be categorised into three main groups:

- General purpose compression techniques can be used for any kind of data.
- Intra-frame compression techniques work on images. Intra-frame compression is compression applied to still images, such as photographs and diagrams, and exploits the redundancy within the image, known as spatial redundancy. Intra-frame compression techniques can be applied to individual frames of a video sequence.

Inter-frame compression techniques work on image sequences rather than individual images. In general, relatively little changes from one video frame to the next. Inter-frame compression exploits the similarities between successive frames, known as temporal redundancy, to reduce the volume of data required to describe the sequence.

2.5.6 Need for Video Compression

The high bit rates that result from the various types of digital video make their transmission through their intended channels very difficult. Even entertainment video with modest frame rates and dimensions would require bandwidth and storage space far in excess of that available on the CD-ROM. Thus, delivering consumer quality video on compact disc would be impossible.

Similarly, the data transfer rate required by a video telephony system is far greater than the bandwidth available over the plain old telephone system (POTS). Even if high bandwidth technology (e.g. fiber-optic cable) was in place, the per-byte-cost of transmission would have to be very low before it is feasible to use for the staggering amounts of data required by HDTV.

Lastly, even if the storage and transportation problems of digital video were overcome, the processing power needed to manage such volumes of data would make the receiver hardware highly optimized.

Although significant gains in storage, transmission, and processor technology have been achieved in recent years, it is primarily the reduction of the amount of data that needs to be stored, transmitted, and processed that has made widespread use of digital video a possibility.

This reduction of bandwidth has been made possible by advances in compression technology.

2.5.7 Video File Formats

DV Encoder Types

When DV is captured into a computer it is stored in an AVI file, which is Microsoft's standard file format for video files. Video support in Windows is provided by DirectShow, a high performance 32 bit interface.

Digital video can be stored in two formats, DV Encoder Type 1 and DV Encoder Type 2.

DV Encoder Type 1

The standard DV bit stream interfaces the video and audio streams together. This format is fully supported by DirectShow which accepts this interleaved stream and provides splitter and multiplexer filters to isolate or interlace the video and audio streams from DV. With an Encoder Type 1 AVI file the raw DV interleaved data stream is simply written into the file.

DV Encoder Type 2

Encoder Type 2 produces a VfW compatible AVI file format. This file has separate streams for video and audio and it can also be processed by DirectShow. The advantage of creating an Encoder Type 2 file is that the file can be read by the older applications that do not support DirectShow.

Other Video File Formats

There are numerous other formats for storing video in digital formats. These formats are generally used for the storage and viewing of video by and on computer systems (with the exception of the MPEG formats).

AVI CODEC Formats

There are numerous AVI file formats other than the DV Types 1 and 2 formats discussed earlier. All these other formats involve the use of Compressor / DE-Compressors (CODECs) to read and write the AVI file. All invariably compress the video by reducing frame size from the standard 720 x 480 to 240 x 160 or smaller, by reducing the number of frames per second and by washing out colour, contrast and intensity. The resulting file size may be attractive, but the quality is usually quite poor. CinePac and Indeo are commonly used CODECs.

MPEG-1

MPEG-1 (Moving Picture Experts Group format 1) is an industry standard encoding format that is widely used. It's normal format is a frame size of 352 x 240 and a constant bit stream of around one megabit per second, a rate well within that of any CD player. MPEG-1 at this size consumes around 10 megabytes for each minute of video, so a typical CD can hold about 1 hour of video.

MPEG-1 is roughly equivalent to VHS in quality, although one might not think so, when one watches the video on a computer. Video CDs (VCDs) use the MPEG-1 format, and look good when viewed on a television.

MPEG-2

MPEG-2 is the standard used by DVD and is of a much higher quality than MPEG-1. This format provides for 720 x 480 resolution and with much less loss of detail over MPEG-1. However, the file sizes are 3 to 4 times larger than MPEG-1.

A DVD can contain many hours of MPEG-2 video, but the cost of the DVD writer is still high. MPEG-2 on a CD is possible, using a format called that SVCD but that can only contain about 20 minutes of video.

Quicktime

Quicktime is the video format devised by and used by Apple and can be used at varying quality and file sizes. It is quite widely used and has influenced the design of the MPEG formats.

Real Video

Real video is a streaming video format used for distributing video in real-time over the internet. With streaming video, you do not have to download the complete file before beginning to watch it. Rather the viewer will download the first section of the video while the remainder downloads in the background.

☞Check Your Progress 4

1) Compare analog and digital sounds.

   ……

   ……

   ……

   ……

   ……

2) What are various types of audio file formats?

……

……..……

……..……

……

……

3) What are the various types of video file formats?

……

……..……

……..……

……

……

4) Why is compression required in digital video ?

……

……..……

……..……

……

……

5) Explain interlaced and progressive scan in image capturing techniques.

……

……..……

……..……

……

……

2.6 MULTIMEDIA TOOLS

In this section, we will emphasise on various tools used in the field of multimedia.

2.6.1 Basic Tools

The basic toolset for building multimedia projects, contains, one or more authoring systems and various applications for text, images, sounds and motion video editing.

A few additional applications are useful for capturing images from the screen, changing file formats and moving files among computers when you are part of a team. These are basically tools for the housekeeping tasks that make your creativity and productivity better.

The software in your multimedia toolkit and your skill at using it will determine the kind of multimedia work you can do and how fine and fancy you can render it.

2.6.2 Types of Basic Tools

Various types of basic tools for creating and editing multimedia elements are :

- Painting and Drawing tools
- Image editing tools
- OCR software
- 3-D Modeling and Animation tools
- Sound editing programs
- Animation, Video and Digital movies

Painting and Drawing Tools

Painting software is dedicated to producing crafted bitmapped images. Drawing software like Corel Draw and Canvas is dedicated to producing vector based line art easily printed to paper using Postscript or another page mark up system such as Quick Draw.

Main features / criteria for selection are:

- Intuitive graphical interface with pull down menus, status bars, palette control and dialog boxes for quick logical selection.
- Scalable dimensions for resizing, stretching and distorting.
- Paint tools to create geometric shapes.
- Ability to pour a colour, pattern or gradient.
- Ability to paint with patterns and clip arts.
- Customisable pen and brush shape and sizes.
- Eyedropper tools for colour sampling.
- Auto trace tool for converting bitmapped images into vector based outlines.
- Multiple undo capabilities.
- Support for scalable text fonts.
- Painting features with anti-aliasing, air brushing, color washing, blending, masking etc.
- Support for third party special effects.
- Object and layering capabilities.
- Zooming for magnified pixel editing.
- All common colour depths.
- Good file importing and exporting capabilities.

Image Editing Tools

These are specialise and powerful tools for enhancing and re-touching existing bitmapped images. These applications also provide many of the features and tools of the painting and drawing programs and can be used for creating images from scratch as well as images digitised from scanners, video frame grabbers, digital camera, clip art files or original art work files created with a drawing package.

Features Typical of image editing applications are:

- Conversion of major image data types and industry standard file formats.
- Direct input from scanners etc.
- Employment of virtual memory scheme.
- Multiple window scheme.
- Image and balance control for brightness, contrast etc.
- Masking undo and restore features.
- Multiple video, Anti-aliasing, sharpening and smoothing controls.
- Colour mapping controls.
- Geometric transformations.
- All colour palettes.
- Support for third party special effects plugins.
- Ability to design in layers that can be combined, hidden and recorded.

Optical Character Recognition Software (OCR)

Often, you will have printed matter and other text to incorporate into your project but no electronic text file. With OCR software, a flat bed scanner and your computer you can save many hours of rekeying printed words and get the job done faster and more accurately than a roomful of typists.

OCR software turns bitmapped characters into electronically recognizable ASCII text. A scanner is typically used to create the bitmap. Then, the software breaks the bitmap into chunks according to whether it contains text or graphics by examining the texture and density of areas of the bitmap and by detecting edges. The text areas of the bitmap are then converted to ASCII characters using probability and expert system algorithm. Most OCR application claim 99 percent accuracy when reading 8 to 36 point characters at 300 dpi and can reach processing speeds of about 150 character per second.

3-D Modeling and Animation Tools

With 3-D modeling software, objects rendered in perspective appear more realistic. One can create stunning scenes and wander through them, choosing just the right lighting and perspective for your final rendered image. Powerful modeling packages such as Macromedia's Extreme 3 D, Autodesk's 3 D Studio Max. Strata Vision's 3D, Specular's Logo motion and Infini-D and Caligari's truespace are also bundled with assortments of pre-rendered 3-D clip art objects such as people, furniture, buildings, cars, aero plane, trees and plants.

Features for good 3-D modeling software are :

- Multiple window that allow you to view your model in each dimension.
- Ability to drag and drop primitive shapes into a scene.
- Create and sculpt organic objects from scratch.
- Lathe and extrude features.
- Colour and texture mapping.
- Ability to add realistic effects such as transparency, shadowing and fog.
- Ability to add spot, local and global lights, to place them anywhere and manipulate them for special effects.
- Unlimited cameras with focal length control.

Sound Editing Programs

Sound editing tools for both digitised and MIDI sound lets you see music as well as hear it. By drawing a representation of a sound in fine increments, whether a score or a waveform, you can cut, copy, paste and otherwise edit segments of it with great precision – something impossible to do in real time with music playing.

System sounds are beeps used to indicate an error, warning or special user activity. Using sound editing software, you can make your own sound effects and install them as system beeps.

Animation, Video and Digital Movies

Animations and digital video movies are sequences of bitmapped graphic scenes or frames, rapidly played back. But animations can also be made within the authoring system by rapidly changing the location of the object to generate an appearance of motion. Most authoring tools adapt either a frame or object oriented approach to animation but rarely both.

Movie making tools take advantage of QuickTime and Microsoft Video for Windows also known as AVI or Audio Video Interleaved technology and let you create, edit

and present digitised video motion segments usually in a small window in your project.

To make movies from video you need special hardware to convert the analog video signal to digital data. Movie making tools such as Premiere, Video Shop and Media Studio Pro let you edit and assemble video clips captured from camera, tape and other digitised movie segments, animations, scanned images and from digitised audio and MIDI files. The completed clip usually with added transition and visual effects can then be played back either stand alone or windowed within your project.

Morphing is an animation technique that allows you to dynamically blend two still images creating a sequence of in-between pictures that when played back rapidly in Quick Time, metamorphoses the first image into the second. For example a racing car transforms into a tiger, and a daughter's face becomes her mother's.

Accessories

A Screen Grabber is an essential accessory. Bitmap images are so common in multimedia, that it is important to have a tool for grabbing all or part of the screen display so that you can import it into your authoring system or copy it into an image editing application. Screen grabbing to the clipboard lets you move a bitmapped image from one application to another without the cumbersome steps of exporting the image to a file and then importing it back to the destination.

Another useful accessory is Format Converter which is also indispensable for projects in which your source material may originate on Macintoshes, PCs, Unix Workstations or even mainframes.

2.6.3 Authoring Tools

Authoring tools usually refers to computer software that helps multimedia developers create products. Authoring tools are different from computer programming languages in that they are supposed to reduce the amount of programming expertise required in order to be productive. Some authoring tools use visual symbols and icons in flowcharts to make programming easier. Others use a slide show environment.

Authoring tools help in the preparation of texts. Generally, they are facilities provided in association with word processing, desktop publishing, and document management systems to aid the author of documents. They typically include, an on-line dictionary and thesaurus, spell-checking, grammar-checking, style-checking, and facilities for structuring, integrating and linking documents.

Also known as Authorware, it is a program that helps you write hypertext or multimedia applications. Authoring tools usually enable you to create a final application merely by linking together objects, such as a paragraph of a text, an illustration, or a song. By defining the objects' relationships to each other, and by sequencing them in an appropriate order, authors (those who use authoring tools) can produce attractive and useful graphics applications.

The distinction between authoring tools and programming tools is not clear-cut. Typically, though, authoring tools require less technical knowledge to master and are used exclusively for applications that present a mixture of textual, graphical, and audio data.

Multi media authoring tools provide the important framework you need for organising and editing the elements of your multi media project including graphics, sounds, animations and video clips. Authoring tools are used for designing interactivity and user interface, for presenting your project on screen and for assembling multimedia elements into a single cohesive project.

Authoring software provides an integrated environment for binding together the contents of your project. Authoring systems typically include the ability to create, edit and import specific types of data, assemble raw data into a playback sequence or a cue sheet and provide a structured method or language for responding to user input.

2.6.4 Types of Authoring Tools

Authoring tools are grouped based on metaphor used for sequencing or organising multimedia elements and events:

- Card or Page Based Tools
- Icon Based or Event Driven Tools
- Time Based and Presentation Tools
- Object Oriented Tools

i) **Card or Page Based Tools**

In these authoring systems, elements are organised as pages of a book or a stack of cards. Thousands of pages or cards may be available in the book or stack. These tools are best used when the bulk of your content consists of elements that can be viewed individually, like the pages of a book or cards in a card file.

The authoring system lets you link these pages or cards into organised sequences. You can jump on command to any page you wish in the structured navigation pattern. Card or Page based authoring systems allow you to play the sound elements and launch animation and digital video.

ii) **Icon Based or Event Driven Tools**

In these authoring systems, multimedia elements and interaction cues or events are organised as objects in a structural framework or process. Icon – based, event driven tools simplify the organisation of your project and typically displays flow diagrams of activities along branching paths. In complicated navigational structures, this charting is particularly useful during development.

iii) **Time Based and Presentation Tools**

In these authoring systems, elements and events are organised along a timeline, with resolutions as high as 1/30 second. Time based tools are best used when you have a message with a beginning and an end. Sequentially organised graphic frames are played back at speed that, you can set. Other elements such as audio events are triggered at a given time or location in the sequence of events. The more powerful time based tools lets your program jump to any location in a sequence thereby adding navigation and interactive control.

iv) **Object Oriented Tools**

In these authoring systems, multimedia elements and events become objects that live in hierarchical order of parent and child relationship. Messages are passed among these objects, ordering them to do things according to the properties or modifiers assigned to them. In this way, for example, Jack may be programmed to wash dishes every Friday evening and does so when he gets the message from his wife. Objects typically take care of themselves. Send them a message and they do their thing without external procedures and programming. Object – oriented tools are particularly useful for games, which contain many components with many "personality".

2.6.5 Multimedia Tool Features

Common to nearly all multimedia tool platforms are a number of features for encapsulating the content, presenting the data, obtaining user input and controlling the execution of the product. These feature include:

- Page
- Controls
  - Navigation
  - Input
  - Media Controls
- Data
  - Text
  - Graphics
  - Audio
  - Video
  - Live Audio/Video
  - Database
- Execution
  - Linear Sequenced
  - Program controlled
  - Temporal Controlled
  - Inter activity Controlled

☞Check Your Progress 5

1) What are the basic tools of multimedia?

……

……

……

……

……

2) What is the selection criteria for image editing tools ?

……

……

……

……

3) What are multimedia authoring tools ?

……

……

……

……

4) What are the types or categories of authoring tools ?

……

……

……

……

2.7 SUMMARY

Multimedia as the name suggests MULTI and MEDIA uses several media (e.g. text, audio, graphics, animation, video) to convey information. Multimedia also refers to the use of computer technology to create, store, and experience multimedia content.

In this unit, we have tried to understand the concept of multimedia, its applications in various fields like education, training, business, entertainment to name a few.

Another section deals with defining objects for multimedia systems in order to understand the nuts and bolts of multimedia technology like still pitures, graphics, animation, sound, video etc.

These objects of multimedia system need to be transmitted, hence, there is a need for their compression and various techniques of compression for optimum bandwidht usage.

The last section deals with the basic toolset for building multimedia projects which contains one or more authoring systems and various applications for texts, images, sounds and motion video editing. It also addresses the questions – What is the basic hardware and software needed to develop and run multimedia technology and applications?

The software in your multimedia toolkit and your skill at using it determines what kind of multimedia work you can do and how fine and fancy you can render it.

2.8 SOLUTIONS / ANSWERS

Check Your Progress 1

1) **Hypertext** - Hypertext is conceptually the same as a regular text - it can be stored, read, searched, or edited - with an important difference: hypertext is text with pointers to other text. The browsers let you deal with the pointers in a transparent way -- select the pointer, and you are presented with the text that is pointed to.

   Hypermedia - Hypermedia is a superset of hypertext. Hypermedia documents contain links not only to other pieces of text, but also to other forms of media - sounds, images, and movies. Images themselves can be selected to link to sounds or documents. Hypermedia simply combines hypertext and multimedia.

2) Humans associate pieces of information with other information and create complex knowledge structures. Hence, it is also said that the human memory is associative. For example, a person starts with an idea which reminds him/her of a related idea or a concept which in turn reminds him/her of another idea. The order in which a human associates an idea with another idea depends on the context under which the person wants information. When writing, an author converts his/her knowledge which exists as a complex knowledge structure into an external representation. Information can be represented only in a linear manner using physical media such as printed material and video tapes. Therefore, the author has to convert his knowledge into a linear representation using a linearisation process. The reading process can be viewed as a transformation of external information into an internal knowledge representation combined with integration into existing knowledge structures, basically a reverse operation of the writing process. For this, the reader breaks the information into

smaller pieces and rearranges these based on the readers information requirement. We rarely read a text book or a scientific paper from start to end. Hypermedia, using computer enabled links, allows us to partially imitate writing and reading processes as they take place inside our brain. We can create non linear information structures by associating pieces of information in different ways using links. Further, we can use a combination of media consisting of text, images, video, sound and animation for value addition in the representation of information. It is not necessary for an author to go through a linearisation process of his/her knowledge when writing. The reader can also access some of the information structures the author had when writing the information. This helps the readers create their own representation of knowledge and to gel it into existing knowledge structures.

3) Different types of links used in hypermedia are :

Structural Links: The information contained within the hypermedia application is typically organised in some suitable fashion. This organisation is typically represented using structural links. We can group structural links together to create different types of application structures. If we look, for example, at a typical book, then this has both a linear structure i.e. from the beginning of the book linearly to the end of the book and usually a hierarchical structure in the form of the book that contains chapters, the chapters contain sections, the sections contains sub-sections etc. Typically in a hypermedia application we try to create and utilize appropriate structures.

Associative Links: An associative link is a link which is completely independent of the specific structure of the information. We have links based on the meaning of different information components. The most common example which most people would be familiar with is cross-referencing within books for example - for more information on X refer to Y.

Referential Links: A third type of link is a referential link. It is related to the associative link. Rather than representing an association between two related concepts, a referential link provides a link between an item of information and an explanation for that information.

Check Your Progress 2

1) Interactive: Users can use a variety of input devices to interact with the computer, such as a joystick, keyboard, touch screen, mouse, trackball, microphone, etc.

Multi refers to the multiple file usages used in the multimedia product, such as sound, animation, graphics, video, and text.

Media: Many media sources can be used as components in the multimedia product, such as a videodisk, CDROM, videotape, scanner, CD or other audio source, camcorder, digital camera, etc. Media may also refer to the storage medium used to store the interactive multimedia product, such as a videodisk or CDROM.

2) Multimedia is used in education and training fields as follows :
   - Computer simulations of things too dangerous, expensive, offensive, or time-sensitive to experience directly. Interactive tutorials that teach content by selecting appropriate sequencing of material based on the ongoing entry of student responses, while keeping track of student performance.
   - Electronic presentations.
   - Instruction or resources provided on the Internet (World Wide Web; 24 hours a day).
   - Exploratory hypertext software (i.e. encyclopedias, databases) used for independent exploration by learners to complete research for a paper, project,

or product development. They may use IMM resources to collect information on the topic or use multimedia components to create a product that blends visual, audio or textual information for effectively communicating a message.

Education courses, skills, and knowledge are sometimes taught out of context due to lack of application of real time examples. To overcome this, educators are using multimedia to bring into their classrooms real-world examples to provide a in-context framework important to learning. Multimedia and tools like the Internet give Faculty instant access to millions of resources.

Education training procedures fall into three general categories:

1) **Instructor Support products:** These are used by teachers in addition to text books, lectures and other activities within a class room environment.
2) **Standalone or Self paced products:** These are also called Computer based training and are designed for students to use in place of a teacher.
3) **Combination products:** As the name implies these fall between support and standalone products. These are used by students at the direction of instructors or to enhance classroom activities.

3) When a conference is conducted between two or more participants at different sites by using computer networks to transmit audio and video data, then it is known as video conferencing. A videoconference is a set of interactive telecommunication technologies which allow two or more locations to interact via two-way video and audio transmissions simultaneously. It has also been called visual collaboration and is a type of groupware.

   Digital compression of audio and video streams in real time is the core technology behind video conferencing. Codec is the hardware or software that performs compression. Compression rates of upto 1:500 can be achieved. The resulting digital stream of 1's and 0's is subdivided into labelled packets, which are then transmitted through a digital network usually ISDN or IP.

   The other components required for a VTC system include:

   Video input: video camera or webcam

   Video output: computer monitor or television

   Audio input: microphones

   Audio output: usually loudspeakers associated with the display device or telephone

   Data transfer: analog or digital telephone network, LAN or Internet.

Check Your Progress 3

1) Technology that makes computer capable of displaying and manipulating pictures.
2) Bitmap graphic images and vector graphic images.
3) The graphic images are quite useful on web but because of limit to the bandwidth of network it is necessary to compress and reduce the size of any image file, thus compression makes faster data access.
4) Since, JPEG file formats has incredible compression ratio of 1:100, so we can have better image in less size. Thus, JPEG file format is ideal for faster downloads.

Check Your Progress 4

1) **An analog recording** is one where the original sound signal is modulated onto another physical signal carried on some media or the groove of a gramophone disc or the magnetic field of a magnetic tape. A physical quantity in the medium (e.g., the intensity of the magnetic field) is directly related to the physical properties of the sound (e.g., the amplitude, phase and possibly direction of the sound wave.)

   A digital recording, on the other hand is produced by first encoding the physical properties of the original sound as digital information which can then, be decoded for reproduction. While it is subject to noise and imperfections in capturing the original sound, as long as the individual bits can be recovered, the nature of the physical medium is of minimum consequence in the recovery of the encoded information

2) There are three major groups of audio file formats:

   - common formats, such as WAV, AIFF and AU.
   - formats with lossless compression, such as FLAC, Monkey's Audio (filename extension APE), WavPack, Shorten, TTA, Apple Lossless and lossless Windows Media Audio (WMA).
   - formats with lossy compression, such as MP3, Vorbis, lossy Windows Media Audio (WMA) and AAC

3) DV Encoder Types
   DV Encoder Type 1
   DV Encoder Type 2
   Other Video File Formats
   AVI CODEC formats
   MPEG-1
   MPEG-2
   Quick time
   Real Video

4) The high bit rates that result from the various types of digital video make their transmission through their intended channels very difficult. Even entertainment videos with modest frame rates and dimensions would require bandwidth and storage space far in excess of that available on the CD-ROM. Thus, delivering consumer quality video on compact disc would be impossible.

   Similarly, the data transfer rate required by a video telephony system is far greater than the bandwidth available over the plain old telephone system (POTS). Even if high bandwidth technology (e.g. fiber-optic cable) was in place, the per-byte-cost of transmission would have to be very low before it would be feasible to use for the staggering amounts of data required by HDTV.

   Lastly, even if the storage and transportation problems of digital video were overcome, the processing power needed to manage such volumes of data would make the receiver hardware very

   This reduction of bandwidth has been made possible by advances in compression technology.

5) Progressive scan is used for most CRT computer monitors. (Other CRT-type displays, such as televisions, typically use interlacing.) It is also becoming increasingly common in high-end television equipment.

   With progressive scan, an image is captured, transmitted and displayed in a path similar to the text on a page: line by line, from top to bottom.

The interlaced scan pattern in a CRT (cathode ray tube) display would complete such a scan too, but only for every second line and then the next set of video scan lines would be drawn within the gaps between the lines of the previous scan.

Such scan of every second line is called a field.

The afterglow of the phosphor of CRT tubes, in combination with the persistence of vision results in two fields being perceived as a continuous image which allows the viewing of full horizontal detail but with half the bandwidth which would be required for a full progressive scan while maintaining the necessary CRT refresh rate to prevent flicker

Check Your Progress 5

1) Various types of basic tools for creating and editing multimedia elements are :

- Painting and Drawing tools
- Image Editing Tools
- OCR software
- 3-D Modeling and Animation tools
- Sound Editing Programs
- Animation, Video and Digital Movies.

2) Selection criteria for image editing applications are :

- Conversion of major image data types and industry standard file formats.
- Direct input from scanners etc.
- Employment of virtual memory scheme.
- Multiple window scheme.
- Image and balance control for brightness, contrast etc.
- Masking undo and restore features.
- Multiple video, Anti-aliasing, sharpening and smoothing controls.
- Color mapping controls.
- Geometric transformations.
- All colour palettes.
- Support for third party special effects plug ins.
- Ability to design in layers that can be combined, hidden and recorded.

3) Authoring tools usually refers to computer software that helps multimedia developers create products. Authoring tools are different from computer programming languages in that they are supposed to reduce the amount of programming expertise required in order to be productive. Some authoring tools use visual symbols and icons in flowcharts to make programming easier. Others use a slide show environment.

4) Authoring tools are grouped based on metaphor used for sequencing or organising multimedia elements and events

- Card or Page Based Tools
- Icon Based or Event Driven Tools
- Time Based and Presentation Tools
- Object Oriented Tools

2.9 FURTHER READINGS

Books

a) Multimedia Technology and Applications by David Hillman
b) Multimedia – Making it work by Tay Vaughan
c) Multimedia Systems Design by Prabhat K. Andleigh and Kiran Thakrar

Websites

a) www.en.wikipedia.org
b) www.computer.org
c) www.ieeecomputersociety.org
d) www.webopedia.com
e) www.fcit.usf.edu
f) www.why-not.com